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Tsetse and trypanosomiasis intervention policies supporting sustainable animal-agricultural development

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Abstract

In tsetse and trypanosomiasis (T&T) infested areas and countries the poverty and food security status of communities is rather heterogeneous and so is the impact of trypanosomiasis on the agricultural production process. Therefore, intervention to reduce or eliminate the impact of the disease requires, beyond an analysis of technical feasibility, a full appreciation of the causal relationship between poverty and the tsetse related development constraints. T&T intervention needs to be conceived and implemented in the context of sustainable agriculture and rural development (SARD). Hence, areas are selected not just on technical grounds but, most importantly, on the basis of their potential for sustainable and improved agricultural production. Under the umbrella of the Programme Against African Trypanosomiasis, and in collaboration with the Pan African Tsetse and Trypanosomiasis Eradication Campaign of the African Union, a set of criteria and guiding principles for prioritisation of intervention areas has been established to facilitate this approach. In order to maximise benefits of interventions, a concept for Area-Wide Integrated Pest Management (AW-IPM) has been developed. AW-IPM targets at the entire pest population and capitalises on locally prevailing factors and favourable trends (agro-ecological, climatic and demographic) assisting a reduction of fly challenge and disease risk. Substantial benefits from interventions against T&T are predicted for the mixed crop-livestock systems of the "cotton belt" running through parts of Burkina Faso and Mali, and the Southern Rift Valley of Ethiopia. Blending the technical AW-IPM approach and the SARD policy increases the chances of technical success, yields maximal economic returns which, in turn, paves the road for a move away from subsistence and towards market agricultural practices.

Key words: Area-wide integrated pest management, food security, mixed crop-livestock systems, nagana, rural development, sleeping sickness, sub-Saharan Africa.

Introduction

The tsetse fly, vector of sleeping sickness (Human African Trypanosomiasis, HAT) and Nagana (Animal African Trypanosomiasis, AAT), is unique to Africa. Tsetse fly occurs in 37 sub-Saharan countries covering nearly nine million km^2, an area which corresponds approximately to one-third of Africa's total land area. In tsetse-infested countries, half of the population suffers from food insecurity. Approximately 85% of the poor are located in rural areas out of which over 80% relies on agriculture for their livelihood.

Sleeping sickness potentially threatens around 60 million people. Currently, an estimated 500,000 people are believed to be infected. In addition, some 50 million head of cattle are exposed to infective tsetse fly bites. This compares to over 170 million cattle concentrated in tsetse-free areas of these same 37 AAT affected countries [8]. FAO estimates that every year AAT causes about three million deaths in cattle while approximately 35 million doses of trypanocidal drugs are administered to protect livestock in tsetse-infested areas. Nagana has a severe impact on agriculture in sub-Saharan Africa. While direct losses in cattle production alone are in the range of US$ 1.0-1.2 billion[10], the indirect impact engendered by the disease goes beyond this amount and encompasses the potential benefits that would come from enhanced crop production. The overall impact extends to the restricted access to fertile and cultivable areas, imbalances in land use and exploitation of natural resources and compromised growth and diversification of crop-livestock production systems. Clearly, the AAT risk contributes to rural poverty. In ten fully infested countries alone the impact of T&T on the agricultural gross domestic product (GDP) was estimated to amount to 10% below a theoretical AAT free agricultural GDP level [20]. In monetary terms this corresponds to US$ 1.0 billion.

These figures depict in broad terms the economic magnitude of the problem posed by the presence of tsetse fly and trypanosomiasis to agricultural development. Less discernible, but equally important, are the socio-cultural and food insecurity dimensions.

The Need For an Institutional Entente for a Sound Technical Approach

Given the magnitude of the problem and its interdependency with different related special fields it is unlikely that one single, usually specialized, institution could cope appropriately with all the aspects that need to be addressed. With regards to T&T intervention technologies, a range of "tools" exists for integrated application in various problem scenarios, but this does not suffice to attain large-scale and sustainable success. Therefore, in order to comprehensively deal with the complexity of the problem a joint multidisciplinary approach by different specialized partners is essential. It is also important to involve all the relevant stakeholders

at an early stage and place due emphasis on the technical, economic and environmental feasibility of any T&T intervention and of related development efforts. This will usually involve the collation of available information and special investigations in the field. However, partners and stakeholders must ensure that the main objective of their interaction, i.e. sustainable and productive rural agriculture and livestock development, are not lost out of sight. In this context, the close interaction of a strong alliance of mandated international organization helps the different stakeholders in keeping goal-oriented.

The Programme Against African Trypanosomiasis (PAAT) forms such an international alliance and combines the forces of FAO, IAEA, AU (formerly OAU)/IBAR, WHO and other stakeholders. PAAT seeks to create a conducive environment to: 1) define viable strategies and technical guidelines for intervention; and 2) ensure direct involvement of technical staff and policy makers of tsetse-affected countries.

Considerations regarding the management of AAT and related agricultural development will be largely influenced by the mentioned set and feasibility assessments. On the other hand, the guiding considerations pertaining to interventions against HAT will clearly reflect the acute severeness of the problem and may prioritise mass surveillance and treatment over preventive vector control measures. Immediate and preventive actions against HAT form part of improved overall public health measures that aim at increased well being and an improved health status of the communities living in current T&T infested areas.

In summary, the PAAT strategy is to link T&T intervention to overall public health policies and to Sustainable Agriculture and Rural Development (SARD), where the SARD goal is defined as: "the enhancement of the productive capacity of the natural resources base as a whole, and of the regenerative capacity of renewable resources, without disrupting the functioning of basic ecological cycles and natural balances or destroying the socio-cultural attributes of rural communities, but instead provide durable conditions for agricultural production".

T&T Control to Promote SARD

If we accept the principle that T&T constrains the entire agricultural process it follows that intervention strategies will need to be conceived accordingly, implemented in a SARD context. History has taught us that a disconnection of T&T intervention from the SARD planning process may result in indiscriminate removal of tsetse fly and over-exploitation of the natural resources [21]. The latter poses a special threat to fragile, marginal agricultural production environments where poor soil conditions and other constraints inhibit agricultural development [9].

T&T interventions are likely to yield maximal economic returns and growth if properly inserted into the broader policy of agricultural development. This can be achieved through an approach that matches and balances existing agricultural practices and the options for T&T control and sustainable agricultural development. A set of criteria and guiding principles for prioritising intervention areas has been recently developed under the PAAT umbrella in collaboration with the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) (Table 1). These criteria, though not exhaustive, form a comprehensive set of aspects most of which may need to be addressed in the planning process.

Table 1. Criteria and guiding principles for prioritising areas for tsetse and trypanosomiasis (T&T) interventions in the context of sustainable agriculture and rural development (adapted from FAO [6]).

Criteria	Guiding principles
1. Severity of the impact of the T&T problem	1. Expansion and intensification of mixed farming
2. Desire for intervention by local communities and national governments	2. Improved subsistence farming and/or production of cash crop
3. Opportunity to reduce tsetse-linked poverty and increase food security	3. Land use/tenure as component of sustainability
4. Socio-economic returns through SARD	4. Sustainable utilisation of natural resources
5. Factors affecting feasibility	5. Objective achievable within 5-7 year project cycle
	6. Presence of natural barriers and/or options for temporary barriers
	7. Favourable agro-ecological features
	8. Favourable climatic conditions
	9. Existence of local technical and logistic support
	10. Existence of parallel agricultural development programmes with recognition of T&T constraint

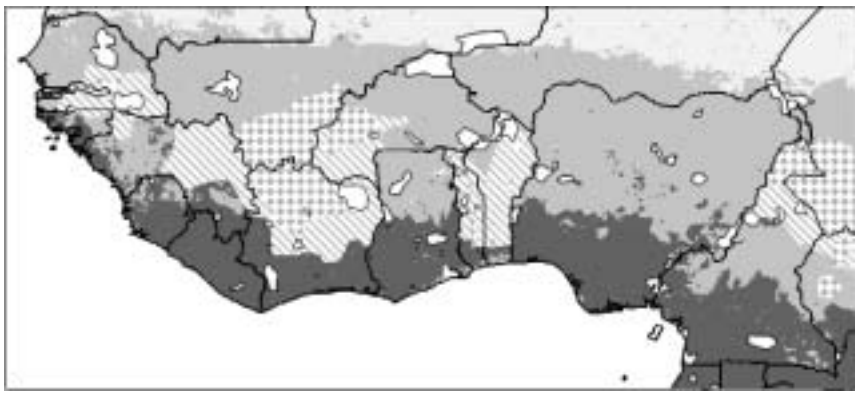

Figure 1. Map of main farming systems in West Africa: marginal in light grey, mixed cereal and livestock in mid-grey, and moist crops in dark grey. The diamond stippled regions are traditional cotton areas, the diagonal stippled areas are extensions to the cotton belt.

The concept of Area-Wide, Integrated Pest Management (AW-IPM)

The above criteria lead us to the concept of Area-Wide Integrated Pest Management (AW-IPM), as first described by Knipling [12]. According to this concept a uniform and synchonized intervention against an entire population of an insect pest in a selected area, even if at lower intensity (lower amounts of insecticides used, etc.), results in substantial higher impact than uncoordinated, fragmented control measures against only parts of the pest population, even if they are applied at a very high control intensity (large amounts of insecticides used, etc.). Based on sound information on the problem, in each situation a "tailored" set of the environmentally most appropriate and technically most efficient intervention tools will be applied. In addition, AW-IPM seeks to capitalize on natural forces wherever they may be in place to assist in reducing the fly challenge and disease risk. Specific agro-ecological and climatic features and trends may affect the presence and hinder the continued spread of the vector population and, therefore, disease transmission. When taken together with the needs to preserve the natural resource base and to opt for economically profitable pest management programmes, the main building blocks of the AW-IPM start falling into place.

In essence, it argues for a full appreciation of the interaction between the vectorial capacity of the tsetse fly and the dynamic of agricultural landscape and related farming practices. This relationship has been extensively explored by Ford [7], Jordan [13], de la Rocque et al. [3] and Hendrickx et al. [9], and critically reviewed also by Bourn et al. [1], and it is believed to hold the key to successful interference.

Autonomous fly habitat reduction by anthropogenic factors is sometimes pronounced in situations where land pressures are high. However, even in these scenarios tsetse encroachment often continues to curtail crop-livestock integration. This is particularly the case for riverine tsetse fly species that often are able to become peri-domestic and accept irrigation schemes as new habitat and change host preference from reptiles to livestock and man. Wherever tsetse advance into previosuly not T&T affected areas, the introduction or continued use of draught power for ploughing becomes impossible. This is the case in the "cotton belt", a transfrontier zone comprising part of Burkina Faso and Mali (Fig. 1) and in the Southern Rift Valley of Ethiopia (Fig. 2). In these scenarios, active T&T control with local elimination of the vector is likely to yield maximal benefits when expressed in terms of SARD[19]. It has been computed, for the mixed crop-livestock systems, that farmers using animal traction generate 25-45% more income per unit of land and 140% more income per unit of labour than farmers using hoes [20]. These calculations presume that the elimination of T&T is sustained and consolidated by increased mixed farming activities, not requiring a continual investment by the farmers to keep tsetse at bay. If additional health measures are simultaneously enforced with T&T intervention, it may also be possible to improve the productivity of the local stock through the introduction of upgraded genetic material. Further considerations should be given to the adaptation of the newly created genetic stock to the prevailing environmental factors and production system conditions.

In favourable scenarios, the benefits of tsetse control/elimination may spread to adjacent areas on the basis of mounting land pressure. Hence, also here active vector control could be considered at some stage, when and where conditions are conducive. Each time it is essential to carefully phase the

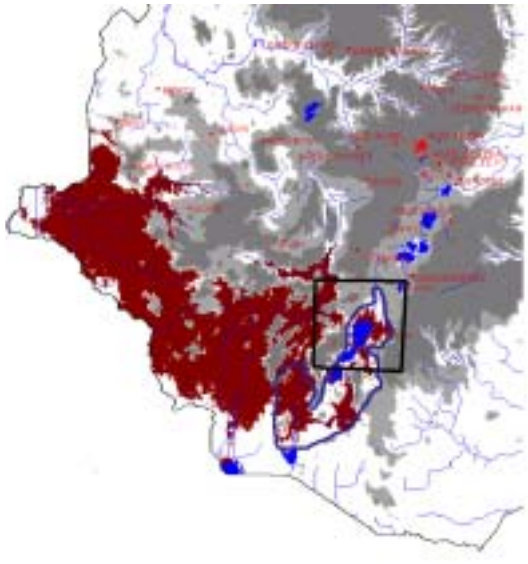

Figure 2. Map of south west Ethiopia, showing the identified project area (zone within the square) for tsetse and trypanosomiasis intervention. Regions over 1600 and 2000 metres are shown in light and dark grey respectively. Tsetse infested zones are in red.

integrated area-wide fly intervention. This process will usually start with active fly suppression, aiming at a gradual but progressive expansion of low/nil disease risk zone, enhancing and in return being supported by gradual "autonomous" or "agricultural" tsetse control. The anticipated generation of benefits will substantially capitalize from the introduction of general animal health protection measures, preferably planned well in advance, initiated before or simultaneously with vector control and pursued after enforced, systematic tsetse clearance all across the target area is completed. Furthermore, development programmes of a more general nature may contribute to achieve more permanent alterations in the local agro-ecology and improve the prospects for consolidation of the new disease free zone [1].

A different set of circumstances, which may also offer opportunities for an increased income for livestock producers, concerns the removal of peri-urban pockets of tsetse flies in support to dairy development. The rapidly growing demand for dairy has stimulated milk production by mainly smallholder livestock producers. Given the relatively low milk productivity of indigenous African cattle breeds, exotic and crossbred cattle proliferated, like in Kenya [17], Uganda [2] and Senegal [4]. However, these "upgraded" crossbreds or pure bred cattle are much more vulnerable to local disease agents [14, 15] and suffer more from trypanosomiasis [16] and the harsh (sub-)tropical environment than native cattle do [18]. Consequently, for dairy development around major cities in tsetse infested sub-Saharan Africa to become successful, it may take local tsetse elimination, provided such action is coupled to a series of accompanying measures as a basis for sustaining such profitable systems.

Integration of Technical, Socio-economic and Policy Considerations

Since the socio-economic impact of AAT varies within and between countries, regions and agro-ecological zones, a proper appreciation of the causal relationship between poverty and tsetse related development constraints is crucial. The finetuning of investments in T&T control requires harmony with national and regional animal-agricultural development priorities and policies. Interventions should always aim at improving the conditions of poverty stricken rural communities and seek their participation in market agriculture through generating sustainable opportunities for profitable investments for stakeholders.

Besides the above agricultural, ecological, socio-economic and cultural aspects influencing the strategy of the T&T intervention there is the choice to be made for an appropriate mix of technical tools to reduce and/or eliminate vector and the disease from a given area. Strong political and appropriate financial commitments of the local authorities are prerequisites for the success of an intervention campaign. The commitment, responsibilities and contribution of the national government is equally important and this has to be absorbed in the planning phase of an intervention programme and ensue from the national Poverty Reduction Strategy Plan. Last but not least, there is the commitment and interest of the international community in reducing rural livelihood vulnerability in tsetse affected areas and countries. Given that the T&T problem is of transboundary nature, regional and international cooperation and coordination is essential for the successful implementation of AW-IPM.

Balanced Investment

The relationships between "T&T risk - animal production – land - natural resources - food insecurity - poverty and T&T intervention – agricultural expansion – increased income" differs from one area to another, given the prevailing agro-ecological and the socio-economic and cultural conditions [11]. The complexity of the problem deserves particular attention at the planning phase. Considering that the aim is a positive SARD outcome, this should be reflected in the definition of outputs, activities and, of course, the inputs. Investment may spread over six main areas: (i) human resource development, improved technology and information; (ii) institutional support; (iii) removal of tsetse and trypanosomiasis from target area and other animal health measures (related public human health measures are an additional separate issue); (iv) land use, land tenure and management of the natural resources; (v) agricultural infrastructure support; and (vi) development of market agriculture.

An *ex ante* assessment is required not just to appreciate the overall feasibility and to estimate the initial budget but also to ensure optimal resource allocation (Fig. 3 and Fig. 4). This may pave the way also for multi-donor support through customizing

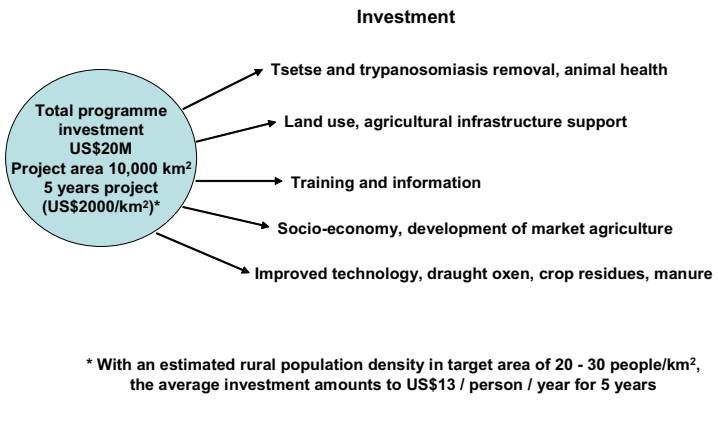

Figure 3. Spreading investment in AW-IPM scheme.

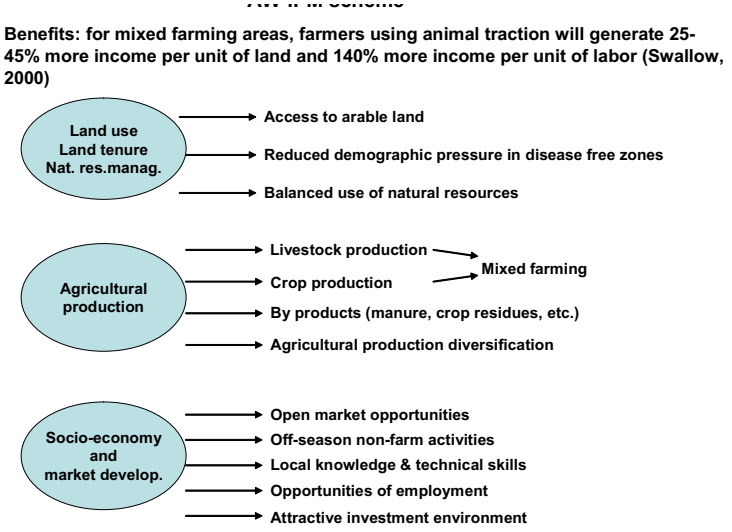

Figure 4. Spreading of benefits in AW-IPM scheme.

the various packages according to the individual donor priorities.

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