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Community- and farmer-based management of animal African trypanosomosis in cattle

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Tsetse eradication is impossible in many parts of Africa given environmental, political, and economic circumstances. Animal African trypanosomosis (AAT) control then relies on implementation of local, integrated control strategies by communities or farmers that must take into account the eco-epidemiological context and the cattle rearing system to be sustainable.

Local integrated pest management: when and how?

Tsetse flies are the major vectors of human African trypanosomosis (HAT) and animal African trypanosomosis (AAT), two major plagues for the development of Africa [1]. The African Union launched the Pan African Tsetse and Trypanosomiasis Eradication Campaign (AU-PATTEC) in 2001, aiming to encourage tsetse eradication initiatives, which are considered the most cost-effective option. However, successful examples of sustainable tsetse eradication cover less than 2% of the total infested area (estimated around 10 million km^2) [2]. Eradication is only possible when the total tsetse population is addressed, which requires either an isolated population [3] or the sequential eradication of a full tsetse belt [4], and the use of appropriate techniques (Figure 1) [5]. This paper addresses AAT control in cattle when eradication is not an option.

In most situations (Figure 1), farmers and communities will need to conduct tsetse control (local integrated pest management or L-IPM) in order to reduce their density enough to prevent or reduce transmission of AAT and lower the probability that trypanosome strains resistant to trypanocides establish and spread within cattle populations. The cost of this reduction will be considered as an ongoing production cost and needs to be minimized as much as possible. Effective L-IPM will require the combined use of tsetse control methods, diagnostic tests, and medications. The extent of adoption of the proposed strategy by stakeholders will depend on their analysis of the benefits and risks derived from the control activities and associated changes required within their farming system, which in turn depends mainly on their socio-technical networks (including sanitary and technical services, farmer associations, availability of equipment, communication pathways, etc.) [6]. The selection of suitable control techniques ideally should be grounded on a baseline data collection, including entomological, epidemiological, socio-economic, and environmental data. However, simple indicators might be used to select appropriate L-IPM strategies based on eco-epidemiological settings, rearing systems, and cattle breeds, and this implementation would have to be refined according to the socio-technical networks involved.

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Description of AAT eco-epidemiological cycles

Only AAT transmitted to cattle by tsetse – or Nagana – is considered here, with a special focus on *Trypanosoma congolense* and *Trypanosoma vivax*, for which four major eco-epidemiological cycles occur [1,7]:

i. Sylvatic trypanosomosis is transmitted by tsetse among trypanotolerant wild fauna species. Cattle sometimes enter this system from grazing purposes and are then infected with highly virulent strains.
ii. Interface trypanosomosis occurs at the edge between agro-pastoral and conservation areas. Tsetse diversity and abundance is high (border effect), and virulent strains are transmitted from wild fauna to cattle.
iii. Endemic trypanosomosis refers to cattle as the main host for tsetse. Tsetse density, lifespan, and diversity tend to decrease because of landscape fragmentation. The virulence of trypanosome strains is reduced by their circulation within cattle. Cattle have adapted to 'living with the disease'.
iv. Mechanical trypanosomosis is caused by *T. vivax* and occurs outside the limit of tsetse distribution. In West Africa, cattle transhumance into the tsetse belt imports trypanosomes that are then locally transmitted to resident herds by mechanical vectors [7]. In

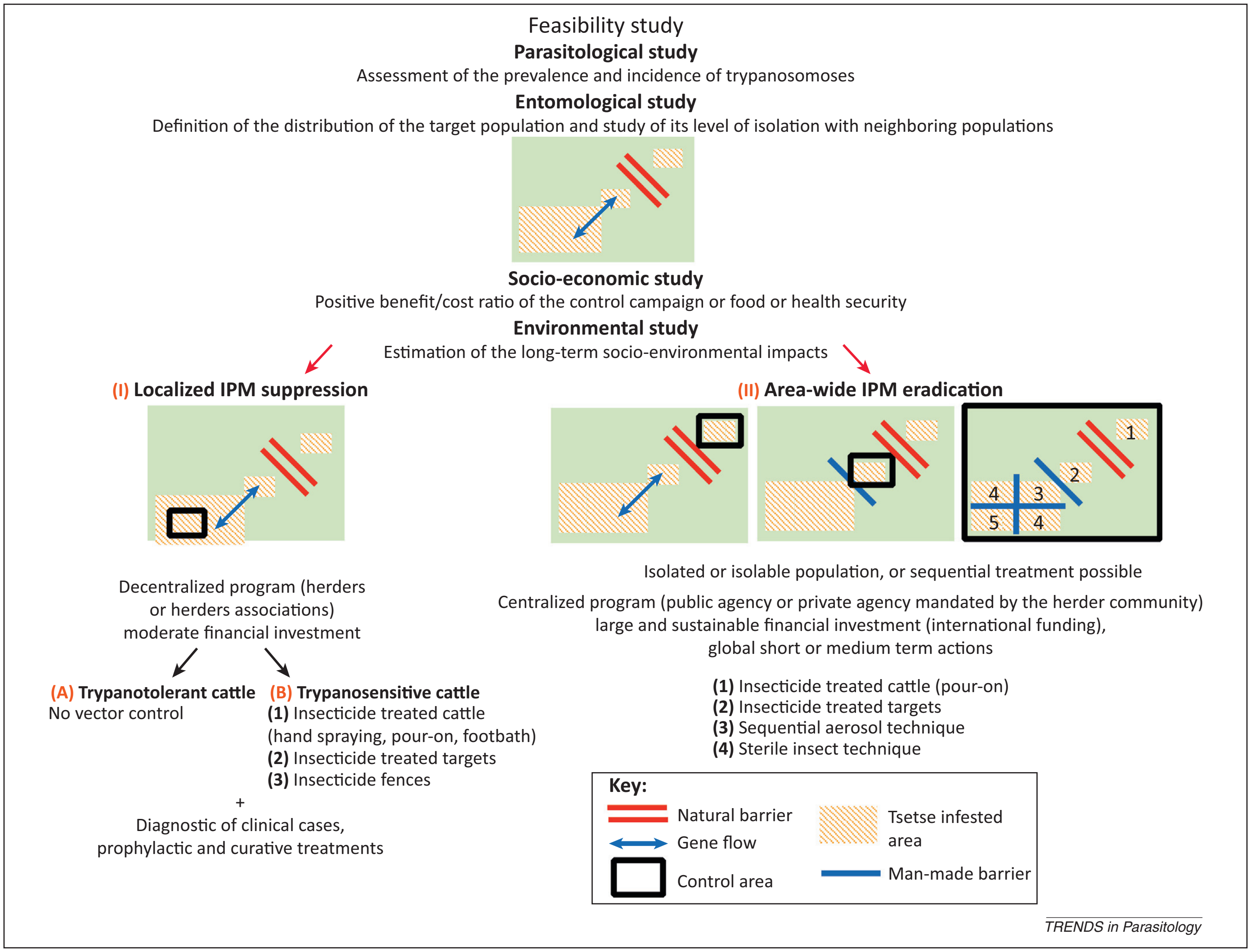

Figure 1. Decision framework for tsetse and trypanosomosis control. A step-wise decision diagram developed following a feasibility study is presented. The bold black boxes present the tsetse populations targeted by the control program; if the population is not isolated (section I, A and B), farmer-based integrated control of African trypanosomosis (local integrated pest management or L-IPM) should be preferred to the eradication scheme (section II). This is based on area-wide integrated management principles (AW-IPM), which are government or agency based, more costly, and technically intensive (see [4] for details on this strategy). Even if the AW-IPM eradication is theoretically more cost effective, it is not possible for environmental or political reasons in most tsetse-infested areas.

other countries such as Ethiopia, *T. vivax* is well established in sedentary cattle in the total absence of tsetse flies, but numerous movements of cattle occur and might also allow the importation of trypanosomes. More research is needed on the mechanical transmission of *T. congolense* in the absence of tsetse [8].

Sylvatic and endemic cycles can be considered as equilibriums where the parasites and hosts are well adapted to each other (high virulence versus trypanotolerant and low virulence versus trypanosensitive, respectively). Morbidity is medium to high, but mortality is generally low. Mechanical and interface cycles, however, are not at equilibrium and correspond to epidemic situations. Morbidity is more variable and appears as epidemics, associated with high mortality.

Major cattle rearing systems

Three main types of cattle rearing systems impacting AAT transmission are encountered throughout Africa, with various innovation trajectories.

In transhumant rearing systems, herders drive their cattle to remote grazing areas, up to several hundred kilometers, and can encounter tsetse in different eco-epidemiological cycles than their origin area. These herders generally use more or less trypanotolerant, local breeds. Inputs to improve productivity are very low. Animals are mostly considered as a heritage and secondarily as a production system.

The other cattle rearing systems are sedentary and exposed to one eco-epidemiological cycle. In agro-pastoral systems, farmers have mixed cropping and cattle rearing activities, mainly using crop residuals and natural pastures within a range of 5 to 10 km. Farmers generally use local breeds that are more or less trypanotolerant depending on AAT pressure. Inputs to improve productivity are low to medium. Herd sizes are variable depending on whether farmers utilize the cattle solely as draught animals or, in addition, as a means to increase their wealth.

Finally, zero grazing units correspond to intensive farms, generally in peri-urban areas, where animals are fed with harvested forage or agro-industrial subproducts.