Tsetse and Trypanosomiasis Control[22]

Introduction

Tsetse-transmitted African animal trypanosomiasis (AAT)[23] infests between 9 and 10 million km2, or 37 percent of the continent, and affects 37 countries.[24] Some 45 million head of cattle and many other domestic animals live within or directly at the margin of the tsetse-infested areas. According to the World Health Organization (WHO), many millions of humans are also at risk, with tens of thousands of deaths attributed each year to sleeping sickness, the human form of trypanosomiasis, and an estimated 300-500 thousand people carrying this usually fatal form of the disease.[25]

The disease leads to loss of productivity in animals and, without treatment, is frequently fatal. Large areas of land are today left with relatively few cattle because of the presence of the tsetse fly, and the estimated losses in agricultural output and productivity are very significant.[26] However, the costs of tsetse/trypanosomiasis (T&T) control or eradication are considerable and only relatively limited evidence is available on the cost-benefit relationship of T&T control and/or eradication on a sub-Saharan scale.

The direct impact of trypanosomiasis

The disease reduces livestock productivity.

The disease directly affects livestock productivity by:

- reducing calving rates by 1-12 percent in trypanotolerant breeds and 11-12 percent in susceptible breeds;
- increasing calf mortality by 0-10 percent for tolerant breeds and 10-20 percent for susceptible breeds;
- reducing milk offtake by 10-26 percent in tolerant breeds.[27]

Although there are significant variations among observations, an average reduction of 20 percent in herd meat and milk output in areas of tsetse challenge is considered to be a conservative estimate.[28] Overall, the cattle population is reduced by 30-50 percent because farmers keep their animals away from areas with a high tsetse challenge or trypanosomiasis risk.

Evidence based on actual farmer's practice (as opposed to controlled experiments) from a sample of livestock owners in Burkina Faso indicates that 87 percent of respondents recognized a substantial reduction in the number of cattle dying of AAT following implementation of tsetse control. Livestock owners estimated that the overall mortality rate fell from 63 percent in 1993/94 - prior to control - to 7 percent in 1996/97 - after control.[29]

Using data from the Programme Against African Trypanosomiasis (PAAT) Information System, it has been estimated that a 200 percent increase in cattle numbers in areas at risk might result in the theoretical case of complete and instant tsetse removal.[30]

The disease

The indirect impacts of the disease

also has negative implications for crop-livestock production systems.

Even more significant may be the indirect impact on crop production, land use, ecosystem structure and function, and human welfare. Trypanosomiasis prevents, in many places, the development of integrated crop-livestock production systems. That means that tilling must be performed by hand and agricultural productivity is lower than if healthy animals were available to provide draught power.

Evidence from Ethiopia suggests that a team of oxen in a tsetse-infested area is only capable of cultivating 60 percent of the land that can be cultivated in a tsetse-free area.[31] The disease can lead to species well suited for animal traction not being introduced into areas at risk. For example, West African zebus and horses are little used in the wetter semi-arid and drier subhumid regions of West Africa because of the risk of contracting AAT.

Box 5

THE PROGRAMME AGAINST AFRICAN TRYPANOSOMIASIS

The Programme Against African Trypanosomiasis (PAAT) was endorsed in 1997 by the FAO Conference. By combining the forces of FAO, WHO, the International Atomic Energy Agency (IAEA) and the Organization of African Unity (OAU)/ Interafrican Bureau for Animal Resources (IBAR), the programme seeks to:

- ensure a harmonious, sustainable approach towards improved human health and sustainable socio-economic and agricultural development of tsetse-infested areas;
- promote and coordinate international alliances and efforts assisting in harmonized interventions against T&T;
- achieve integrated trypanosomiasis control in Africa.

PAAT is primarily concerned with the development and application of science-based standards for assessing the economic, social and environmental benefits and costs of T&T management. It studies and analyses the balance between human needs in terms of food security and livelihood sustenance and the preservation of natural resources and prevention of environmental degradation.

Much discussion within PAAT has focused on prioritizing tsetse interventions, integrated into the overall agricultural production scheme, in selected, well-demarcated areas. This principle has become recognized as a prerequisite for success. The integration of T&T intervention into the general process of agricultural development and production provides the opportunity to maximize the benefits for the rural poor while minimizing the negative effects on the environment. It will thus contribute to sustainable pest management in targeted farming systems, and enhance the opportunities for adoption by livestock owners and producers.

In order to deal comprehensively with the magnitude and complexity of the T&T problem within the context of national and regional action plans for poverty alleviation, multidisciplinary efforts are progressively replacing the technology-based approaches of the past.

The low use of draught animal power in sub-Saharan Africa, even within trypano-free areas, means that additional measures, such as training, credit and infrastructure, are needed to obtain the full benefit of tsetse control.

Table 8
CATTLE STOCKS, CATTLE AT RISK AND CATTLE NOT KEPT OWING TO TSETSE INFESTATION[1]

	Total cattle stocks	cattle at risk	Cattle not kept owing to tsetse infestation
	(Thousands)		
Sub-Saharan Africa	196 196	45 343	90 743

[1] Based on 1997 data.

Source: FAOSTAT; PAAT; M. Gilbert, C. Jenner, J. Pender, D. Rogers, J. Slingenbergh and W. Wint. 1999*. The development and use of the Programme Against African Trypanosomiasis Information System*. Paper prepared for the International Scientific Council for Trypanosomiasis Research and Control (ISCTRC) Conference, 27 September to 1 October 1999. Mombasa, Kenya.

Further adverse effects of trypanosomiasis include less-efficient nutrient recycling, less diversification of income and less access to credit. Moreover, substantial (tenfold) increases in milk production can result from the introduction of dairy cows that are trypano-intolerant.[32]

Cost-benefit ratios for tsetse control

The relationship between the cost of T&T control/eradication and its resulting benefits depends on a number of factors. For example, in areas of low-challenge trypanosomiasis control through trypanocides is possibly more profitable than through other techniques.[33] The appropriate type of T&T control (see Box 6) depends on the type of farming landscape, topography, the degree of tsetse challenge, the type of insecticide used, the scale of the operation and the time frame envisaged; it therefore follows that a multitude of different approaches are required in sub-Saharan Africa. Consequently, any effort to assess the cost-benefit ratio of T&T control is a complex undertaking.

Setting up a trap to catch tsetse flies
This trapping technique, in comparison with other catching methods, is appealing for its cheapness, flexibility and environmental compatibility.

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A study of cost-benefit ratios for a number of techniques, time periods and degrees of tsetse challenge, using data from Burkina Faso, suggests that at low levels of challenge trypanosomiasis control through trypanocides is the most profitable option unless the time period is very long. A comparison of the use of traps versus insecticide shows that the latter technique produces higher cost-benefit ratios only when the time period is long and the interest rate used for discounting future benefits is low. The sterile insect technique (SIT) is profitable only when applied to areas of relatively high tsetse challenge and over a long time horizon (15 years). Even under such assumptions, SIT does not compare favourably with the trap and insecticide methods.[34]

A further study estimated, on the basis of available evidence for a wide range of techniques and making some simplifying assumptions, cost-benefit ratios of regionwide tsetse control.[35] These estimates, which should be taken as approximations only, range from 1:1.4 to 1:2.6 when considering a 20-year period. The full extent of the benefits is expected to be obtained at the end of the 20 years, when the cost-benefit ratio is estimated to rise to 1:5.

Studies have shown the favourable cost-benefit ratios of tsetse

Conclusion

control.

Tsetse control or eradication thus appears to be desirable and feasible in certain sets of circumstances, where the conditions are conducive and long-term agricultural benefits can be secured. Many different methods have been, and are being, applied, including drug therapy, trypanotolerance, vector control or eradication and SIT. However, controversy remains within the scientific community with regard to appropriate products and methods and whether they would be effective in the long run.

It is perhaps relevant here to consider the campaign to eradicate Chagas disease (American trypanosomiasis) from South America. The so-called Southern Cone Initiative against Chagas disease is one of the largest disease-control programmes ever mounted, covering an area of over 6 million km2 with a time frame of ten years. The aim is to eliminate transmission of the causative agent *Trypanosoma cruzi* in Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay. Formally launched in 1991, the programme has achieved remarkable success, with transmission interrupted in Uruguay in 1997. Interruption of transmission is expected for the other countries within the next few years. More recently, the Andean and Central American Initiatives have started with the same aim.

This suggests that concerted action on the part of the affected countries and international organizations is indispensable to the eradication of this disease. It is in this spirit that PAAT (see Box 5) is seeking to combine the forces of FAO, WHO, the International Atomic Energy Agency (IAEA) and the Organization of African Unity (OAU)/Interafrican Bureau for Animal Resources (IBAR) to promote integrated trypanosomiasis control within the broader goal of enhancing food security, sustainable agriculture and rural development.

More recently, the OAU Heads of State and Government Summit of July 2000 endorsed the Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC), with the ultimate objective being the eradication of tsetse and trypanosomiasis from Africa. With a view to pursuing this objective, PATTEC will undertake the organization and coordination of the campaign and mobilize the necessary human, financial and material resources to do so.

Box 6

METHODS OF TSETSE CONTROL

Combating trypanosomiasis is technically and organizationally difficult. First, civil stability is needed for any large-scale vector control programme. Moreover, the sustainability of funding that takes into account the permanent nature of the commitment of maintaining an area's trypanosomiasis-free status is necessary.

Drug therapy

Drug therapy currently protects more cattle than all other artificial techniques combined. At a cost of about $35 million (about $1 per dose), it protects 10-15 million head of cattle living in tsetse-infested areas from the full effects of trypanosomiasis. A drawback to drug therapy is that cattle that have been treated are not as productive as those in a completely disease-free environment.[1] Moreover, there is concern that the level of resistance to the two main drugs (isometamidium and diminazine), which were developed in the 1950s, may be increasing.

Trypanotolerance

Trypanotolerant and partially or semi-trypanotolerant cattle in West Africa account for about 10 million (in 1983) of the 45 million head of cattle living in and in close proximity to tsetse-infested areas.[2] Although these cattle are not immune, they do possess a degree of tolerance that allows them to remain productive while being infected.

Vector control or eradication

Tsetse flies require a tree habitat. Early in the twentieth century, wide areas of land were cleared of trees and game. After the Second World War, insecticide-based control techniques, i.e. ground and aerial spraying, were developed and deployed widely. Ground spraying and sequential aerosol technique (SAT) have been tried and proven in field situations, with variable results but general technical success in Nigeria, South Africa and Zimbabwe.

In response to increasing concern about the environmental impact of control measures, and with the advancement of science, different bait systems such as various traps and odour-baited targets impregnated with insecticide were developed. Artificial bait techniques are appealing for their cheapness, flexibility, low pollution factor and relatively larger local input. A drawback that is preventing their widespread use is the recurrent costs of continuous tsetse suppression, which is necessary to keep re-invading flies at bay. The use of herd animals treated with insecticide is a technique that is currently being evaluated on a significant scale. The cost of this control method is difficult to compare with those of other methods as it is proportional to the number of cattle per square kilometre. However, where dipping infrastructure is in place, the use of live animals as bait is invariably the most appropriate method of tsetse control.

The sterile insect technique (SIT) is very sophisticated and, under specific conditions, potentially powerful. It is also relatively expensive and may therefore prove cost-effective only when implemented on a relatively large scale and in an organized manner. This method was successfully applied against New World screwworm in the Libyan Arab Jamahiriya, Mexico and the United States, and in Central America, and against the fruit fly in countries in the Mediterranean basin, the Near East and South America. SIT was successfully applied against the tsetse fly in Zanzibar, where eradication was achieved by the aerial release of sterilized males over Unguja island (1 500 km^2) in 1995-97.

Following successful control or eradication, re-invasion must be controlled in order to sustain livelihoods. Tsetse flies are estimated to be able to regenerate their population from very low levels within four years. In practice, the greatest threat of re-invasion comes from outside the cleared area.

[1] J.C.M. Trail, K. Sones, J.M.C. Jibbo, J. Durkin, D.E. Light and M. Murray. 1985. *Productivity of Boran cattle maintained by chemoprophylaxis under trypanosomiasis risk*. ILCS Research Report No. 9. Addis Ababa, International Livestock Centre for Africa.
[2] FAO. 1987. *Trypanotolerant cattle and livestock development in West and Central Africa*. Vol. 1*. International supply and demand for breeding stock*, by A.P.M. Shaw and C.H. Hoste. FAO Animal Production and Health Paper No. 67/1. Rome.

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