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Managing animal trypanosomosis in Africa: issues and options

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Summary

This paper discusses past and present approaches to managing tsetse-transmitted animal trypanosomosis in Africa and describes the three main weaknesses of these approaches, i.e., inappropriate objectives, inadequate links between research and policy-making and a lack of recognition that trypanosomosis should be high up on the social science research agenda. Making progress in managing trypanosomosis has been difficult and the authors argue that the weaknesses of the approaches must be corrected if Africa is to benefit from the few advances made so far, and for the continent to make further sustained efforts to combat the disease. The authors explain that this can be achieved by replacing the current widespread preoccupation among researchers and policymakers with controlling (or eradicating) trypanosomosis with a focus on managing (or coping with) the disease. In addition, ways of achieving greater coherence between research and policy-making must be explored. Finally, the social science issues raised by the question of which practical steps need to be taken to manage trypanosomosis in Africa should be placed at the forefront of research efforts.

Keywords

Africa – Policy – Research – Sustainable management – Trypanosomosis.

Introduction

Public campaigns against trypanosomosis are several decades old in many parts of Africa (11, 23, 27, 32). However, both the disease and the vector thereof, the tsetse fly, are still very present on the continent (30). Conservative estimates put the number of cases of human trypanosomosis in Africa at 300,000 (68). Annual direct and indirect economic losses on the continent from animal trypanosomosis have been estimated to be at least US$1.6 billion (60) and as high as US$5 billion (44). This clearly shows the inefficacy of past and current approaches to managing the disease.

The focus in this paper is on tsetse-transmitted animal trypanosomosis (although many of the arguments and conclusions probably also apply to human trypanosomosis. Non tsetse-transmitted animal trypanosomosis is acknowledged as important in certain areas, but this form of transmission, considerably less significant than the tsetse-based form, is not given specific consideration in this paper). The disease is considered to have been addressed in Africa in three 'wrong' ways, each one related to the others. The first is that most operations against trypanosomosis have been motivated by inappropriate objectives. The second is that the links are poor between research on the disease and the policy environment within which interventions are planned and implemented. The third is that the social science research agenda that would promote relevance and effectiveness in programme design and implementation has been largely unrecognised and thus, equally unexamined.

The following three sections focus on these three 'wrongs,' including the implications of the 'wrongs' for research and policy-making for the sustainable management of trypanosomosis in Africa. A summary and broad conclusions finalise the paper.

Inappropriate objectives

Outcomes of development initiatives are based on the relations between objectives, constraints, and instruments. Among these, objectives are key. When the objectives are more relevant and feasible the identification of constraints on their achievement

will be clearer, the instruments identified and utilised to overcome these constraint will be more relevant and powerful, and the prospects for policy success will be greater, and vice versa (40, 67).

This recognition is important in light of one of the most significant lessons to emerge from recent research on trypanosomosis in Africa. This lesson is that the technical effectiveness of alternative methods to reduce the prevalence of the disease varies according to interactions among such factors as tsetse and trypanosome species, landscape and topography, natural vegetation types, livestock breeds, livestock and human population distributions and densities, conditions in factor and product markets, and agricultural production systems (7, 14, 23). These interactions among biophysical and socio-economic factors mean that there is no single solution that is equally applicable and effective everywhere.

The biology and ecology of trypanosomes and tsetse support these results, for they define a highly non-linear relationship between tsetse challenge and trypanosomosis prevalence in cattle (35). Large decreases in disease prevalence can be achieved only with near eradication of tsetse populations. Vector challenge has to drop considerably before much change in prevalence can be observed. However, below a certain level of challenge, the drop in prevalence is precipitous. Given reductions (or increases) in vector challenge result in greater than proportionate declines (or increases) in disease prevalence. This makes reducing vector challenge and disease prevalence a complicated process. Relatively large scale, widely dispersed, sustained and intense efforts are therefore required. Small-scale, spatially confined, short-lived, incrementally increasing measures are liable to be ineffective. Also, in most circumstances, measures must not only be used in combination, they must also be integrated in ways that vary from case to case.

Most countries in Africa lack the institutional environment necessary for any large-scale, widely dispersed, sustained and intense development efforts (35, 45). In most cases, trypanosomosis and the tsetse fly will be fundamentally uncontrollable – where controlling refers to having power over or being in command of a phenomenon. However, precisely such control is the primary objective of most campaigns against the tsetse fly and trypanosomosis. How this objective came to prominence is interesting to consider.

For most of the 20th Century, the principal objective was eradication of the tsetse fly (and thus trypanosomosis). The early methods of choice involved destroying tsetse habitats by widespread clearing of vegetation, and depriving the flies of their natural hosts by shooting game and creating game reserves (23). More targeted campaigns against the fly were developed in the 1950s and 1960s with the increased availability and lower cost of effective and powerful insecticides. Several countries developed programmes aimed at eradication of tsetse on a national level through ground and aerial spraying (38). Top-down organisational structures were typical and affected populations and other stakeholders were not involved in programme design and implementation. Variations across regions with respect to overall levels of social and economic development were seldom considered (39).

Area-wide eradication programmes were discontinued due to a number of parallel developments. Firstly, economic growth in much of Africa has never been very rapid (8). The continent also suffered a major economic downturn in the 1980s as prices for key commodity exports declined relative to those for major imports. Most governments could no longer afford the significant budgetary outlays associated with area-wide tsetse eradication. Secondly, with growing awareness of the negative environmental impacts of insecticides (dichlorodiphenyltrichloroethane [DDT] in particular), committing increasingly important external donor funds to such operations became very difficult. Only a few countries, e.g., Nigeria and Zimbabwe, were able to continue independently for some time. Thirdly, new environmentally friendly methods were developed, which had the apparent advantage that they could be used on a small-scale.

These developments had important consequences. Firstly, supposedly eradicated tsetse flies reappeared in purportedly cleared areas. The technical efficacy of the methods used in the eradication campaigns was questioned (26, 27). Eradication was discredited as an objective and replaced by control, which, with the new insecticide-based methods, seemed feasible and sensible. Secondly, the increasingly critical attitude of environmentalists and policymakers towards the side-effects of wide-scale use of insecticides led to more critical evaluations of new tsetse fly and trypanosomosis control efforts, particularly with respect to how they contributed to development objectives (17, 58).

By the late 1980s, programmes had to meet at least three criteria. Firstly, they had to be economically sound and sustainable. Secondly, their direct and indirect effects on the environment had to be negligible. Thirdly, and perhaps most importantly, they had to fit into the rural development policy of a country (59).

These new requirements implied important changes in the design and implementation of control programmes. The economic problems of Africa meant that foreign governments were funding most control efforts. The political viewpoints of these governments became increasingly important. One such position was the need for greater decentralisation of public services in Africa. Many governments on the continent, who realised that they would be relieved of onerous financial burdens and spared criticism from environmentalists, rapidly accepted this position. Communities in tsetse-affected areas thus became increasingly involved in implementation (2), permitting more logical arguments about links between control efforts and broader rural development programmes.

The shift from eradication to control implied both new technical opportunities and new technical constraints. For instance, some experts argued that maintaining expensive barriers to prevent re-invasion was no longer necessary because invading flies were constantly eliminated within a controlled area. Furthermore, with the steadily mounting opposition to area-wide use of insecticides, alternative control methods, such as the sterile insect technique (SIT), odour-baited traps, insecticide-impregnated targets and insecticide-treated animals as 'live baits', became increasingly popular and were widely recommended (6, 65, 69, 70).

However, the biology and ecology of the tsetse fly and trypanosomosis soon revealed that control could not be a one-off event. Rather, as Ford (23) had cautioned, the process was ongoing. A new set of problems arose revolving around sustaining control following the supposedly successful elimination of the vector. These problems were soon seen as especially acute in the small-scale community-based programmes that so mesmerised decision makers in key development agencies. What farmers said they were willing to pay for (or contribute to) control efforts was totally at odds with what they actually eventually paid (61). Each year seemed to bring new evidence of poor performance of community-based initiatives, leading some experienced observers to conclude that such approaches were simply not economically viable (5). Given this history, a return to large-scale area-wide eradication methods, most notably using the SIT, has unsurprisingly been recommended (21).

The process seems to have made a full circle, but that is an illusion as it has been driven throughout by the non-linear relationship between tsetse challenge and trypanosomosis prevalence. According to that relationship, eradication and control of trypanosomosis are isomorphic as objectives. Trypanosomosis has to be eradicated to be controlled, and eradication of the disease requires control. Control and eradication measures have identical institutional requirements. Indeed, permanent control of tsetse and trypanosomosis has occurred only where they have been eradicated by agricultural expansion and intensification, which have fundamentally altered both the physical features of the affected rural areas and their institutional characteristics (32).

Most of the typically small-scale farmers and herders of Africa have been unaffected by even the most supposedly successful eradication and control efforts. Furthermore, the vast majority of them have also long fallen outside the ambit of formal veterinary services (public or private). The question of how they coped with tsetse and trypanosomosis has been raised. Firstly, they have sought to build their homesteads, and to graze and water their livestock, in locations and manners that allow them to avoid tsetse-infested areas. Secondly, the few farmers with access to veterinary services have used that access mainly to acquire curative and preventive trypanocidal drugs. Thirdly, those that have access to (and knowledge of) trypanotolerant livestock have introduced these animals into their herds, or have actively carried out selection for the tolerance trait.

These activities are often dismissed or met with reservation and scepticism by scientists preoccupied with eradication and control. Civil strife and growing land pressure mean that selective settlement and grazing are progressively less viable as options (19). Improper use of trypanocidal drugs is leading to growing resistance to many of these drugs, and thus also to increasing costs of prevention and cure (24). Trypanotolerant breeds account for no more than 20% of the livestock population in tsetse-affected parts of Africa. Specifically, they add up to 10 million out of 48 million cattle in 39 countries (13). These are accurate observations, although they largely miss the point. Opportunistic settlement and grazing regimes, chemotherapy, and selection and breeding for disease resistance are longer-lived than are most eradication and control efforts. Furthermore, as proactive measures that reflect the underlying rationales of the production systems of farmers and herders, they are also more sustainable. These measures also indicate that while controlling tsetse and trypanosomosis may not be possible, managing them is certainly feasible where managing refers to dealing with or coping with a phenomenon. Such management is more justifiable an objective for interventions against trypanosomosis than is control.

Poor research-policy links

There are additional implications of the wide preoccupation with control of trypanosomosis, as is evidenced by the following quote from a leading expert on trypanosomosis (51):

'Tsetse/Tryps control has become complicated by a wealth of subsidiary, and often political/unimportant, issues that have successfully distracted from the main goal [of] delivery at the ground level, [which] no longer seems to be the immediate and urgent objective'.

The implicit point of the expert appears to be 'if tsetse/trypanosomosis control were left to those who shun politics and really understand what is happening at the ground level, i.e., to the scientists and practitioners who are working hard at finding answers to ground-level problems, then everything would be fine.'

However, nothing could be further from reality as proven by the case of an intervention to suppress tsetse that is widely viewed to have been successful, providing compelling answers to several pressing issues and allowing a number of previously unconsidered hypotheses to be posed and explored in detail. The intervention also changed the lives of many poor people for the better (53).

The intervention was designed and implemented by the then International Livestock Center for Africa (ILCA) and the International Laboratories for Research on Animal Diseases (ILRAD). In 1991, these organisations – which now comprise the International Livestock Research Institute (ILRI) – began conducting research on tsetse suppression in the upper reaches of the Ghibe River Valley of Ethiopia, 180 km south-west of the capital, Addis Ababa. The aim was to assess the efficacy and impacts of a then relatively novel tsetse suppression method that involved applying particular concentrations of insecticides as 'pour-ons' along the spines of cattle – the so-called 'live-bait' method. Tsetse and other biting flies landing on animals treated with pour-ons are contaminated and, in time, die. Trials in other parts of Africa confirm that if enough animals in a tsetse-infested area are treated, and if sufficient flies make contact with those animals, the live-bait method can be extremely effective (40).

The trial has been very successful in reducing tsetse challenge and disease prevalence in parts of the region, with considerable impacts on farm productivity and farmer incomes (detailed descriptions of these and other impacts of the intervention [e.g., the ecological and environmental impacts of changes in tsetse fly habitats in relation to land use and human and livestock population] are well-documented [36, 42, 52, 54, 56, 62]). The estimated benefit/cost ratio for the project is 11.6 over two years and 9.3 over ten years, with increases in annual household incomes of between 10% and 34% (42).

Whether these important results can be generalised is not fully clear as even within the control area, the effect of the intervention has not been uniform, with greater success in some areas than in others. The sites where vector suppression has been most successful are located in a relatively gently sloping part of the valley. On one side, the sites are bordered by a mountain range that reaches an altitude unsuitable for tsetse, and on the other, by a highland area of intensive cultivation that is also a poor fly habitat. Cattle treated with pour-ons cover the sites fairly evenly. As a result, once initial suppression of tsetse flies was achieved, the risk of re-invasion was minimal and the gains were sustained. The topography of sites where suppression has been less successful differs significantly. These occur in a more rugged and low-lying part of the valley. Cattle graze in a few herds, which are not spread evenly across the valley, leaving large areas of suitable tsetse habitat with little cattle-to-fly contact. The dense thickets along the Ghibe River form particularly ideal habitats, as do a number of tributaries, all of which represent re-invasion fronts. Thus, despite regular treatment of cattle with pour-ons, vector challenge and disease prevalence remain high.

The sustainability of the impacts in Tolley-Gullele, the segment of the Ghibe Valley where suppression was successful is also at issue. The uncertainty has two sources. Firstly, not only did ILRI scientists design the trial, ILRI undertook to provide pour-ons on the international market, store them, transport them to the nine supply points ('crushes') and apply treatments to animals presented by farmers. The ILRI team members periodically engaged local cattle owners in formal and informal discussions about the effectiveness of the pour-ons and the need for a minimum level of pour-on application to maintain low levels of tsetse density and trypanosomosis prevalence in the region. Local community organisations and participating cattle owners were responsible for building and maintaining the treatment centres in their localities. The ILRI thus operated very much like many of the non-governmental organisations (NGOs) engaged in localised development activities in Africa.

Secondly, while the ILRI initially provided pour-on treatments to farmers free of charge, full cost-recovery was implemented after two years (62). However, the price charged for the pour-ons has not changed since then. Given that pour-ons are imported from abroad, and given that the value of the Ethiopian currency, the birr, has fallen sharply in recent years, the ILRI has clearly been subsidising the cost of pour-ons to farmers for some time. Moreover, transport and other marketing costs have not been fully passed on to farmers. There is no market for pour-ons in the region, but the full market price, i.e., computed at the correct exchange rate and including these costs, is estimated to be between three and four times the current selling price of 3 birr/treatment (47). Budget-based analysis of farming systems in the region indicates that the majority of these systems can withstand increases in pour-on prices within the range expected under market-based delivery, i.e., prices within the range of 9 birr and 12 birr per treatment (47).

Insecticide pour-ons are unquestionably highly effective for tsetse suppression. They confer both the public good of tsetse control and private goods such as control of biting and nuisance flies and ticks. Farmers are keenly aware of the latter effects. However, like almost every other organisation that has embarked on this kind of localised intervention, whether against trypanosomosis or any other welfare-decreasing phenomenon, the ILRI is faced with a difficult two-pronged problem, i.e., how to sustain the effects of the intervention beyond the duration of the involvement of the organisation and how to scale-up these effects beyond the intervention area.

These comments should not be taken as criticism of the efforts of the ILRI in the Ghibe Valley. Both the trial and the efforts to sustain the gains produced have been widely applauded as well designed and highly informative. Moreover, the predicament which faces the ILRI is not unique to the organisation, to the Ghibe Valley or to Ethiopia. Both the Regional Tsetse and Trypanosomosis Control Programme (RTTCP) in southern Africa (15) and the Centre International de Recherche-Développment sur l'Elevage en Zone Subhumide (CIRDES: International Centre for Research and Development for Breeding in Sub-humid Zones) in western Africa (7) report mixed results and similar difficulties in sustaining and scaling-up positive impacts.

Pressure is often heavy to address problems in rural development at their source. Typically, sources are mistakenly viewed to reside only at the points at which the primary clients of development initiatives (usually farmers) make their decisions. However, in initiatives that seek lasting solutions to development problems, the sources are multiple, appear at different points in time, and must be met by different innovations (both the RTTCP and CIRDES recognised this complexity in their tsetse and trypanosomosis control activities, but were clearly overwhelmed by the situation [7, 15]). Failures in trypanosomosis control are often linked to technical failures, i.e., to mismatches between control methods (technologies) and particular manifestations of the tsetse-trypanosomosis problem (6, 7, 21). However, technological impediments to growth are typically jointly determined with institutional ones (12, 25), although institutional causes of project failure are seldom identified. When they are, analyses fall into two contrasting categories. On the one hand, farmer willingness to pay for (or contribute to) given control measures is narrowly examined (18, 61) while on the other hand, the constraints posed by donor conditionality are only vaguely referred to (15, 50). There is a total lack of any detailed analysis of the wider institutional context that determines and reflects that willingness to pay, or that gives a cutting edge to conditionality.

This situation is not accidental. Accounting simultaneously for the structural influences that shape the development of a phenomenon while still crafting a clear, penetrating narrative (microanalysis) of that phenomenon is a demanding task (22). To achieve this, researchers must have much closer and effective links with the practice of policy-making (64).

Forging an effective interface with practical policy-making represents as deep a challenge for research on trypanosomosis management as for any other kind of research. Neither researchers nor policymakers may be accustomed to working with each other. They may communicate in very different fashions. The ways in which they define and resolve problems and the time-frames they view to be relevant for these problems may be very different. One group (researchers) values objectivity while the other (policymakers) attaches importance to insider loyalty. Advocacy coalitions may act to exclude the scientific voice. With thin institutional structures supporting research and development activity, neither scientists nor policymakers may face competitive pressures to co-operate (63).

Even a cursory reading of the electronic discussion forum hosted by the Programme Against African Trypanosomiasis (51) confirms that a number of these conditions hold for trypanosomosis research, as demonstrated in the following sampling of recent postings to the forum:

'[The] Professors… have presented an elaborate document which – from a pure academic point of view – is unlikely to provoke a lot of disagreement… [But] shouldn't the authors devote more time [to] proposing practical (that is for the field situation) and fairly reliable diagnostic procedures? Shouldn't we try to look much more into this problem of field diagnosis and come up with some practical guidelines for the practitioners?'

'Rather than refine solutions and tools, a concerted effort is needed to identify constraints…'

'Perhaps it is necessary to talk about this in more detail, since if we really do not have much "insight into the ways that farmers and veterinary assistants are using trypanocides" it is impossible to plan for changes.'

'Who will pay, who will collect the data, and who will complete the analysis?'

'This would appear to be logical, but where is the field evidence?'

'Little emphasis has been [placed] on capacity building of the farmer with respect to drug use.'

'As the various players find their niches in an evolving system, it is important that scientific and animal and human health considerations are not completely eclipsed by economic and political ones.'

'The overall objective… is to exploit results relevant to control of pathogenic trypanosomes and their vectors obtained in ongoing and future research projects funded by the European Commission and other donors. This will be effected through a series of seven international workshops, and through scientific exchanges, a World Wide Web site (Internet), and a newsletter. It is thereby intended to make a positive contribution towards increased livestock productivity and lead to economic benefit in the developing countries affected by trypanosomosis.'

The question of how a research community can achieve a better interface with a policy community must be answered. The most important requirement is obvious: researchers and the organisations in which they work must become more oriented toward producing research outputs that meet the needs of public policymakers. Clearly, these needs must first be ascertained. Simultaneously, public policymakers must become more active stakeholders in the research process (64). Introducing research results into the policy domain implies that researchers need a better understanding of how policy processes generally function.

That barriers to effective communication exist is well understood (48). The specific barriers and the potential institutional innovations that can override them will vary depending on extant political relationships (48). However, the earlier quote from the trypanosomosis expert illustrates the deep distrust within the trypanosomosis community for all

things political. Indeed, to the expert anything that is political is unimportant and he is far from alone in this view. Many researchers avoid politics. This is as big a mistake in the area of trypanosomosis management as for any issue in rural development, in view of the fact that anywhere in the world, rural development is fundamentally political. The structure of interests that seek advantages in rural Africa rests on the interplay of the inherent nature of competition and co-operation in rural areas (as defined by markets and other rural institutions that govern economic allocation and exchange) and the distribution of political power that gives competition and co-operation their actual expressions (3, 4, 31, 41, 43, 55). Distributions of political power typically have distinct (spatial) patterns. Redistributive gain (over such spatially-defined entities as administrative provinces and districts) is thus typically a compelling motivation for change and stability in rural Africa.

The expert is therefore absolutely correct. Trypanosomosis control is highly political. It is so by virtue of its being a phenomenon that changes the path and pace of rural development, which is one of the major concerns of politicians in Africa (52, 54).

Part of the political charge springs from the ecology and biology of tsetse and trypanosomes. Seldom are fly belts and trypanosomosis outbreaks confined to single countries, or to particular administrative (i.e., political) units within countries. Major challenges in co-ordination across political boundaries are thus likely to be the norm rather than the exception (23). Escaping politics of this type is impossible, even if to scientists the issues appear to be unimportant. Added to these exogenous political pressures resulting from the ecology and biology of the tsetse fly and trypanosomes, are a set of endogenous ones. These pressures are linked to the largely external origin of most of the resources for trypanosomosis control in Africa, and to the particular agendas of given donor countries and organisations on the continent. A further important point is that almost all of the most effective and widely used control technologies (e.g., trypanocidal drugs and insecticides) are manufactured outside Africa. Finally, many of the senior advisors and technicians involved in control programmes across the continent reside outside Africa and spend considerable amounts of time debating the minutiae of tsetse and trypanosomosis control with one another (51). Therefore, when these experts talk to policymakers, their intended audience most often resides outside Africa and when decision makers in Africa are targeted, they are either presented with lengthy and crude lists of actions and recommendations for action (29), or with ex-post justification for projects already underway.

Poor links between researchers and policymakers have led to separation of the questions of 'what' to do about trypanosomosis and 'how' to do this, i.e., how the what can be made to happen. Researchers are preoccupied with the former question (what to do), while policymakers, insofar as they take research outputs into account in their decisions (which is often not the case), are concerned with the latter one (how). This is a perfect recipe for failure in any circumstance (57), and the record of interventions against trypanosomosis in Africa confirms this thesis (Budd [9] estimates a benefit/cost ratio of only 2.5 for over 20 years of British investment in trypanosomosis control in Africa. Given the high risks typically associated with investment in most parts of Africa, such a ratio would be considered too low by most investors).

Uniting the two questions means changing the ways in which research activity and development initiatives are organised and integrated (57). This also entails a largely unrecognised agenda for social science research on agriculture in Africa (46). According to the authors, these conclusions also apply to trypanosomosis management on the continent.

Unrecognised social science research agenda

The number of social scientists undertaking research on issues related to trypanosomosis in Africa is small, probably around one dozen. Each shoulders major responsibilities, although few, if any, have independent research agendas. Rather, these researchers are mainly service providers, performing numerous impact assessments within research programmes motivated by epidemiological and ecological concerns. Indeed, when their research outputs have been published in peer-reviewed journals (and most have not), these have been ex-ante and ex-post impact assessments.

Impact assessment is certainly necessary and often pioneering work, but conceptually, often very simple. Moreover, such studies usually fail even to raise interesting social science questions, let alone seek to answer the most pressing among them. Two fresh additions to this body of work illustrate not only the strengths and achievements but also the limitations and failings of these types of studies (singling out these two studies to carry the burden of a deficiency that extends well beyond trypanosomosis management is slightly unfair, but the authors hope that their comments will serve as educative examples of what may be possible under different expectations in study design and implementation. Note also that the authors collaborated on one of the papers).

The first example is a study by Kristjanson *et al.* (33) that measures the potential benefits and costs of research on a vaccine against trypanosomosis. This is a truly pioneering work, being the first ex-ante impact assessment to use geographic information systems (GIS) to spatially integrate a biophysical livestock herd simulation model with an economic surplus model of the kind typically employed in ex-ante assessments of research investments (1). An impressive internal

rate of return of 33% is computed, with an equally remarkable benefit/cost ratio of 34.

However, the paper is motivated and developed as a purely methodological piece. The authors thus ignore the important (and potentially debilitating) set of issues raised upon recognition that the great majority of potential users of any vaccine (i.e., small-scale farmers) are poor. Potential demand for any vaccine may be high, but actual market demand is likely to be very low. The opportunity costs of both private and public investment in delivery systems that reach these farmers will thus be high. The authors fail to examine questions such as the following: even if a vaccine were to be successfully developed, and both now and at the time of the analysis, this was a highly contentious issue, would it be commercialised? What role would markets play in that process, and what would be the residual roles for public bodies? What collaborative relationships in research and technology development would be required? Instead, conclusions are drawn regarding the believability of assumptions about key model parameters. Implicitly (and inadvertently) assuming a competitive pricing regime for the vaccine, the authors use break-even analysis to show that to achieve a hypothetical target of 20% return on investments in vaccine research, an adoption rate of 3% (840,000 households) is required. However, they argue, this adoption rate – which at first glance appears to be low but actually swamps adoption rates for all but a small number of commercially-priced technologies in Africa – is highly achievable, and well below the adoption rate of 30% assumed in their base simulations. In short, a central feature of a hypothetical model is used to justify results of experimental simulations of hypothetical changes in assumed parameters.

The second example is a study by Falconi *et al.* (20). This is also an ex-ante economic analysis of a particular research thrust, i.e., on how trypanotolerance can be maintained and enhanced in livestock populations while retaining and reinforcing characteristics of economic importance to farmers, and on how trypanotolerance can be imparted to susceptible livestock while retaining their other important traits. Again, this is a pioneering initiative in that few attempts have been made to complete such analyses for research on livestock disease resistance, i.e., on the genetic option in animal health management. None at all have been undertaken for research on trypanotolerance in Africa. Using the production and prices data developed by Kristjanson *et al.* (33), but a somewhat different modelling strategy and proposing sets of parameters that define alternative scenarios of progress toward key milestones in research on trypanotolerance, the authors find that potential benefits to research – historically field-based but increasingly biotechnology-driven – range from two to nine times potential costs and that the internal rate of return on investments can be as high as 30% (quantitative field-based research has yielded basic tools with which the trypanotolerance trait can be identified, quantified, and exploited. Considerable progress has been made in using criteria on trypanotolerance in the field to quantify links between trypanotolerance measurements and a number of economically important production traits [13]. However, these conventional field-based approaches to selection and breeding are lengthy and at times, inaccurate. Recent advances in deoxyribonucleic acid [DNA] technology offer the prospect of progress in understanding trypanotolerance in more direct and precise ways. Marker-assisted selection [MAS] of target genes within breeds of tolerant animals, and marker-assisted introgression [MAI] of target genes from tolerant to susceptible breeds are major research thrusts in molecular genetics research on trypanotolerance. Coupled with artificial insemination and embryo transfer technology, MAS and MAI are expected to produce possible rapid results in genetic resistance to trypanosomosis in the cattle population of affected areas of Africa [66]).

The paper is motivated principally as an analysis of policy options. The authors thus consider the problems posed by delivering research outputs to the impoverished farmers of Africa (specifically, source or reference herds will probably need to be maintained and the embryos and nuclei emerging from MAS and MAI within these herds, appropriately stored and effectively delivered to farmers. Ideally, such herds should be held in the village settings within which farmers make their decisions. However, historically, even in livestock experiment stations where environmental factors are easily controlled, work on improvement of livestock in Africa has often produced disappointing results. In particular, delivering superior animals to local breeders has met with major institutional hurdles [10, 49]). Three broad options are identified: private delivery using markets, provision by public agricultural research and extension systems largely outside markets and mixed private-public provision (e.g., using farmer collective organisations). Depending on the intellectual property rights regime in place, each option has advantages and drawbacks relative to the others.

The implications of wide scale poverty in rural Africa suggest there may be no system of private ownership of research results that would justify private investment in these technologies. Diseases such as trypanosomosis that are concentrated in poor countries typically do not interest the private sector. Trypanocide or trypano-prophylactic molecules in use today are the same as those available half a century ago. Major pharmaceutical companies clearly regard Africa as a poor market and disdain research on new molecules. The role of national and regional research in Africa, as well as of international public research, must therefore be reinforced.

However, the institutional constraints facing public development and delivery of agricultural technologies in many countries in Africa (28) suggest that pure public ownership of rights and pure public delivery of technologies are unlikely to be feasible and sustainable. The authors suggest two intermediate (or mixed) options. The public sector might pursue a 'market segmentation strategy' in which innovations

are licensed out at zero cost for marginal farmers while charging some cost to larger farmers more able to pay for the technologies. Alternatively, private companies might be contracted to undertake delivery of innovations for which the public sector has ownership but for which they (the private sector) can charge market-determined rates.

These mixed options are theoretically appealing, but the authors do not raise the question of how precisely they can be implemented. This, however, is the most important question from a social science standpoint. Moreover, the authors seem oblivious to the incongruity of proposing that supposedly weak and poorly performing public sectors should design and implement even more complex and management-intensive policy measures than those they are currently failing to design and implement. This is a common failing in this type of research and a clear sign of poor research-policy links. The analysis does, however, suggest that the answer to the 'how' question lies in new organisational forms and new patterns of learning in agricultural technology systems.

Neither of these (the new forms and the new patterns) appears spontaneously, nor are they costless to create (57). Organisational forms and learning patterns display inertia and path-dependence over time (16). Learning cannot be easily adjusted to any organisational form, or organisations rapidly reshaped in light of changing learning environments. For instance, the fact that in a heavily tsetse-infested part of south-eastern Uganda, use of both preventive and curative trypanocidal drugs has been found to be confined to less than 23% of farmers whose animals are at risk of infection is not purely coincidental (34). Indeed, only that proportion of farmers even knows the true cause of trypanosomosis. Not surprisingly, few traders and animal health officers operate in the area, implying low volumes and high unit costs for inputs and services delivered to farmers. This further reinforces the low levels of drug adoption by farmers, low farm productivity and muted farmer incentives to invest in acquiring improved information about the disease. Those traders and service providers who do operate in the region restrict their activities to areas immediately surrounding the rural townships in which they reside, leaving the great majority of farmers sited far from these centres without access to drugs and information.

Such situations of low supply and low demand for improved agricultural technologies are common across Africa (46). How to bridge the gap remains an open question. An essential requirement is viewed to be proactive action-research within these systems, where opportunities to improve the systems are sought and outcomes of research-based actions used to inform further analysis. Two types of action are possible: indirect actions, i.e., those aiming to influence framework conditions, including the institutional context, and direct actions, i.e., initiatives and interventions in the creation of new systems and processes. There is no reason to expect trypanosomosis to be managed any differently.

Trypanosomosis management therefore is no different from other aspects of rural development in that the key challenges centre not so much on 'what' to do (e.g., increase the access of smallholders to improved inputs) as on 'how' to do it. Research-based answers to these challenges clearly lie in the social science domain. This domain considers conditions 'on the ground' (focusing on the rationale behind the responses of farmers and herders to these conditions) and also those at progressively higher levels of aggregation (focusing at each stage on organisational forms and learning patterns).

The social science research agenda thus extends well beyond the conservative impact assessments currently preoccupying most social scientists working on trypanosomosis management. Rather, the agenda embraces the inherently political nature of trypanosomosis management and considers the organisational forms and learning patterns that determine and reflect one another, and which together, define and are expressed in political outcomes. These outcomes rest on mechanisms of power over the definition of current and future alternatives. The full set of social science questions should incorporate issues such as defining existing power relations and determining the possibilities of changing them, as well as whether this is desirable or not. The following should therefore be questioned: the direction a country or region takes for trypanosomosis management, whether this is desirable or not, the winners and losers, and the mechanisms of power involved. Further issues include questioning the actions to be taken and the means by which this should be done.

Unsurprisingly, a basic organisational challenge faces the research enterprise itself. Ways must be found to arrange work programmes that are not too close to policy, become enmeshed with it, and thus enter more into advocacy than objective research (e.g., most of the research to date on the SIT). Similarly, programmes must not stray too far from basic issues of policy and settle instead for routine descriptive work (that answer sterile 'what' questions) without reaching for inferences and interpretations (that respond to practical 'how' questions) that are relevant to major policy choices (e.g., most of the work on economic impact assessment of given intervention methods and approaches).

Summary and conclusions

This paper basically centres on defining the elements for sustainable management of trypanosomosis in Africa. The nature of the disease is such that actual interventions must differ from case to case, depending on complex interactions among biophysical and socio-economic factors. No 'toolbox' of methods or 'checklist' of activities that are relevant and effective everywhere exist. However, the viewpoint of the authors is that 'an outlook on' or 'framework for' trypanosomosis management

in Africa may be proposed, which would render the actions more sustainable than at present.

Whether made explicit or not, the framework guiding trypanosomosis management in a given country or region will exist, in the form of extant structures and processes that define opportunities and constraints for disease and vector management. The more coherent and transparent the framework, the clearer the signals sent to stakeholders, and thus the associated allocations of resources, in terms of their contributions to rural development objectives, will be more effective, efficient, and sustainable. Conversely, the less coherent and transparent the framework, the more confusing the signals sent, and the given initiatives will be less efficient, less effective, and less sustainable. The history of trypanosomosis control (and eradication) in Africa indicates that these positive and negative consequences can be mutually reinforcing. The better and more relevant the framework, the more successful the investments undertaken within the ambit thereof, the more rewarding the activities associated with these investments, the better and more relevant the appearance of the framework (in hindsight), and so on. The converse is also true. An incoherent and inappropriate framework sharpens instability in investments in disease management, erodes the sustainability of participating institutions, confirms the incoherence and inappropriateness of the framework, and so on. Vast returns can be expected from a coherent – explicit or implicit – framework for trypanosomosis management.

The authors have shown that a fully consistent framework should have at least three features. Firstly, the currently dominant control objective should be replaced with one that focuses on management, i.e., with one built explicitly on the rationale of disease management decisions of farmers and herders and aimed at providing them with more effective ways of dealing with (and coping with) the disease within the contexts of their extant production systems. For instance, nomadic and transhumant pastoralists are among the most knowledgeable of livestock farmers (19), but their decision-making processes remain largely misunderstood, as scientists seek greater control over a fundamentally uncontrollable phenomenon.

Secondly, a consistent framework should seek to better integrate research with policy by recognising and embracing basic issues in politics and exploring institutional innovations to override ever-present political constraints. A significant part of the management challenge would thus be seen to lie in the political domain.

Thirdly, a consistent framework should place the social science research agenda implied by the greater integration of research and policy (and the greater attention to political issues) at the forefront of research efforts, i.e., as opposed to the current, largely 'service' role of social science. In such an agenda, the question of 'what' to do in trypanosomosis management would not be separated from the 'how' question.

An explicit theme lying behind these propositions has been that consistent programmes for trypanosomosis management begin and end with firm understandings of the basic ecology and epidemiology of the disease (23). The relationship of greatest policy significance is the highly non-linear one between vector challenge and disease prevalence. This relationship defines not only basic economic relationships in vector and disease management (and thus the extreme unlikelihood of eradication and control), but also shapes political associations and outcomes. All complications in programme financing and co-ordination, each difficulty in technology procurement and distribution (and pricing), and every hurdle in collective action and community organisation derive from this relationship, not least because several measures must typically be used in combination and be strategically integrated (14).

An implicit theme has been that trypanosomosis management faces a strong 'horizontal imperative' in programme formulation and implementation. Management of the disease has numerous links, not only with other segments of the rural economy, but also with other non-rural sectors, both within and across national boundaries. Factors influencing the sustainability of given programmes extend well beyond the bodies directly charged with administering them. Very little can be taken as 'given' if real problems are to be correctly identified and adequately addressed. The organisational challenge must be met by research aiming to comprehend this complexity and to design formal and informal institutional innovations that limit the transaction costs associated with accommodating the horizontality and the political expression thereof (Ford [23] presents several examples of recandescence of infection in a number of countries after control relapsed. In almost every case, the horizontality of trypanosomosis management coupled with high dependence on political factors [political instability in particular] were the key undermining causes).

A lesson to be learned from the brief outline presented of the history of trypanosomosis eradication and control in Africa is that any new control method introduced was considered a panacea and viewed to be effective everywhere, under all conditions. With the inevitable failures came sometimes-fatal assessments of the methods and subsequent abandoning of the associated control strategy. Fads and reversals of this sort continue, suggesting the continued absence of a consistent rationale for trypanosomosis management on the continent.

This absence is especially dangerous at the present time. In many countries in Africa, public sectors are downsizing and restricting their activities, and public provision of inputs and services outside markets is being replaced by private delivery in increasingly liberalised markets (37). By design or by default, this trend also applies to trypanosomosis management (7, 18), implying new constraints on campaigns against the disease,

many of which are purely political. The type of framework for research-based trypanosomosis management proposed in this paper may guard against reversals of rare and hard-won gains over the disease, or lead to new and sustained advances.

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La gestion de la trypanosomose animale en Afrique : problèmes et alternatives

S.W. Omamo & G.D.M. d'Ieteren

Résumé

Les auteurs de l'article passent en revue les méthodes en usage dans le passé et à l'heure actuelle pour lutter contre la trypanosomose animale transmise par les glossines en Afrique. Selon eux, elles présentent trois faiblesses principales, à savoir des objectifs inadaptés, des relations inadéquates entre la recherche et les politiques, et l'absence de prise de conscience quant à la nécessité de placer la trypanosomose au premier rang des priorités de la recherche socio-scientifique. Des obstacles importants ont entravé le progrès dans la lutte contre la maladie. Les auteurs estiment qu'il convient de remédier impérativement aux lacunes de ces méthodologies pour permettre à l'Afrique d'exploiter les quelques résultats déjà acquis et de redoubler d'efforts pour enrayer la maladie. À cette fin, les auteurs préconisent de renoncer aux préoccupations actuelles des chercheurs et des hommes politiques, qui se soucient davantage de « contrôler » ou « d'éradiquer » la maladie, et de s'attacher plutôt à la « gérer » ou à « y faire face ». Par ailleurs, il conviendra d'étudier les moyens à mettre en œuvre pour assurer plus de cohérence entre la recherche et les politiques. Enfin, les aspects socio-scientifiques liés à la question des mesures pratiques à adopter pour faire face à la trypanosomose en Afrique devraient figurer au premier plan des efforts de recherche.

Mots-clés

Afrique – Gestion durable – Politique – Recherche – Trypanosomose.

Problemas y posibilidades de gestión de la tripanosomosis animal en África

S.W. Omamo & G.D.M. d'Ieteren

Resumen

Los autores examinan una serie de métodos, tanto tradicionales como modernos, utilizados en África para hacer frente a la tripanosomosis animal transmitida por tsetse, y postulan que todos ellos adolecen de tres puntos débiles fundamentales: objetivos inadecuados; deficiente relación entre la investigación y las políticas zoosanitarias; e incapacidad de entender que las tripanosomosis deberían ocupar un lugar preeminente en los planes de investigación científica y social. Hasta ahora ha sido difícil avanzar en el tratamiento de la enfermedad. En opinión de los autores, para que África se beneficie de los exiguos progresos realizados hasta la fecha y sea capaz de luchar de manera más sostenida contra la enfermedad es indispensable corregir las mencionadas deficiencias metodológicas. Para ello, explican los autores, es preciso dejar de lado el afán de 'controlar' (o 'erradicar') la enfermedad, tan común hoy entre investigadores y planificadores, y dedicarse en su lugar a 'gestionarla' (o 'lidiar con ella'). Es necesario además buscar el modo de lograr una articulación más coherente entre la investigación y los programas de lucha zoosanitaria. Está por último la cuestión de cuáles son los pasos que en la práctica deben darse para hacer frente a la tripanosomosis en África. Los problemas científico-sociales que ello plantea deberían ser un tema prioritario en los programas de investigación.

Palabras clave

África – Investigación – Gestión sostenible – Políticas – Tripanosomosis.

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