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DFID-AHP

Recent advances in livestock keeper-based tsetse control

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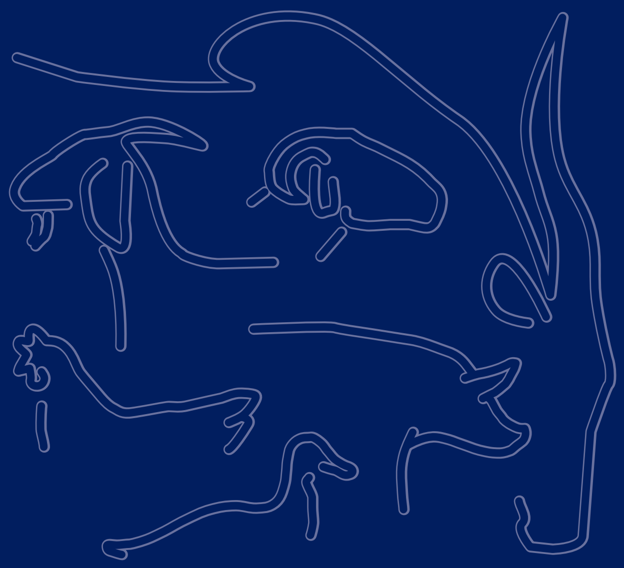

Recent advances in livestock keeper-based tsetse control: the way forward

Report of a workshop organised by the DFID Animal Health Programme

21-23 October 2003
Nairobi, Kenya

Healthier livestock, wealthier people

The DFID Animal Health Programme

The research strategy of the UK Government's Department for International Development (DFID) is to generate new knowledge and promote its uptake and application, thereby improving the livelihoods of poor people. The bilateral component of this strategy is organised as research programmes covering agriculture, forestry, livestock and fisheries, managed by institutions contracted by DFID. The Animal Health Programme is managed by the Centre for Tropical Veterinary Medicine (CTVM), University of Edinburgh, Scotland, under the leadership of Professor Ian Maudlin.

The Animal Health Programme´s mission statement:

Livestock are vital to the lives and livelihoods of two-thirds of the world's rural poor – close to 700 million people. But chronic endemic diseases and zoonoses constrain livestock productivity and endanger human health, thereby contributing to the perpetuation of poverty. Bringing together veterinary, medical and social scientists from the UK, Africa and South Asia, DFID's Animal Health Programme (AHP) funds research leading to better control of these diseases. Effective dissemination and uptake of AHP research findings can enhance the livelihoods and health of poor livestock keepers.

For more information contact the AHP:
Website: www.vet.ed.ac.uk/ctvm/AHP/ahp/index.htm
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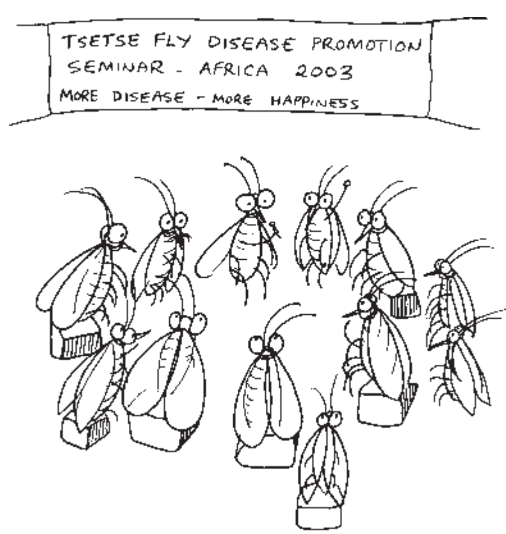

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Contents

A CD accompanies this report. See inside back cover

Preface

Tsetse and trypanosomiasis feature prominently in the Animal Health Programme's portfolio, reflecting the impact they have on the lives and livelihoods of poor livestock keepers throughout much of sub-Saharan Africa. Recently the Animal Health Programme (AHP) has supported a number of different activities related to both the livestock and human forms of the disease, *nagana* and sleeping sickness.

A cluster of research projects located in Ethiopia, Kenya, Tanzania, Uganda and Zimbabwe are looking at a wide range of aspects of trypanosomiasis and its control. In September 2002, we organised a major international meeting in Edinburgh, *Tsetse control: the next 100 years*, to consider the broad topic of tsetse control and, in particular, the pros and cons of tsetse eradication. The report of that meeting is now available[1] and consists of both a printed summary report and a multimedia CD. The report also contains an essay by a highly experienced and respected writer who specialises in agriculture and development – Simon Chater of Green Ink – which injects a refreshing, outsider's perspective into the often polarised arguments and issues.

A companion volume to the Edinburgh meeting report presents the findings of John Hargrove, a gifted modeller, who applied his not inconsiderable skills and intellect to the question of what methods, if any, were 'necessary, sufficient and desirable' for the eradication of tsetse populations[2]. In addressing this question he used field data from past campaigns to develop quantitative models of the time course of tsetse control operations. He went on to use these models to forecast the basic entomological eventualities of employing one or a combination of control techniques. His report, *Tsetse eradication: sufficiency, necessity and desirability*, is also available on request from the AHP office.

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[1] AHP (2002) *Tsetse control: the next 100 years*. Report of a meeting organised by DFID–AHP, 9–10 September 2002, Edinburgh, Scotland. DFID Animal Health Programme, Centre for Tropical Veterinary Medicine, Edinburgh, Scotland.
[2] Hargrove, J. (2003) *Tsetse eradication: sufficiency, necessity and desirability*. A review commissioned by DFID–AHP. DFID Animal Health Programme, Centre for Tropical Veterinary Medicine, Edinburgh, Scotland.

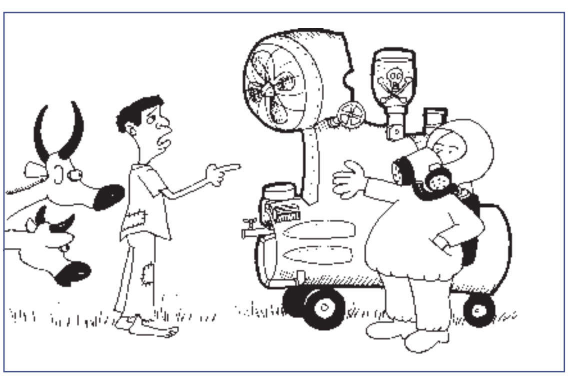
On the eve of the present workshop, Glyn Vale and Steve Torr launched *Tsetse Plan*, an idea developed with AHP funding. It is an interactive computer programme providing specialist assistance, and is mainly concerned with planning the strategy and tactics of bait campaigns (a copy is included on the CD that accompanies this report). This is achieved by 'what-if' analyses based on modelling of tsetse populations. The programme aids practical aspects, such as budgeting, shopping lists and accounting as well as exploring the experimentation and statistical analyses that are associated with bait campaigns.

The present workshop builds on and complements all prior activities. DFID (and its predecessor, the Overseas Development Agency) has invested heavily in livestock keeper-based tsetse control, and the AHP continues to fund research in this vital field. With the demise of tsetse control departments throughout Africa during the last few decades, farmers are now, more than ever, on the front line of the battle against tsetse. I believe this workshop has made a significant contribution to providing them with the weapons they need to win the war.

Professor Ian Maudlin
Animal Health Programme Manager
Edinburgh, February 2004

Acknowledgements

The AHP workshop, *Recent advances in livestock keeper-based tsetse control: the way forward*, was enjoyable, different and, we believe, useful. The credit for achieving this commendable result belongs to a team of people led by Keith Sones, who conceived, designed and organised the event. The idea of dispensing with conventional presentations in favour of interviews made a refreshing change and the interviews were carried out with considerable skill and aplomb by the workshop facilitator, Nigel Campbell. The three 'technology champions', Glyn Vale, Burkhard Bauer and Rajinder Saini, enthusiastically embraced the new approach and performed their roles admirably.



WREN Media provided an excellent service in sound recording the workshop and carrying out supplementary interviews with workshop participants. This workshop report was written and compiled by Keith Sones with considerable input from Susanna Thorp of WREN Media, and the report was copy-edited, designed and laid out by Green Ink. WREN Media were also responsible for producing the excellent multimedia CD that complements the printed document.

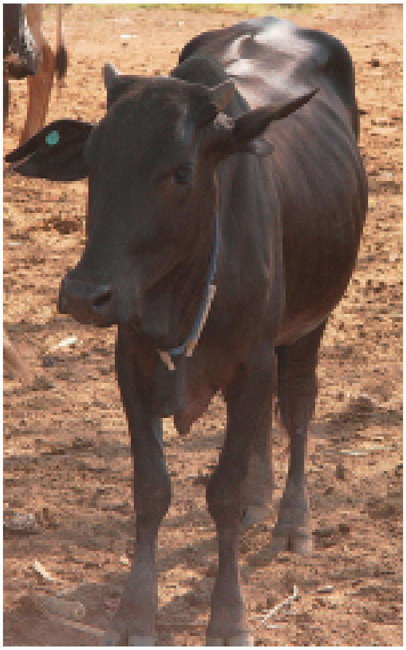
The eve of workshop reception was generously sponsored by the French animal health company CEVA Santé Animale, represented by Dr JJ Oduor. In total, around 50 people participated in the workshop, some travelling thousands of miles to do so.

Ian Maudin and the AHP wish to thank everyone who took part in or contributed to the success of the workshop and hope that you will find this workshop report and CD useful.

1. Workshop concept and approach

Introduction

In September 2002, the UK's Department for International Development (DFID) Animal Health Programme hosted a meeting in Edinburgh, Scotland titled *Tsetse control: the next 100 years*. The title came from an interview conducted with Solomon Haile Mariam of the African Union's Interafrican Bureau for Animal Resources (AU/IBAR), published in a newsletter of the European Union (EU) Concerted Action on Integrated Control of Pathogenic Trypanosomes and their Vectors (ICPTV)[1], in which he said: 'The vision is for a continent free of tsetse, but that is far in the future…I hope that we could be rid of tsetse, perhaps within the next 100 years…'.



Before the Edinburgh meeting, the debate on eradication of tsetse appeared largely in the pages of specialist and mainstream publications and was, at times, highly vituperative. The confusion raised in the minds of donors by this very public argument did nobody any good – least of all the millions of poor Africans whose lives and livelihoods are seriously endangered by tsetse flies and the diseases they transmit. In an attempt to pour oil on troubled waters, the management of the DFID Animal Health Programme decided to invite the key proponents

1. Newsletter on Integrated Control of Pathogenic Trypanosomes and their Vectors (ICPTV), March 2002, Issue 5, pp. 26–27.

and opponents of tsetse eradication to a meeting in a convivial atmosphere where rational debate could take place.

More than 40 participants attended the Edinburgh meeting, which had an unusual format (for the livestock sector). All presentations and discussions were sound recorded, as were the supplementary interviews conducted outside the meeting room. The proceedings were published in an attractive and informative meeting report, combining print and multimedia formats. The meeting helped to reunite the divided international tsetse and trypanosomiasis community. Just two weeks after the Edinburgh meeting, at a meeting of the Programme Against African Trypanosomiasis (PAAT) Advisory Group, a statement was issued reflecting consensus of a wide range of stakeholders (see Annex 4). Among other things, the statement noted:

- The tsetse and trypanosomiasis community…is united in its resolve to reduce and ultimately eliminate the constraint of tsetse-transmitted trypanosomiasis in man and animals.
- The PAAT community believes that progress towards the final objective is best achieved through concerted efforts for intervention, in a sequential fashion, with the focus on those areas where the disease impact is most severe and where control provides the greatest benefits to human health, wellbeing and sustainable agriculture and rural development.
- In animal trypanosomiasis, tsetse control has a key role to play in the effective control and eventual elimination of the disease. A significant stage in achieving this objective is the creation of tsetse-free zones through the integration of appropriate and environmentally acceptable technologies, including sequential aerial technique (SAT) and sterile insect technique (SIT), as economically justified.
- There is a need to encourage livestock producer-based practices against tsetse and trypanosomiasis wherever the associated diseases create problems.
- In this regard, it is opportune to consider the refinement of tsetse and trypanosomiasis intervention policies, and to enhance synergies and complementarities among all concerned international agencies and governments.

DFID (and its predecessor, the Overseas Development Agency) has a history of investing in livestock keeper-based tsetse control technologies, an area in which significant advances have been made recently. By bringing together the champions of these technologies, some of their disciples and other interested parties for an international workshop, it was hoped to build further on the enhanced synergy and complementarity already created by the Edinburgh meeting and PAAT statement.

State-run tsetse and trypanosomiasis control capacity has declined over the last few decades and it is widely recognised that, for the short and medium term at least, African livestock keepers will be the vanguard in the battle to control trypanosomiasis. In many cases, livestock keepers have to rely on trypanocidal drugs to treat or, less often, to prevent trypanosomiasis. Despite the fact that these drugs have allowed millions of livestock keepers to successfully raise their animals in tsetse-infested areas, the workshop devoted little time to drugs. The reason is simple: the workshop focused on 'recent advances' and there have been few of these in the use of trypanocidal drugs over the past four decades. Instead, the workshop concentrated on livestock keeper-based tsetse control technologies – an area that has seen significant recent advances and that promises to bring a range of affordable technologies within the reach of even poor livestock keepers.

The objective of the workshop was to review the current state of knowledge in relation to three technologies, namely restricted application of insecticide to livestock, use of impregnated netting around zero-grazing units, and tsetse repellents. Having ascertained what is known, the participants proceeded to identify what needs to be done next. Originally the workshop was scheduled to take place as a satellite meeting to the International Scientific Council for Trypanosomiasis Research and Control (ISCTRC) meeting held in Pretoria in October 2003, but unfortunately there were too many other competing satellite meetings and it was decided that it made more sense to reschedule and relocate to Nairobi.

Following on from the Edinburgh meeting, we were keen to explore new formats for meetings as an alternative to the tired, presentation-dominated norm. For this workshop something different was tried – television-style interviews in place of conventional presentations. In addition, the event was sound recorded to facilitate accurate reporting, and excerpts of the interviews and discussions are reproduced in this report and on the accompanying CD.

Workshop objectives

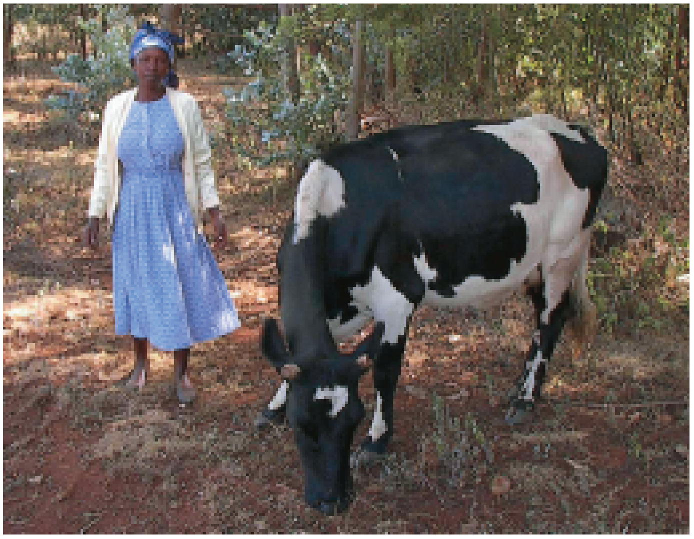
The workshop brought together researchers from various African countries who are working on one of three new approaches to livestock keeper-based tsetse control, and other participants with complementary experience and expertise. These included specialists in social sciences, extension approaches and environmental impact, and a sizeable contingent from the commercial sector who have, or could have, interest in the technologies under consideration.

The workshop was primarily concerned with three recent advances that appear highly relevant to livestock keeper-based tsetse control: 1) refinement of application of synthetic pyrethroids (SP) to cattle in tsetse predilection sites, 2) use of SP-impregnated netting to protect zero-grazed dairy cattle and 3) development of tsetse repellents that exploit novel 'push–pull' strategies.

Ahead of the event, the ambitious plan for the workshop was to:

- determine the current state of knowledge regarding these technologies
- undertake a critical analysis of the different approaches
- determine significant knowledge gaps and decide how these can be addressed
- determine the best-bet options for exploiting these technologies
- consider who are the different players and what are their respective roles
- consider public and private sector responsibilities and the scope for public–private partnerships
- consider how these approaches can be integrated into other initiatives, e.g. the Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC)
- consider how these advances can be disseminated and how to promote 'good news' stories and positive public relations
- determine the best way forward.

At the start of the workshop, participants were reminded that DFID's natural resources research strategy is 'to generate new knowledge and to promote its uptake and application to improve the livelihoods of poor people'. It was suggested that the workshop fitted perfectly into that strategy, by targeting an important constraint to the livelihoods of poor livestock keepers, i.e. trypanosomiasis. The workshop also fitted DFID's strategy by reviewing recent knowledge relating to managing trypanosomiasis (three different approaches to livestock keeper-based tsetse control) with a view to evaluating the potential of each technology and, if appropriate, promoting their uptake and application.



What makes a successful product?

Over the two-day period, the participants worked through a process that started by considering why some products and technologies are successful, with a particular focus on technologies appropriate to the poor in Africa.

The characteristics of two existing products from outside the animal health sector were briefly considered: Bic® pens and Freeplay™ wind-up radios. It was suggested that Bic® pens are an example of a near perfect technology, accessible to and appropriate for even the poor. The pens meet a demonstrable need, that of writing and keeping records; it was noted that even the illiterate sometimes need to record information (e.g. forms have been developed for use by illiterate community-based animal health workers using symbols and a simple scoring system). Bic® pens were described as effective, cheap, simple to manufacture and use, robust, requiring no maintenance or spare parts, available in even the smallest and most remote *dukas* (small shops) and having user-friendly features – the visible ink reservoir means that it is easy to judge when they are about to run out of ink.

It was noted that the Freeplay™ wind-up radio also has a number of very attractive characteristics and features but ultimately falls down in one crucial area; it is simply too expensive for poor people to buy – the cheapest models cost around US$ 60. The issues that determine whether a technology is taken up or not are further explored in an essay commissioned to complement this report (see page 7).

After this brief consideration of two marketed products, participants considered the criteria that determine whether products or technologies are useful and applicable in the African context. Each characteristic was written

Technology evaluation checklist

- Is it commercially viable?
- Is there a demand from the end-user?
- Is it effective?
- Is it simple to use?
- Is it affordable?
- Is it sustainable?
- Does it have acceptable externalities (positive or negative)?
- Is an enabling environment in place?
- Is it environmentally friendly?
- Is it culturally acceptable?
- Can it be made readily available?
- If the technology requires collective action, can it be managed?
- How is it going to be disseminated/ promoted?

down on a separate card, and the cards were grouped into clusters of similar themes. A small group synthesised the clusters further to derive a checklist (see box), which could be used to evaluate the three technologies under consideration – and which may also have wider applications.

Of these, some participants felt that the first question: 'Is the technology commercially viable?' was the key one. If the answer was no, then no further assessment was required.

To test the checklist, the questions were considered in relation to trypanocidal drugs for the treatment of animal trypanosomiasis. The objective was to see if the checklist was comprehensive and whether any significant areas had been overlooked. In the process of working through the checklist it was concluded that the list worked well. It seemed to cover all the major factors and prompted adequate consideration of important issues.

The key criterion: 'Is the technology commercially viable?' was clearly met since these drugs have been marketed successfully in Africa for several decades. This also means that there must be demonstrable demand. Regarding efficacy, the increasingly common problem of drug resistance means that trypanocidal drugs are not always effective, but it was recognised that millions of cattle are successfully protected against, or treated for, trypanosomiasis. Trypanocidal drugs are relatively simple to use, although there is some potential for incorrect dosage due to the difficulty of estimating the weight of cattle accurately. At a cost of less than US$1 per dose, the products are considered affordable. Drug residues in tissues of treated animals may represent unacceptable externalities, especially if recommended withdrawal times are not followed. The enabling environment was considered to be in place to support the use of the drugs. There are no direct negative environmental impacts associated with their use, and the products are culturally acceptable and readily available. Collective action is not an issue as the drugs are generally used by individual stockowners on their own animals. The products are well-known and require little promotion.

Why are some technologies successful?

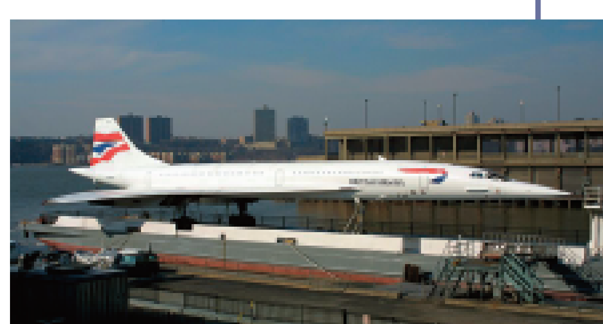
Essay by Susanna Thorp, WREN Media

Although this essay is titled ‘Why are some technologies successful?’ it is perhaps better to consider the question: ‘What makes a technology successful for Africa?’ This is not an easy question. The answers, if they could be determined, would surely make life better for millions of poor Africans, who currently subsist but are constrained from achieving a better life.

Africa may be the birthplace of humanity but for hundreds of thousands of years, human activity on the continent has been defined by the need to cope with unpredictable climates, harsh environments, pests and more disease-causing parasites than exist anywhere else in the world. While the hundreds of migrants that were the first to leave Africa dispersed, thrived and multiplied, those that remained behind had to struggle to survive. Over millennia, Africans’ potential to prosper has been constrained by many parasites, including malaria and bilharzia. But, above all, the tsetse (*Glossina* spp.) and the trypanosomes it carries have limited the land available for cultivation and the spread of domesticated livestock.

Despite many and various approaches to its control over the last 100 years, tsetse remains a problem and the group of diseases, collectively known as the trypanosomiases, continue to affect millions of poor people and their livestock. The challenge today, according to Ian Maudlin, Programme Manager for the DFID Animal Health Programme, is to provide tools for individual farmers so they can deal with the problem of tsetse and trypanosomiasis in their own way and in their own time. In resolving this challenge, participants were asked, during the course of the workshop, to draw up and agree on a checklist of questions about what makes a technology useful or applicable in the African context. While this exercise did not answer the question ‘What makes a technology successful?’, nevertheless, the issues raised are important components of what determines widespread acceptability and use.

A supersonic success?



In considering ‘Why are some technologies successful?’ it was perhaps symbolically coincidental that Concorde, a technological pioneer in aviation, flew its last commercial flight (after 27 years in service) on 24th October 2003, the day after the close of the workshop. Concorde, the world’s first supersonic commercial aircraft, may also be its last, as the airlines concentrate on super-efficient, not supersonic flight. So, although Concorde was considered 'an amazing feat of engineering', can it be considered a success? For those participants at the workshop who stressed that technologies should be commercially viable if they are to be deemed successful, this was one criterion that Concorde did not meet.

The development of Concorde took years of investment and, according to British Cabinet documents now being released, at near-completion of the project the aircraft was viewed by many as a 'commercial disaster', which 'should never have been started'. However, political pressures of the day ensured that Concorde would fly commercially from London and Paris even after (or perhaps because) £1.2 billion had been spent on the project and thousands of jobs were at stake.

So, at the time of developing Concorde, the enabling environment was in place for the project to continue, but ultimately, it was not commercially viable, environmentally acceptable or affordable. Despite its elegance and unique capabilities, this supersonic aircraft was not sustainable and Concorde was never sold to any other airline.

Concorde demonstrates how an enabling environment (or rather 'vested interests') can be a key to the successful launch and persistence of a technology. Jared Diamond, in his book *Guns, Germs and Steel*, quotes another example, the QWERTY keyboard. There were very good reasons why, in 1873, manufacturers designed the keyboard this way, primarily to slow typing speed and prevent keys jamming. Later, despite the development of more 'jam-free' keyboards, the QWERTY layout, by then well entrenched, persisted and continues to be used today. Another example of how vested interests can prevent the successful transfer or uptake of appropriate technology was demonstrated by the continued use of gas lighting in Britain long after the United States and Germany had converted to electricity.

Prevailing political winds

Political pressure, vested interests, an enabling environment – one or all will undoubtedly play a part in the acceptance, or not, of another new technology, genetically modified (GM) crops. This technological development, some argue, could be successful in Africa if legal frameworks can be drawn up to govern the introduction and commercialisation of GM products. Egypt, Nigeria, South Africa, Uganda and Zimbabwe are currently developing pathways to allow the use of GM technology and, for these countries, the companies supporting GM seeds will ensure that they are commercially viable. But, as Orla Ryan, writing for the BBC Business News from Uganda says, 'little research has been done to develop products that will specifically help poor farmers, for example, more productive cassava or fungus-resistant bananas'. The jury is still out on the health and environmental risks posed by GM crops, so whether the externalities of growing GM crops are acceptable or not is yet to be determined. With the widespread negative perception of GM technology, it is also difficult to ascertain what sort of demand there will be for GM seeds but, even if they are made readily available, they are likely to be neither affordable by subsistence farmers nor of help to improve their livelihoods.

But, even if GM technologies were specifically designed according to smallholder needs, and were made available and affordable, this would not guarantee demand. Subsistence farmers are naturally risk averse and are wary of investing in new technologies unless they can see clear benefits and returns to pay for the investment. Farmers who have learned to survive the conditions of marginal environments depend on proven and well known (even if not the most productive) systems. New ideas are far more likely to be adopted by middle-income farmers involved in, for example, growing cash crops or other commercial activities.

Sowing the seed or seeing the need?

Middle-income farmers are also more likely to be better educated and able to benefit from infrastructure set up to support commercial activities. However, despite the positive move towards education in Uganda, for instance, a recent survey conducted in the rural sub-counties of two districts revealed that almost a third of the people interviewed (aged between 15 and 55) were illiterate and that nearly 20% had received no formal education. The majority of the people interviewed were smallholder farmers. But does a lack of education prevent people from accepting new technologies? The two are not necessarily linked. Many technological advances have been brought about not through education but through a change in human lifestyles. In early human development, the evolution of sedentary living, for example, allowed the rapid development of technologies for improving food production. Settled populations were not better educated than their nomadic counterparts, it was simply that, without the constraints of moving with what could be carried, the potential for a wide range of technologies, which may have previously been explored but not taken up, could finally be realised.

It is possible that the same principles of technological advancement through a change in lifestyle may apply as the reality of HIV/AIDS in Africa hits home. Losing families as a result of war, disease and disaster results in grief and hardship for those directly affected. And, as the latest survey in sub-Saharan Africa published by the *Economist* (Guest, 2004) says in relation to AIDS and poverty, 'when people do not expect to live long, they tend to invest less in the future'. However, for some, it brings an added strength and determination to continue, and even overcome adversity, in the struggle for survival. The General Union of Co-operatives in Maputo, for example, was established by poor, uneducated (and mostly widowed) women during the worst years of Mozambique's civil war, and is today one of the country's premier agricultural businesses, supplying fruit, vegetables and chickens to Maputo and flowers for export.

And yet, investing for the future is something that many Africans, particularly subsistence farmers, do not practise as much as they might, perhaps for good reason; when you have to struggle to survive today, why worry about tomorrow? For others, simply endeavouring to find an appropriate pathway out of poverty means navigating around a series of too many hurdles. 'Many individual Africans are working hard to better their own lot, but their rulers are prone to getting in their way,' states the *Economist*. This was strongly echoed by John Hargrove at the international meeting held in Edinburgh in 2002, *Tsetse control: the next 100 years*, when he concluded that, 'trypanosomiasis: *that* is a problem and that is not the message; AIDS: that is a *serious* problem and that is not the message either. Bad governance: that is the *real* problem'. But although good governance encourages economic growth and investment in the future (Botswana is felt to be one example of where this has been achieved), farmers also need the stability of sound property rights. Without security of land tenure, farmers have less flexibility to make choices or to access credit and are therefore less likely to plan for or invest in the future.

Engaging private interest

Good governance, security of land tenure, education and the infrastructure to support agricultural activities would almost certainly encourage farmers to be less risk averse and therefore more likely to adopt new technologies. But this still does not determine what makes some technologies successful. Mobile phones are a good example of a technology that has taken off rapidly in Africa during recent years. Taxi drivers and market traders are rarely seen without one, or even two, if calling between networks proves expensive, as in Kenya. As demand has risen, mobile phones and the facility to make calls (particularly with the advent of 'pay as you go') have become more affordable. But in many rural areas, network availability is still nonexistent or patchy at best and with dispersed, poorer populations, it is these areas that will be the last to cash in on the benefits.

The success of mobile phones and, to give another example related to tsetse and trypanosomiasis, trypanocidal drugs, demonstrates the power of the private sector. For over 50 years, trypanocidal drugs have been the most commonly used method of controlling trypanosomiasis in most regions of Africa where the disease occurs. Without the private sector, the Green Revolution in Asia would not have taken off. And, although the same is yet to occur in Africa, tremendous progress has been achieved with cotton in West Africa and with fruit and vegetable exports and dairying in Kenya. These successes have been achieved not just with the involvement of middle-income farmers; smallholders produce more than half of Kenya's horticultural exports, while over 80% of Kenya's milk is produced by more than 600,000 smallholders, owning between two and four cows each.

And yet, in order to engage private sector interest, a technology has to be commercially viable. As one participant at the workshop concluded, 'this is the single most important criteria included in the checklist because if the answer is yes, then most of the other questions do not need to be answered'. The three technologies put forward for livestock keeper-based tsetse control have each shown potential for the systems for which they have been devised. Ultimately, they may also be adapted and taken up in other systems. The repellent collar could, for instance, be used by sedentary communities for their cattle, although it is currently only being tested with pastoralists. But, if a product or technology is not commercially viable, it is unlikely to be sustainable. This is particularly the case in Africa where governments do not have the funds to support control strategies, however effective. This has been shown clearly with the deployment of tsetse traps and targets, which cease to be maintained if government or donor funds are not available. At the end of the day, whatever the potential benefits to individual farmers, without the involvement of the private sector it is unlikely that any one of the three technologies for tsetse control discussed at the workshop will be truly successful.

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The big picture: farmer-based tsetse control in the context of PATTEC

Address by Dr John Kabayo

To see how farmer-based tsetse control may contribute towards the big picture, Dr John Kabayo, Co-ordinator of the Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC), was invited to address the workshop participants. He focused on three main questions: (1) Why is PATTEC necessary? (2) What progress have we made? and (3) Why I am attending this meeting?

Participants were reminded that, until about the year 2000, trypanosomiasis was largely a forgotten disease. Although there were widespread reports of infestations – even in areas that had previously been tsetse-free – and an increasing incidence of disease in cattle and in humans, perhaps to even worse levels than in the 1930s, there was a complete absence of government attention. The issue of drug resistance was also becoming a problem. PATTEC was initiated to draw attention to this situation, to mobilise action and to drum up the necessary support to find a solution.

Based on past successes in clearing tsetse from large tracts of land in the 1950s and 60s, and the more recent example of eradication on the island of Zanzibar, there was considerable support for the viewpoint that the problem of tsetse and trypanosomiasis could be eliminated 'once and for all'. In July 2000, the African Heads of State declared that the constraint of trypanosomiasis would be removed from the continent. In December the same year, a plan of action was drawn up: basically to identify isolated pockets of infestation of tsetse flies and remove them, one at a time, until the whole tsetse infestation or the whole disease problem was solved. All 37 tsetse affected countries agreed to the plan and the Commission of the African Union was mandated to oversee implementation.

One of PATTEC's principal aims is to place the affected countries at the forefront of the war against tsetse. In the past, the majority of activities were donor driven, inspired and funded. PATTEC intends to change this focus, which has been unsuccessful in the past because whenever the donors withdrew from a particular area, the problem returned.

Several countries have now included tsetse in their Poverty Reduction Strategy Papers and so qualify for International Monetary Fund debt relief mechanisms. Many are also drawing up national strategies and specific plans for identified areas of action. PATTEC has brought together countries that share a common tsetse belt, such as Angola, Botswana, Namibia and Zambia, helping them to formulate joint action plans on how they are going to implement eradication. PATTEC has

also held joint talks with South Africa and Mozambique. Meetings are planned for East Africa and other areas. In Central Africa, Cameroon, Chad, Congo, Democratic Republic of Congo, Gabon and Guinea have agreed to increase the surveillance and treatment of sleeping sickness cases and have declared that by the year 2010 there will be no sleeping sickness in their countries. Eight West African countries have been identified that share a common tsetse belt and have a history of co-operation and working together. PATTEC is also in contact with potential partners like the African Development Bank (ADB), DFID and New Partnership for Africa's Development (NEPAD).
In brief, the objective of the PATTEC initiative is to 'drum up action and to ensure that action is sustained.'

In answer to the question: 'Why am I here?' John explained that PATTEC took part in the AHP's meeting in Edinburgh in September 2002. He said that although this meeting was widely called a 'debate', it was not a debate in his view because there was no need to debate a decision that had already been made. The decision had been taken by the Heads of State that the problem should be removed. But the Edinburgh meeting presented a useful opportunity to correct misconceptions that had arisen in relation to the PATTEC initiative: PATTEC never said that it would embark on eradicating tsetse from the whole continent at once, which he described as 'quixotic'. The objective was to create the necessary sense of urgency so that attention was drawn to the problem and so that the necessary funds could be secured.

In Edinburgh, John Kabayo suggested that, while we may aim at eventual eradication, the operational strategy should be one of control. Explaining that PATTEC is not tied to a timeframe, he said the idea of 100 years to achieve eradication was misleading because it is not known how long it will take. The eradication campaign will proceed 'one step at a time'. Or, as the Africans say, 'how do you eat an elephant? – one bite at a time'.

PATTEC will determine a budget for each area that needs to be tackled, e.g. 15,000 sq km in the Ethiopian Rift Valley. Project proposals are currently being written for a number of targeted areas. PATTEC believes that this method of working should be acceptable to all concerned and hopes that all those engaged in appropriate activities and their partners, such as the workshop participants, should agree that efforts can be reorganised and a specific area can be cleared every year. Dr Kabayo believes the real issue is not one of developing more technologies, because technologies are already available. The issue is to align those technologies to achieve a solution.

He concluded that the subject of this workshop, i.e. uptake and application of technologies to solve the problem of trypanosomiasis, was central to his heart. People tend to focus on poverty eradication, and he agreed that is the ultimate objective. However, an important interim goal is to remove the constraint that is preventing people from enriching themselves – i.e. remove the tsetse and trypanosomiasis problem.

2. Review of new technologies

Instead of conventional presentations, the workshop facilitator interviewed the three ‘technology champions’ – Glyn Vale, Burkhard Bauer and Rajinder Saini – on restricted application of insecticide, zero grazing and use of natural repellents. Edited highlights and excerpts from the interviews appear on the accompanying CD. The text below summarises the main points of each interview and the workshop participants’ questions and comments.

Restricted application: a reason for restraint?

One of the best-known techniques of farmer-based control of tsetse is the application of insecticides (synthetic pyrethroids or SPs) to cattle. However, the method of application has generally involved ‘whole-body’ treatments, as recommended for tick control, often applied at monthly intervals. Ready-to-use, oil-based pour-on formulations are readily available and convenient, but are too expensive for poor livestock keepers. Spray and dip formulations, although cheaper, require a plentiful and guaranteed supply of water, spray equipment or dip-tanks, and a degree of communal action. While communal dip-tanks worked well when they were run on a heavily subsidised basis by state veterinary services, privatised and community-run dips have been less successful and many communal dips in Africa have now fallen into disuse. Researchers have additional concerns concerning whole-body application. Dung contamination with synthetic pyrethroids could have adverse effects on dung beetles and other dung fauna and could also affect soil fertility, while total destruction of tick populations could interfere with the development of natural immunity against tick-borne diseases.

> *“In the late 1990s, it was clear that donors were going to pull out of mass tsetse control. We had to think about local control in farming areas so we returned to the idea of restricted application of insecticides.”*
>
> Glyn Vale

The solution appears to be a simple one. Research at Rekomitjie in Zimbabwe suggests that the answer could be restricted application of insecticide and, it seems, not all the animals in a herd need to be treated. Glyn Vale has been working with the Natural Resources Institute (NRI), UK to refine the technology. He points out that 'this is not a new idea. In fact, many people are already using restricted application for ticks. But we are suggesting that a slight tweaking of the application could help farmers to save an enormous amount of money and still get good control of tsetse'.

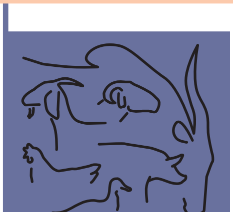
> *"We are currently trying more and more restrictions. Ultimately it may be possible to take the cattle through a small footbath or, to take it further, to treat only the front pasterns of the cattle, which requires only 0.5% of the normal insecticide application."*
>
> Glyn Vale

For *Glossina pallidipes,* the research team in Zimbabwe found that the flies feed mainly on the belly and legs of cattle, especially the lower front legs (cannon and pastern regions). By limiting treatment to these areas, intervals for application can be doubled to once every two weeks, and total insecticide use, when compared to whole-body applications, can be reduced to less than 40%. The result is much more cost-effective tsetse control without undesirable effects on the environment or a reduction in natural immunity to tick-borne diseases.

> *"If you use restricted application then you can reduce the cost of treatment from what might have been 50 cents a cow to 5 cents or less. We don't know; it might be 1 cent. It certainly will be affordable by really poor livestock keepers; there is no doubt about that."*
>
> Ian Maudlin

Further reductions in both cost and usage of insecticide can be achieved by restricting treatment to particular animals within the herd. Previous AHP-funded research has shown that tsetse tend to feed on larger animals, so young livestock can be left untreated. Without treatment, calves will still be bitten by ticks but this will allow natural immunity against tick-borne diseases to develop – a situation known as endemic stability. In some regions of Africa, this practice has already been adopted. Providing the largest animals, on which the majority of tsetse will feed, are treated with insecticide, the cost of effective tsetse control can be reduced while maintaining overall protection of the herd. Studies at Rekomitjie on the distribution of ticks on cows have shown that the highest

> *"All our tests have been with ordinary off-the-shelf materials. We are not asking pharmaceutical companies to change the formulation but it may be worthwhile them selling smaller packages or changing the instructions on how to use it."*
>
> Glyn Vale



"Following the successful results of restricted application trials in Zimbabwe, the Department of Veterinary and Livestock Development, Ministry of Agriculture and Co-operatives in Zambia have conducted similar trials using the protocols established in Zimbabwe. To date, over 4 000 cattle have been treated with insecticide on only the belly, front and hocks. Both commercial and small-scale livestock farmers seem to be quite comfortable with this approach. We hope that construction of a footbath will make application easier as the technique is currently difficult to apply to large numbers of animals."

Peter Sinyangwe

densities are found around the tail and anal region, well away from the areas recommended for restricted application. However, whether this will prove to be the case for ticks in other regions is still to be determined.

"Trials have been conducted in south-eastern Uganda to test the effect of restricted application of insecticide on animal health and transmission of trypanosomiasis. The initial approach is for the investigators to apply the treatment, so that quality control can be assured in the first phase. The next phase will look at adoption of the technology by farmers, as it is the researchers' belief that it will only work if farmers themselves decide to use it. And it will be up to the farmers how they apply the chemicals."

Mark Eisler

The advantage of this modified insecticide technique is that existing formulations of SPs can be used and, more importantly, individual farmers can treat their livestock with their own equipment, such as a simple, inexpensive sprayer – or even a paintbrush. Alternatively, to treat large or communal herds, dipping could be downsized and cattle simply walked through a footbath of insecticide solution. The current limitation of the technology is that is has only been tested in Zimbabwe and only on *G. pallidipes*. However, collaborative studies are in progress to test the method in other regions and with other species of tsetse.

Questions and comments

Types of insecticides tested

Ralf Patzelt: Coming from the pharmaceutical industry, I am interested in what insecticides you have been testing and whether you have found any differences in efficacy of the different molecules?

Glyn Vale: The insecticides that we have tested are the major players: deltamethrin, alphacypermethrin, cyfluthrin, etc. We have not only tested the active ingredi-

ent but also tested the pour-on/dip/spray type of formulations. There is no real difference in efficacy of the insecticides and, if you allow that some have to be applied at greater dose, cost per unit is pretty much the same. If we can get away from the pour-ons, which are very expensive, we don't really mind which active ingredient we use, but we would rather be dipping or spraying. And this is one of the encouraging things; we don't need lots of complicated equipment, and we can start using some of the cheaper formulations.

Standardising the bioassay protocol

Glyn Vale: Regarding standardising the bioassay protocol, I think this is particularly important. We have already produced a protocol but we would be very happy to liaise with other people to firm it up.

Footbath system

Francis Oloo: Is the footbath system used widely in Zimbabwe? Under the programme: Farming in Tsetse Controlled Areas (FITCA) in Kenya, we have over 300 crush pens in use and farmers are spraying their animals by themselves with no external support.

Glyn Vale: In Zimbabwe, this method of restricted application has not been tried yet because the whole animal health system is disintegrating. But the technology is already in existence – where farmers put their cattle through a footbath of copper sulphate as a treatment for foot rot. But of course, in Zimbabwe there is no history of farmers doing it themselves. The government used to support it but can no longer afford to do so.

Francis Oloo: I am thinking about the footbath situation. Will the first animals to pass through get a higher dose of insecticide than the rest?

Glyn Vale: The problem that you mentioned might occur if you were using a large footbath to treat the base of the legs of animals. As the animals pass through, the concentration of chemical reduces – this is known as 'stripping of the dip', and occurs when large-volume dips are used. But we are not talking about filling up a big dip tank, we would use a small footbath – and this would be filled with fresh insecticide solution each time it was used.

Ticks versus tsetse control


Glyn Vale

Peter Van den Bossche: Did you look into the effects of restricted applications on tick burdens?

Glyn Vale: This is one of the great things about the technology. Some people were particularly worried about whole-body treatments reducing tick populations so much that young animals would never get properly exposed to ticks and wouldn't build up natural immunity. But it seems that if you restrict insecticide application on cattle you will kill quite a few tsetse but minimise knockdown of the ticks. We have been checking the abundance of ticks on animals treated with restricted application, not treated or treated all over. There aren't many ticks at Rekomitjie, but most of them feed around the bottom of the animal. So there's plenty of scope for just putting the insecticide in places where you can whack tsetse flies but have relatively little effect on ticks, if that's what you want.

Burkhard Bauer: We maintain for western Kenya that animals below the age of six months should not be treated at all to allow them to develop some kind of decent immunological response to tick-borne diseases.

Glyn Vale: It is worth noting what Steve Torr has done in this area, i.e. you don't actually need to treat young stock for tsetse control because the tsetse will usually feed on older, larger animals in preference.

Burkhard Bauer: In addition, we are getting less and less flies so the farmers are looking for ticks to tell them when to spray for tsetse. This applies to both restricted and whole-body treatment. The farmers themselves have decided that deltamethrin in a spray formulation is effective when applied once every three weeks. This is enough, according to our knowledge, to kill landing tsetse flies but still allow ticks to return.

Andrew Brownlow: The reason that farmers bring the cattle for treatment in southeastern Uganda is not because of tsetse. They are bringing them because the spray-on offers some tick control. We spray them on the belly and the front legs, the site where the ticks are, and after we have sprayed them those ticks disappear. And within the four weeks between visits, the ticks re-appear and the stockowners re-present the cattle for treatment. They certainly have not mentioned to me about the effect on the fly population. And I think this is important for uptake, because in a lot of villages, certainly where I work in southeastern Uganda, the tsetse are invisible but the ticks are seen as a big problem.

Mark Eisler: I think one of the most effective means of tsetse control in Africa is in areas where people have encroached into the bush as a result of population pressure and land use changes, and tsetse habitat is destroyed. When this happens, it is not done with a view to controlling tsetse flies or trypanosomes, it's just one of those things that go on, it's a sort of demographic process. And I think that you have to bear in mind here that people will take up insecticide technologies mainly with a view to controlling ticks or nuisance flies and controlling tsetse and trypanosomes may occur as a fringe benefit of that activity. It may be disappointing to some people, but that is the reality.

Glyn Vale: Yes, I agree. In many places people are far more worried about ticks. But there are huge areas where people are primarily worried about tsetse flies and where it is the greatest restriction to agricultural development and rural wealth.

Francis Oloo: If you apply insecticide via a footbath, my understanding is that the animal will have ticks permanently. How does the farmer know when to go back for treatment? Is it because he is told every three weeks or because he has another reason? Tsetse don't sit on animals and farmers don't see tsetse flies on their animals.

Glyn Vale: In some cases it might be rather difficult to look at ticks to decide whether or not you should re-dip with insecticide because if it is anything like the situation in much of southern Africa, you only see ticks at certain times of the year anyway. So they could only be indicators at certain times of the year.

Steve Torr: We have had several examples from non-government organisation (NGO) led operations in Ethiopia where they are deciding what the interval for treatment should be. Much of this discussion happens with little regard to the technical background. Nonetheless, with these groups in Ethiopia, the farmers wanted to treat only three times a year and anyone who has published information knows that this will not be effective. These farmers are not treating for tick-borne diseases; they are not the problem. It is all about tsetse control and, while the intervals reflect what the farmers are prepared to pay, they do not really fit in with the technical demands of the system.

Is the technology simple to use?

Mark Eisler: In the trial we are doing in Uganda, we thought long and hard about the type of sprayer we would use. There is a tremendous range available – all shapes and sizes – many of which are handed out free to farmers with seeds. The main concern is to provide a type of sprayer that farmers can afford.

Simon Gould: I have been wondering whether insecticide can be put in an aerosol can for single farmer use?

Glyn Vale: I wouldn't want to put it in an aerosol can because that will increase the cost and lots can go wrong with aerosol cans. If you want a really cheap way of applying it then you can buy a small sachet and mix it with water in a jam jar.

Bruno Minjauw: I would like to have more information on the herds you have in southern Africa – where people have up to 100 animals. Is it easy to spray so many? I thought the dip tank was invented for situations like this with large numbers of animals.

Glyn Vale: If you are dealing with a rancher with 1000 head of cattle then I think you would use a decent footbath and just drive the cattle through it. I was talking about sprayers or a paintbrush because in the context of this meeting we are talking about the person with only one or two cows.

Burkhard Bauer: In FITCA we are using farmer-based application of synthetic pyrethroids, mostly deltamethrin, in a restricted manner. This is a self-sustaining system where each farmer presenting his animal is asked for 20 Kenyan shillings. This pays for the insecticide and spare parts for the foot pumps. In certain areas we've had extremely good success with this, with farmers making a business out of it, with all the associated benefits.

Tom Randolph: Do you see this as a stand-alone technology – an answer to trypanosomiasis control for the farmer – or would it require some other complementary technology? Is it idiot-proof in that farmers only need to know where to apply the insecticide, or will they need more information to co-ordinate it with other strategies?

Glyn Vale: The trouble is that there is a huge variation over Africa of what people want from these technologies, in addition to the fact that each situation is completely different. There could not be a general answer to your question. In many cases, yes, I think this can be a stand-alone technology, but in other cases it should be linked with other solutions or methods.

Is the technology affordable?

Ian Maudlin: If you use restricted application then you can reduce the cost of treatment from what might have been 50 cents a cow to 5 cents or less. We don't know; it might be 1 cent. It certainly will be affordable by really poor livestock keepers; there is no doubt about that.

Glyn Vale: If the cost could be reduced to the ridiculous level of just popping an aspirin, that kind of expense, then I think it could be sustainable. At the moment, most stock-keepers can't find the money. I think the will is there but they just can't afford it.

Can the technology be made easily available?

Bruno Minjauw: Is this really a new technology or is it an improved husbandry technique? How do we make people try it and see that it will cost less?

Glyn Vale: It's the easiest thing to transfer because it is an existing technology and people are quite used to doing it to control ticks. And I breathe a huge sigh of relief that it won't be complex to transfer it.

Is an enabling environment in place?

Nigel Campell: There was some concern expressed by the discussion group over the licensing because there will be a change to the dosage, which could require a change to the licensing, which would be expensive for the pharmaceutical companies to implement. Do you see this as a potential problem?

Glyn Vale: We are not asking them to change the formulation of the material. All our tests so far have been with ordinary off-the-shelf materials. But my experience in talking to the pharmaceutical people is quite exciting. Although it looks like they may lose money because we are talking about reducing the amount of insecticide used, which could reduce their market by at least 80%, it's not so bad because whole-body treatment does not sell well. The people I spoke to said 'yes, we will sell less to each farmer but at least we will sell something'.

A net advantage for zero grazing

> "Cattle are not just attacked by tsetse flies: they are harassed and bitten by a number of insects, with serious consequences for both human and animal health."
>
> Burkhard Bauer

An agitated cow will be very difficult to milk and enterprising farmers, who have tried to improve their production by keeping larger breeds of dairy cattle, have tended to achieve disappointing yields. Livestock kept in zero-grazing units are vulnerable to attack by biting flies, including tsetse. When attacked, the animals are constantly on the move, stamping their legs, swishing their tails and twitching their ears. Even without disease, milk yields in such situations can be extremely poor – as little as one litre per milking. If the cows become infected with trypanosomiasis the impact on milk yields, calving rates and farmers' incomes is very marked.

As part of its efforts to improve livestock production and milk yields for smallholders in western Kenya, the EU-funded FITCA project has adapted a well-established technology for mosquito control. By using insecticide-treated netting as a barrier around zero-grazing pens, the occupants are effectively shielded from attack by biting flies. According to Burkhard Bauer, Project Manager for FITCA Kenya, the effects have been quite remarkable.

The netting is produced by a disease-control textile company, Vestergaard-Frandsen, and has been tested at various specifications. It is currently available as 150 denier polyester netting impregnated with 0.6–0.9% SP (e.g. beta-cyfluthrin or deltamethrin). This is equivalent to approximately 50 mg of insecticide per square metre of netting material. The result of erecting a 1-metre high barrier of netting is an almost immediate fly-free area inside the pen; within a short time cows are seen to be noticeably calmer and more settled, and farmers are reporting improved milk yields of up to 2–3 litres a day. Other observations from farmers include significantly fewer cases of trypanosomiasis, fewer calf abortions, better weight gain in calves and fewer cases of mastitis.

"How many units do we need per square km to have a measurable impact on tsetse and on all these various diseases? That is an open question."

Burkhard Bauer

The technology appears to have several additional benefits. Farmers with unprotected zero-grazing units or free-grazing zebu cattle have observed lower trypanosome infection rates when neighbouring farmers are using protective netting. However, the number of protected units per square kilometre needed to have a measurable impact on tsetse is not yet known, and more detailed studies are needed in this area. But, whatever the quantitative results, if poor farmers with one or two zebu cattle can benefit from the activities of their wealthier neighbours (who protect their improved breeds), then everyone can win.

"Childhood malaria is such an emotive subject in Africa that you have to be very careful when you say you may be able to reduce its incidence."

Ian Maudlin

From a human health perspective, farmers using the netting are reporting fewer nuisance flies, including mosquitoes, in their homesteads. Houseflies, latrine flies and stable flies transmit a wide variety of viral, bacterial and protozoan diseases. Although the effect on human health has yet to be quantified, farmers using insecticide-treated netting for their cows have reported less disease in their households, and there are plans to assess the impact of the zero-grazing nets on the incidence of malaria and fly-borne diseases.

> *"There is a sizeable demand from farmers wanting to buy the net. But what we need first is a reliable source of standard quality material."*
>
> Burkhard Bauer

Throughout the trials, the netting has been provided free, but farmers visiting the protected zero-grazing units are expressing an interest in purchasing the insecticide-treated material. FITCA is aware of the pressing need to fulfil farmers' demand for the product and is working with the manufacturer to look at ways to make the net available commercially. Vestergaard-Frandsen suggest that the netting can be provided at a cost of 100 Kenyan shillings per square metre. If using the netting gives them an increase in milk production, farmers should be able to recover their investment within three months.

FITCA has tested the insecticide-impregnated netting on zero-grazing units in western Kenya, and the nets have also been used successfully by a pig farmer at the coast, where tsetse densities are high. There are plans for additional trials in Uganda and Thailand, and FITCA colleagues in Tanzania have expressed an interest in testing the technology as a screen erected around corrals.

> *"Burkhard is in a powerful position. The data on milk yields is enough to sell this technology even without mentioning tsetse. But a lot more work is needed before we are able to predict the effect of the netting on tsetse."*
>
> Glyn Vale

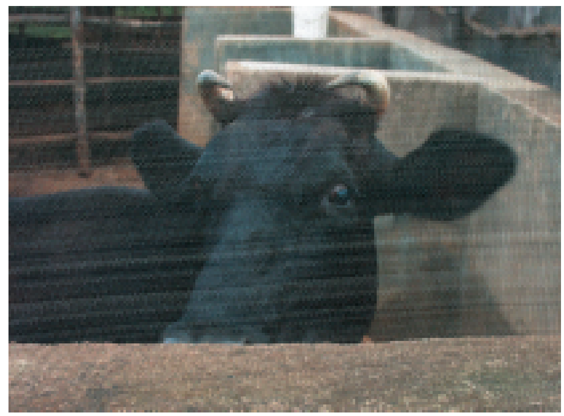
It is thought that the insecticide treatment will last at least a year before the net has to be re-treated or replaced. It is unlikely that farmers will be able to re-treat the net themselves, but it is hoped that a system of collecting and recycling the netting material can be established. To protect the netting from degrading in the harsh African sunlight, the material is already UV-treated. For additional protection against damage from animal movement, farmers are recommended to use chicken wire on the pen side of the net. Ultimately, Vestergaard-Frandsen

> *"Stimulated by the reports from FITCA, carefully controlled experiments have been conducted at Rekomitjie, Zimbabwe to quantify the effects of the netting barriers alone, i.e. with no insecticide impregnation, on the numbers of flies reaching an ox. Testing different heights of barrier (0.75, 1.5 and 3.0 metres) revealed that a 1.5-metre barrier resulted in an 80% reduction in the number of flies entering the pen. Overall, the higher the barrier, the greater the reduction in the numbers of flies entering the pen. But, significantly in Zimbabwe, although the netting was found to be an effective barrier, it appeared that insecticide-impregnated netting was no more effective than untreated netting."*
>
> Steve Torr

plan to manufacture the netting from polyethylene, which is stronger and more durable than polyester. Impregnated polyethylene sheeting is already available but attempts to produce a yarn have not yet been successful.

Questions and comments

Re-impregnating the net

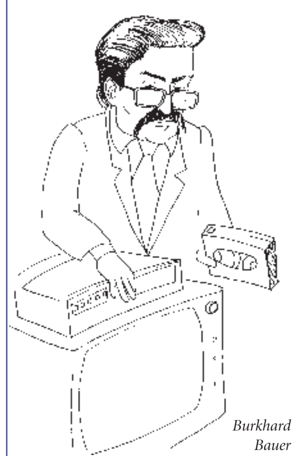


Chris Laker: Is there a need to re-impregnate the net and, if so, at what frequency and cost?

Burkhard Bauer: We believe the insecticide will remain active for around a year. After this the intention is to collect and recycle the netting material. Re-treatment of the netting material is cumbersome and farmers may not be able to do it properly. To test if the insecticide is still active, we would suggest using a small disposable cardboard box. Catch any fly from a trap in a small glass tube and insert this tube into the cardboard box, which is covered inside with the netting material. The flies remain in here for 30 seconds before a latch is opened and the flies go up into a new cage, which is not contaminated. Within the next five minutes, if this product is properly working, there should be no more flies flying around. This is what we propose and we would wish to have this done in the FITCA context in a regionally co-ordinated manner.

Quantifying results

Burkhard Bauer: We have some data but analysing it has proved extremely difficult. The trials were set up to protect the animals inside the pen and the nets were distributed in a random sampling strategy. At this stage we did not think of the externalities, e.g. animals outside would also be protected. However, the spill-over effect could be seen in unprotected units even over a distance of a few hun-



Burkhard Bauer

dred metres. How do you quantify this effect? Large numbers of farmers and many different husbandry methods give a quagmire of results when you try to compare protected with unprotected units. But, the benefits are clearly there and we hope some data will be available by the end of the year.

Rajinder Saini: Can you give us some indication of trypanosomiasis rates before and after the netting was introduced, and can this be attributed to biting flies or tsetse?

Burkhard Bauer: You would expect an infection rate in cattle in western Kenya of 7–12%. With protective netting, we have seen infection rates of less than 2% and partial protection gives a rate of 5–6%. Those are the epidemiological results at monthly intervals.

Specifications for the net

Törben Vestergaard Frandsen: We supply the netting Burkhard has been using. The polyester is now twice as strong; we have gone from 75 to 150 denier. It has a long-lasting impregnation combined with UV treatment and is expected to last for at least a year. We have been experimenting with polyethylene, which is much stronger and should last for at least two years, but this is still at the experimental stage.

Barrier effect of netting

John Morton: Isn't there a rather simple conclusion that the benefits to the individual farmer come from the physical fact of the net, at least while it is an intact barrier, while the spill-over effects that you have described come from the insecticide?

Burkhard Bauer: Actually, we were, at one stage, using a sub-standard quality net and had immediate feedback from the farmers who had bought it, complaining about nuisance flies in their compounds. The farmers could see it was not working, they could see flies inside the unit and they came straight back to us complaining about the net. Apparently, if the net is not treated it may prevent flies from coming in to some extent, but sooner or later flies will manage to get in and harass the animals.

Impact on malaria

Ian Maudlin: Childhood malaria is such an emotive subject in Africa that you have to be very careful when you say you may be able to reduce its incidence. I don't think that you can attribute an effect on malaria to this technology. If you are going to, then you have to show it statistically and not just say 'oh yes, we have fewer cases'.

Burkhard Bauer: We have conducted interviews with several farmers and, without being prompted, they claim they have fewer mosquitoes in their houses. It's a common observation when asked 'what changes have you seen since the netting was put up?' I fully agree with you that we should not stick our necks out and say 'this is how you should control malaria'. What I am saying is that we have observed some benefits.

Is the technology effective?

Glyn Vale: Burkhard is in a powerful position. The data is enough to sell it even without the mention of tsetse. Inevitably he has to rely on hearsay from farmers. Yes, sell it to improve milk yields; you are in a fantastic situation. But for tsetse a lot more needs to be done to confidently predict what effect it may have elsewhere.

Rosemary Dolan: We know that more research is needed to answer some of the queries. We need to quantify milk production and benefits. But we need help. The technology needs to be tried elsewhere and with other projects, not just in Kenya with FITCA. The manufacturer, Vestergaard-Frandsen should distribute the netting free of charge to prove its efficacy. Independent testing by unbiased parties is what we need to prove that this works.

Törben Vestergaard Frandsen: One of Burkhard's colleagues is going to test it in Thailand to see what happens on a different continent. We believe in the product but we need a bit more development before we come up with a formal marketing plan.

Steve Torr: Our Tanzanian colleagues are very interested in this approach and are testing the use of insecticide-treated netting on corrals. In Tanzania, zero-grazing units are unusual and limited to only a few geographical areas. It's the same in Zimbabwe and Ethiopia – zero grazing is not a common production system. Most livestock producers are pastoralists, so the system is not applicable.

Burkhard Bauer: We have tested the technology in a similar situation by using it to protect animals that are corralled only at night, when flies cause problems for stock and humans. We used a corral close to Nakuru and the owner was very keen to say that there had been a real improvement. I am not telling you it is sufficient to kill all tsetse flies. But we do know there was a significant reduction in trypanosomiasis cases. We used three groups: fully protected, partially protected and not protected. Even farmers with partial protection did better than those with none – and we have data to show it.

Is the technology environmentally friendly?

Grace Murilla: I think this technology needs to be evaluated in communities where there is bee farming so that we can evaluate its effects on other economically important insects.

Glyn Vale: There are so many considerations – many of which cannot be seen and, more importantly, cannot be properly quantified. For example, what effect do the nets have on dung beetles? You might be able to save the dung beetles and maximise the effect on undesirable creatures by perhaps leaving a little gap under the netting so the dung beetles can crawl under, for example.

Burkhard Bauer: We suggest that the dung is cleaned regularly from inside the pen. I also have some reservations to your suggestion; if you leave a space above the ground you will allow *G. austeni* to come in and also *G. pallidipes*, which sometimes flies quite low.

Rajinder Saini: Have you looked at side effects, for example, children touching the netting? What is the risk of contamination?

Burkhard Bauer: Before we started the trial, we explained to farmers how to handle it. To my knowledge we have not had any problems with human contamination. Calves have been seen chewing at the net and there have been no signs of intoxica-

tion. The only major problem we have seen was in a dog that ate a large part of the net – which was vomited up and nothing else happened.

Törben Vestergaard Frandsen: We are also involved in impregnating bed nets and we are scrutinised closely by the World Health Organization. A baby would have to eat 500 square metres to ingest a toxic dose, but some people suffer from skin reactions to the insecticide.

Is the technology affordable?

Ambrose Gidudu: Farmers using the technology are largely middle-class. Do you have any plans to reduce the cost of the netting so poor farmers can also use it?

Burkhard Bauer: We know that farmers who are sure about their environment will invest money. Farmers using pyrethroids are also improving their breeds through artificial insemination. But there are many very poor farmers who have 15–20 head of cattle. We would suggest that they sell some of their zebus, maybe five, buy a better quality animal, keep it in a zero-grazing unit and protect it with netting. The other animals can stay outside and will still be better off, and the whole compound will be protected.

Grace Murilla: FITCA's mission is rural development and we are talking about improving livelihoods and putting money in farmers' pockets. Sustainability will depend on the farmers being able to identify a market for their products.

Törben Vestergaard Frandsen: We have set a maximum price of 100 shillings per square metre; if we can't meet this then we have to go back to the drawing board. FITCA has calculated that it will take close to three months' milk production to pay for the netting, but if you take into account lost meat, calf abortions, veterinary costs, etc., then it is closer to a week for payback.

Can the technology be made easily available?

Pamela Olet: My concern is that the project is the main source of the nets, and it is due to end this year. Are there any plans to ensure the nets are available after the project ends?

Burkhard Bauer: We are aiming to produce a standard net that is clearly identifiable, to avoid confusion with copies or fakes. We have seen this problem before with trypanocidal drugs – if someone sees a niche, they will try to capitalise on demand by supplying a substandard product. Farmers want to know that they are buying a good quality net. We are also discussing how to distribute the nets and how to help farmers find a means of buying them.

Pamela Olet: Do we know whether manufacturing tsetse control nets can provide a local enterprise? If they can be made locally, it may be easier to ensure quality control.

Rosemary Dolan: A bitter reminder of production here. We asked various people for quotes for producing Challier traps and, sadly, the quote here in Kenya was twice as expensive as in Vietnam, where they also offered a faster production process. I completely agree with Pamela, but we need to keep the cost as low as possible.

Törben Vestergaard Frandsen: We are currently producing the nets in Vietnam, so we are helping a poorer economy there.

Is the technology commercially viable?

Solomon Haile Mariam: Another application for the nets is to provide protection from mosquitoes and the human mosquito control programmes would probably be really interested. Should we be testing it on homesteads or corrals? How can we introduce it for human health initiatives?

Harald Rojahn: We are talking about take-over by the private sector and the private sector, fortunately, is present here. So talking about the development of the product is one aspect. The second one is the commercial aspect and I would really like to know if there is any estimation of the market in eastern Africa, knowing that there is a very specific use for this technology.

Törben Vestergaard Frandsen: In this forum we are talking about tsetse but the potential is much greater. For instance, in areas where trachoma is a problem, using the nets could eliminate this disease. They could also be used around refugee camps to control nui sance flies and mosquitoes – the potential for this technology could be huge.

How can the technology be disseminated/promoted?

Bruno Minjauw: The question is who is going to use the technology and how are you going to introduce it to farmers? Someone commented that few people in eastern Africa have adopted zero grazing, but perhaps this technology will encourage more people to introduce it. What is your strategy to move ahead with the technology?

Burkhard Bauer: We are not going to start new activities within this project, but farmer groups are visiting our project farmers. This should be encouraged because the best teacher is the farmer not the technician. Exchange visits are the best way forward. The nets can be sold through any outlet. Our only concern is in the rural areas; *dukas* need to be able to provide correct information about using the technology.

Steve Torr: We're in a complete double-bind here. In only 3–5 years, the FITCA project has to come up with a brand new technology, define the science that underpins it, and disseminate it. We are trying to do all of these things – but I don't think it is possible in such a short time.

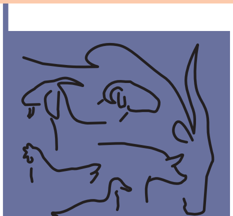
Keith Sones: The answer to that is the project has to let go and if the idea is going to fly, it is going to fly because the private sector picks it up. The project should prove the concept and then let it go.

Repellents: a harmonious approach

What is it about a warthog that makes it so attractive to tsetse, while waterbuck and zebra remain free of the effects of tsetse and the trypanosomes they carry? The answer, according to Rajinder Saini of the International Centre for Insect Physiology and Ecology (ICIPE), is an odorous one: warthogs have a smell that attracts or 'pulls' tsetse to them, whereas the smell of a waterbuck repels or 'pushes' tsetse away.

> *"We started our work several years ago with two main questions in mind: (1) do natural repellents explain the selective feeding behaviour of tsetse and (2) can we develop a synthetic tsetse repellent?"*
>
> Rajinder Saini

Development of repellents has evolved from ICIPE's research on appropriate attractants for use in artificial baits. If it is possible to attract tsetse (a feature already



used to control them) then it was felt that similar principles would be applicable for repelling these pests. The first studies looked at zebra, but they proved rather difficult to handle. In collaboration with the Kenya Wildlife Service, success has now been achieved with waterbuck. The waterbuck repellent was discovered to be a complex of seven volatile compounds, which have all been identified and tested in the field.

> *"What is promising about this technology is that it can stand alone – just like a mosquito coil. You can buy it in a* duka *and an individual can use it to protect his animals."*
>
> Tom Randolph

Like warthogs, cattle are highly attractive to tsetse but it has been known for some time that cattle urine contains one compound (methoxyphenyl) which is mildly repellent. Knowledge of the tsetse fly receptor system has enabled ICIPE to modify the mild repellent into a more effective antagonist, which successfully blocks one of the key kairomones (4-creosol) that enables a tsetse to locate its host. In trials conducted on pastoralist herds in Nguruman, southwestern Kenya, the synthetic repellent has been shown to reduce the risk of trypanosomiasis by more than 80%. It also decreases tsetse feeding efficiency on cattle by more than 90%, although the natural waterbuck repellent is even more effective. Recent results have shown that if 50–75% of animals in a herd wear a repellent dispenser and collar around their necks, over 95% of trypanosomiasis infections occur in the unprotected animals. In addition, it may not be necessary for all animals to be protected; the volatile nature of this phenolic compound means that untreated cattle have some protection too.

> *"We are funding this research for two reasons: it is a sustainable and affordable type of control and it is environmentally friendly."*
>
> Ahmed Sidahmed

The prototype dispenser and collar that has been designed to carry the reservoir of synthetic repellent is simple to use and, most importantly, travels with the animal. It is particularly suitable for transhumant pastoralists who, with no other tsetse control options to suit their lifestyle, currently rely on trypanocidal drugs for trypanosomiasis control.

> *"I think the proposed research would have to address the willingness of farmers to pay proportional to their herd size. I could see several possible scenarios. One is that wealthy but traditional pastoralists would not be willing to pay for all their animals and the other is that the very poorest would not be willing to pay."*
>
> John Morton

> *"The technology is very simple. It doesn't involve any labour and the animal is free to move. It's a mobile technology. The drawback at the moment is that the synthetic compound is only available in very small quantities so it is very expensive."*
>
> Rajinder Saini

However, for more sedentary communities, the use of the collar could be combined with a 'pull' technology such as pour-ons or baits and traps.

At present, this approach is rather expensive. The synthetic compound is only available in minute quantities, while the prototype collar and dispenser costs about US $5 and lasts for one month. However, an agreement has been signed with an Italian pharmaceutical company to start mass-production, and this will dramatically reduce the costs of both repellent and dispenser. The dispenser can be made to hold enough repellent to last six months, or even a year. Meanwhile, work is still in progress to develop the most appropriate way to dispense the natural repellent compounds derived from the waterbuck.

A limitation of these promising developments is that the synthetic and natural repellents developed so far only work with savannah tsetse species, such as *G. pallidipes* and *G. morsitans*. However, the repellents are also effective against other groups of biting flies.

Questions and comments

Numbers of collars required

Joseph Maitima: In your trial, you reported that the animals contracting trypanosomiasis were generally the ones that did not have a collar. So I was wondering what proportion of animals in a group need to wear a collar if the whole herd is to be protected?

Rajinder Saini: One of the objectives of the current project is to determine how many animals in a herd we need to protect with the repellent. The compound is very volatile, so if I am protected and you are standing next to me, you will be protected too. Initially, our results showed that protecting 75% of the animals would extend protection to the whole group. But, when we analysed the data again taking different grazing patterns into account, we found that even if you protect 75% of the animals, the unprotected animals may still get infected. In practice, use of the collars therefore depends on what the farmer wants to achieve and how much infection he can live with.

Ahmed Hassanali: It depends on how coherent the herd is. If you have animals very close to one another then you have a proximity factor. But if you have a highly dispersed herd then you can have a 'push–pull' effect: the animals that carry the repellent will push the tsetse flies onto the ones that don't, so you get a higher rate of infection. Our data at the moment suggest that it is safer to have every animal carrying a repellent dispenser.

Concerns over 'push-pull'

Francis Oloo: My question focuses on the complementary concept of 'push and pull', where the 'push' system is a private good – something that you can buy to repel flies. The 'pull' system, on the other hand, is a public good because it means targets and traps. So what are you going to do if one farmer decides he wants to protect his animals but he doesn't care where the flies go?


Rajinder Saini

Rajinder Saini: When we are talking about pastoralists, I think it makes sense to talk about a 'push' technology alone. But in more sedentary communities, I am sure that the 'push–pull' approach has a role to play. It is appropriate for zero-grazing units; some of the preliminary modelling done shows that 'push–pull' technologies may suppress tsetse populations at faster rates than repellents on their own. You could 'push' the flies with the repellent on the cattle and you could 'pull' them through their attraction to cattle and use restricted insecticides, apply pour-ons to just a few cattle, or just place targets or traps (targets are much cheaper than traps) to kill the flies. Which is the most cost-effective option will need to be worked out for each location or situation.

Need for further research

Rosemary Dolan: You mentioned about doing large-scale field trials with the synthetic repellents. Where are these located?

Rajinder Saini: The trials are going on in Nguruman in southwestern Kenya, with over 400 cattle in about nine different herds. Other trials have begun in Norok, just outside the Maasai Mara, where we have identified several thousand cattle. Unfortunately, we have had to down-scale our trials due to cost limitations.

The sites in Kenya are also very restricted, so I think we need to move out to other countries, especially where savannah tsetse are present, and we are looking for partners to undertake more large-scale validation and dissemination trials. That is where AU/IBAR and partners in other countries can come in. At the moment the repellents only work with savannah tsetse (*G. morsitans* and *G. pallidipes*) and we have not conducted any trials with riverine species.

Simon Gould: Have you any news on the *G. fuscipes* attractant?

Rajinder Saini: If you look at the blood meals of *G. fuscipes*, 75–80% come from reptiles, mainly monitor lizards. We have collected volatiles from monitor lizards and identified three simple compounds that attract *G. fuscipes*. But this is not the whole story, because several compounds remain to be identified. In addition, the thermo-regulatory cycle of the lizards has to be taken into account as the volatiles being emitted by reptiles vary with temperature and our initial collections did not take this into account. At the moment we are looking for some funding to complete the story. Monitor lizards are definitely attractive to *G. fuscipes* and other riverine tsetse and identification of the mediating chemicals may provide an attractive bait for these flies.

Pamela Olet: What about using 'push–pull' in pastoralist areas and in places where there are a lot of wildlife?

Rajinder Saini: This is one of the things that we are going to look at in our ongoing trials in Norok, where we are going to see what happens to the flies that are being 'pushed' by doing blood-meal analysis.

Patenting issues

Steve Torr: I wondered why the repellent discussion group felt that there was a need to patent the 'push' technology but not the 'pull' technology when there has been no history of patenting?

Rajinder Saini: We have patented the synthetic repellent because the EU wanted us to do it. It's a very expensive process and costs US $4 000 a year. I don't think it's worth doing and would rather open up the market. The waterbuck compounds, yes, we are under pressure to patent those, but it would be an African patent only. We have no intention to patent the 'push–pull' technology as a whole.

Is the technology effective?

John Kabayo: I note that most of the repellents are phenolic compounds. I am concerned about their volatility and how long they will last.

Ahmed Hassanali: With the synthetic repellent, we have introduced a system that controls the rate of release to give a constant dose over a couple of months. Your concern would be valid if you were to spray the animal – when evaporation would be very rapid. We have designed our system specifically to control the rate of evaporation.

Is the technology affordable?

John Morton: I think the proposed research should specifically address the idea of scale, i.e. the willingness of livestock farmers to pay in relation to their herd size. I think two groups may not be willing or able to pay: (1) wealthy, but traditional, pastoralists and (2) the very poorest stockowners.

Rajinder Saini: At the moment, the collars are very expensive (about US$ 5 per month per cow) but it is a question of scale. At the moment, both repellent and dispenser are produced in the laboratory. If we could start mass-production, the costs would fall dramatically. The molecules are not difficult to synthesise; in fact the synthetic repellent is already available in the market – although in very minute quantities. For the waterbuck compounds, all the compounds except one are available, and ICIPE has already worked out the synthetic route to making that compound.

Is there a demand from the end-user?

Rajinder Saini: One thing we must keep in mind is that it is very difficult to check community perceptions and adoption potential of a new technology. First of all you have to disseminate the technology and show the farmers how it works. The answer to whether they will accept it or not will come much later.

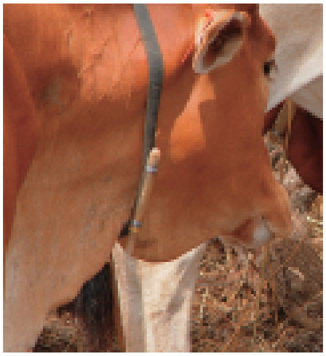
Bruno Minjauw: You say that it is difficult to determine farmer perception for a new technology but you have quite a lot of herds already using it. Have you had a chance to get some perceptions from the trial farmers?

Rajinder Saini: Basically, the farmers are very happy because the technology is very simple, there is no labour involved and there is no maintenance. And the cattle in the protected herds are very healthy. The farmers also appreciate that infections from biting flies are minimised.

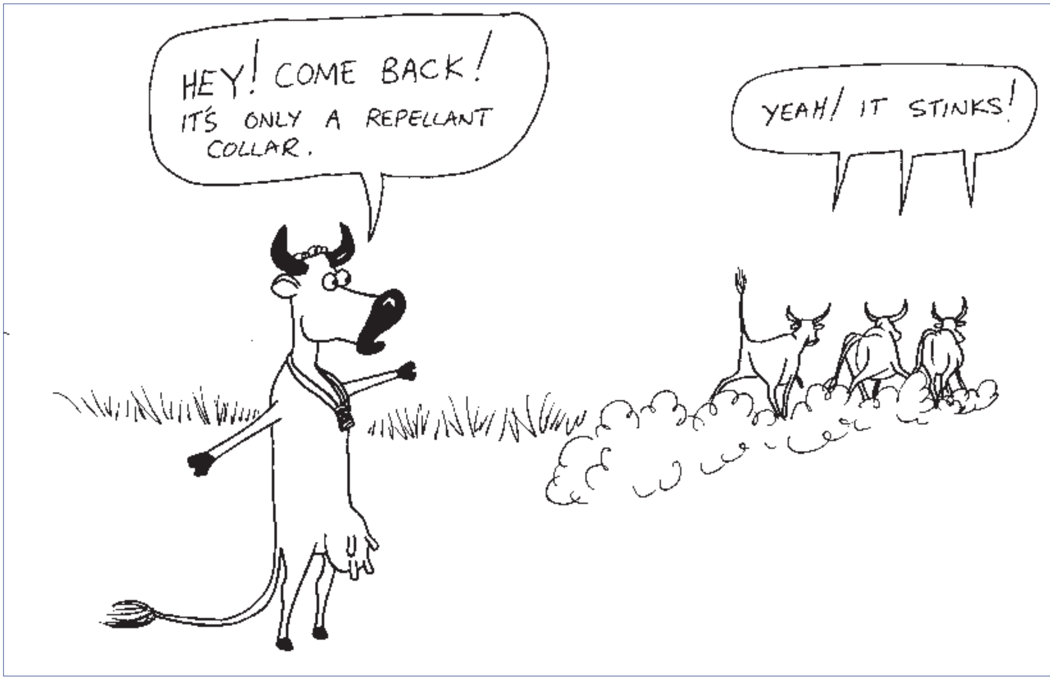
If the technology requires collective action, can it be managed?

John Morton: Clearly this technology does require collective action, either to achieve 100% protection or to put in place a complementary 'pull' technology. Some investigation is needed as to how this could be managed. There is also the issue of dissemination. You cannot simply rely on commercial dissemination that treats pastoralists or other stockowners as consumers. You have to address collective institutions.

Rajinder Saini: I disagree – I don't think there is a need for collective action. I think repellents are more of an individual responsibility.



Tom Randolph: What is promising about the repellent technology is that it can stand alone, just like a mosquito coil. You can buy it in a *duka* and an individual can use it to protect his animals. It doesn't control tsetse, but it does protect the animals from getting trypano-



somiasis. Pastoralist communities really have no other alternatives; their animals are mobile and they can't use traps to reduce tsetse numbers. We thought this was where it would be most popular. If used with a 'pull' mechanism as part of an integrated control programme, then you can start to manipulate and control tsetse populations and it may become an issue of collective action. 'Push–pull' could be very popular in more sedentary populations.

Can the technology be made easily available?

Rajinder Saini: Eventually the private sector will have to be involved. And if *dukas* can sell drugs then why can't they sell repellents? The problem, of course, will be quality control and making sure the technology is being used properly. We are fortunate that our Governing Council and its supporting group of donors has approved an ICIPE 'technopark'. The idea behind this is to mass produce and disseminate ICIPE technologies. The repellents could be mass produced by ICIPE itself and this would bring the cost down significantly.

3. The way forward

Are the technologies appropriate for livestock keeper-based tsetse control?

Each of the three technologies was evaluated using the checklist developed at the start of the workshop to determine whether or not the technologies were ‘useful and applicable in the African context’.

Restricted application of insecticides to livestock

The restricted application discussion results were presented by Birgit van Munster, who began by emphasising the challenge for 12 people to produce concrete proposals on 13 checklist items in only one hour. Nevertheless, she went on to introduce restricted application of insecticide as a technology that is ‘very directed, very targeted and very simple – even a child can do it’.

1. **Is it effective?** The response was ‘yes’ for one species in Zimbabwe, where it has been tried in many experimental circumstances, but it was felt that a response could not be given for other species of tsetse or for other regions. It was decided that further field trials were required to test the technology under different circumstances and with different species in other countries, but that a standardised bioassay or trial protocol would be necessary. NRI and FITCA agreed to discuss this further and it was proposed that pharmaceutical companies should become involved in their discussions.

2. **Is it affordable?** Although preliminary results indicate that most farmers can afford the technology, the group decided that the optimum application rate would still need to be determined in field trials as these would give a better indication of the minimum cost to farmers.

3. **Does it have acceptable externalities (positive or negative)?** Before this question could be answered definitively, the group decided that the field trials should establish the effect of restricted application on ticks, tick-borne diseases, on endemic stability and also on malaria.

4. **Is there a demand from the end-user?** The group response was a 'yes' as it was felt that the reduction in cost would be a positive benefit to farmers, who currently practice whole-body application of insecticides. Restricted application would also appeal to farmers who currently cannot afford to apply chemicals to their livestock.

5. **Is it simple to use correctly?** All agreed that the technology was simple to use.

6. **If the technology requires collective action, can it be managed?** Although the response to this question was affirmative, reference was made to previous discussions on collective action, which the group had felt were too negative. It was decided that those involved in tsetse control technologies should be more upbeat about collective action. But, in order to make sure that it was effective, it would be necessary to establish if any new structures would be required, to determine what works, and finally to establish the minimum number of people that would be required to make collective action for restricted application effective. However, the group pointed out that it would be necessary to be aware of ethnic friction and unsound financial management and to ensure transparency of committee elections. They suggested that some of the issues relating to this question could be determined through field trials.

7. **Is an enabling environment in place?** This was the first question to which the group could foresee problems. Their first concern was that re-registration for restricted application would officially be needed but that the licensing procedures to change the dosage might not be easy and would be very costly. They felt that the pharmaceutical companies might not be interested. Secondly, they felt that in some countries, availability of the insecticide could not be guaranteed. Although the technology might be effective and the farmers might want to use it, if they were unable to purchase the appropriate chemicals, then the interest of the farmers would be lost. The group was unable to put forward any solutions to these issues.

8. **Can the technology be made easily available?** The group answer was 'yes', and the decision was to leave it up to the pharmaceutical companies to address this in their extension efforts.

9. **Is it culturally acceptable?** Again, the group responded 'yes' and decided that no further action was required.

10. **Is it environmentally friendly?** By compiling existing information on the chemicals used for whole-body applications, which is available from the pest control board, it would be easy to

determine whether smaller quantities of the chemicals would be safe for the environment. INTERVET volunteered to collate the required information.

11. **How can it be disseminated or promoted?** The group decided that once the preliminary recommendations were available from the field trials, it would be possible to share the information with the farmers and allow them an opportunity to test the effectiveness of the technology for themselves.

12. **Is it commercially viable?** In areas where people are involved in tick control, it was thought that farmers would be happy to use restricted application and the technique would be commercially viable. However, the group was undecided about its viability in areas where tick control was not practised.

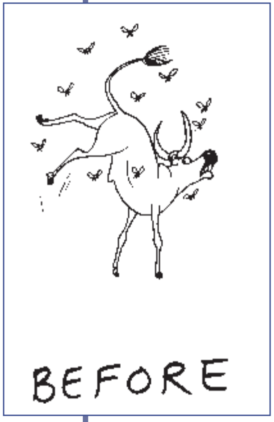
13. **Will it be sustainable?** Birgit concluded: 'only time will tell!'

Impregnated netting

Chesnodi Kulanga presented the results of the discussion on impregnated netting for protecting zero-grazing units. The group was constrained by time and was unable to respond to all the checklist items, but for the questions that were addressed, the group tried to answer them as comprehensively as possible.

1. **Is the technology environmentally friendly?** The group decided that as the impregnated netting is produced in a factory, there is no danger to the farmers from applying the chemicals to the net. However, they stressed that there was a need for further research on the net's impact on non-target organisms as well as a need to identify appropriate types of impregnated net to use in different systems. This point was raised in answer to research from Zimbabwe, presented by Steve Torr earlier in the workshop, which showed that a non-treated net may achieve the same end result of preventing flies from entering the zero-grazing unit. To resolve these queries, it was suggested that further work should be done at Rekomitjie in Zimbabwe as well as perhaps with other research institutes, such as the Kenya Agricultural Research Institute (KARI) and Tanzania's Tanga Tsetse Research Institute, in association with the private sector.

2. **Does it have acceptable externalities (positive or negative)?** The group was able to report only on the two known externalities. The first is that the technology does not only target tsetse flies but also other flies. The second is that the technology has been discovered to have an effect on neighbouring animals that are not protected by impregnated netting. The group suggested that there should be some entomological research conducted in order to validate these two observations. They also suggested further research to test the technology in geographical locations



other than western Kenya and collection of more specific data, as they felt that the existing information was based more on observation than on statistical analysis. It was suggested that research could be carried forward with interested institutes such as the Kenya Trypanosomiasis Research Institute (KETRI) and ICIPE in association with FITCA. Further research would need additional funding and the group suggested that appropriate donors should be approached.

3. **Is it commercially viable?** The group agreed that the technology is commercially viable as it has already stimulated interest from the private sector.

4. **Is it simple to use?** The group also agreed that the technology is simple to use, as the net is pre-treated and easy for farmers to erect around their zero-grazing units. The protection is known to last for at least one year so there is no need for more than annual re-treatment of the net.

5. **Is it culturally acceptable?** The experience and perception of the farmers who have been testing the technology in western Kenya suggest that it is culturally acceptable.

6. **Is an enabling environment in place?** As the technology for impregnating nets and their use as bed nets is already well established, it was felt by the group that the enabling environment was already in place. The chemicals for impregnation are common insecticides, which already comply with required legislation.

7. **How can it be disseminated or promoted?** As the farmers involved in the trials in western Kenya were initially given the impregnated nets at no cost, the group felt that it would be important to establish participatory demonstration units. These would show farmers the technology in use and enable them to decide for themselves whether to buy nets to protect their zero-grazing units. The group also felt that further dissemination and promotion by the private sector would be beneficial. This could be achieved by establishing model units, which would encourage farmer-to-farmer dissemination. However, the involvement of NGOs such as 'Send a Cow' in Uganda should not be overlooked as the technology could be incorporated into their re-stocking schemes.

8. **Is there a demand from the end-user?** The group felt that there is a demand for impregnated nets, especially in areas where zero grazing is practised.

9. **Is it affordable?** On affordability, the group were undecided because there is no statistical information currently available about how much it costs to invest in the technology.

10. **If the technology requires collective action, can it be managed?** The technology does not need any collective action as one farmer can decide to use the technology for him/herself alone.

This ended the outcome of the discussions on the checklist questions but Chesnodi ended his presentation with a general statement from the group. 'This technology appears to have the potential to meet the agreed criteria/checklist BUT it clearly requires some more basic data/studies to validate it, followed by more extensive field trials.'

Tsetse repellents

Peter Sinyangwe presented the results of this group discussion. He began by explaining that, as the checklist items were so broad and numerous, certain assumptions had to be made by the group in order to clarify the decisions on the best way forward for both natural and synthetic repellents. The group decided that pastoralists should be the main target as they would gain the most from using the technology. It was also assumed that the 'push' repellent technology would not create problems for other farmers. Although the group did not have sufficient time to discuss all the checklist items, seven questions were addressed according to the main priorities for moving the technology forward. It was stressed that items not discussed by the group should be reconsidered after further field trials have taken place. One of the main comments was 'if the technology works, then it should be sustainable'. Funding was not mentioned in connection with most of the questions as it was assumed that this constraint applied to all the items under consideration.

1. **Is the technology effective?** To properly address this question, the group felt that funds should be made available to enable the key players to continue evaluating the potential of the synthetic and the waterbuck repellents. It was decided that the International Livestock Research Institute (ILRI) and KETRI should continue to work on this over the next two years and that potential allies could include the International Fund for Agricultural Development (IFAD), FITCA, DFID, AU/IBAR and appropriate NGOs. However, there would be a need to identify other sites for field trials so that these could be compared with farming systems in other regions.

2. **Is the technology environmentally friendly?** Although it appears that the technology is environmentally friendly, under the actions required to determine the definitive answer to this question, the group felt that studies on toxicity to animals should continue together with testing the effects of repellents on humans. These studies have not yet been undertaken but should be incorporated into ICIPE's continuing evaluations of the technology with help from ILRI and

perhaps with national and international environmental groups. The conclusion was that impact assessment studies, in collaboration with appropriate allies, should look at indirect and direct impacts.

3. **Is the technology commercially viable?** The group felt that it would be very important for ILRI and KETRI to develop a business plan to take the technology forward. It was also decided that patenting to protect the pastoralists ought to be considered. In addition, collaboration with the production companies should ensure that the repellent technology is produced at an affordable cost. It was reported that ICIPE is already involved in commercialising the product and will work to take it forward. Allies proposed to help with this process were IFAD, DFID, AU/IBAR, ADB and the African Agricultural Technology Foundation, although the current focus of this foundation is on crops.

4. **Is the technology affordable?** The group suggested that ILRI and KETRI, with assistance from IFAD and ICIPE, should continue to evaluate farmers' perceptions of the technology and their willingness to pay for it. The group also proposed that appropriate information for dissemination activities should be prepared.

5. **Is an enabling environment in place?** The group felt that appropriate legislation should be in place. However, in many instances there has been confusion between legislation and policies. The group advised that this should be looked into and that perhaps it should be the responsibility of the public sector in consultation with relevant stakeholders. The group also felt that farmers should be included in this development process. Additional discussions around this question focused on funding, the development of vector control strategies, and the review of animal health, disease and vector control policies.

6. **Is there a demand from the end-user?** To answer this question, the group agreed there is a need for further assessment of the vector control needs of farmers and their perceptions of the repellent technology. Further work could be done in collaboration with the private sector, NGOs, research institutions and, possibly, FITCA. The group proposed that further projects on repellents should be demand-linked.

7. **How is it going to be disseminated?** The group held detailed discussions on this point. They decided that, if it is to be successful, the technology needs to be picked up and promoted by the private sector. This could involve private sector extension agents, although *dukas*, small shops and sales agents were also regarded as appropriate channels for disseminating the technology and the necessary information. The group proposed that funding should be secured and

dissemination strategies should be developed through involvement of private and public sector partnerships.

General comments

Rajinder Saini: What were the initial objectives of the workshop? And where do we go from here?

Nigel Campbell: The objectives were to examine new knowledge and promote its uptake and application. We have gone further down the road of examining these technologies and done a certain amount of 'handing over' from scientists to others. Although limited by time, I think we have had some useful discussions and made some concrete proposals.

Rajinder Saini: When looking at farmer-based tsetse control, how do we get these technologies to the farmers so they can decide what to use? For instance, with a zero-grazing unit, why can't the farmer apply insecticide to his animals' legs instead of using the net? Or use a repellent collar? How can that farmer decide which technology to use?

Ian Maudlin: Just leave it with the private sector – they will fight it out, the best technology will win and the farmer will use that one. All you have to do is present the technology and the market will sort it out.

John Kabayo: If a technology for tsetse is good and can be independently verified then let it be marketed and subjected to the same standards and rules everywhere. In other words, let's follow the same procedures as other technologies.

Grace Murilla: There are so many technologies available; what we should be doing is giving farmers information on the available options so they can make informed decisions. Maybe the most important thing is to look at producing brochures and other educational materials.

Keith Sones: Before we produce a brochure, we need to have a clear message, and I don't think we have that yet.

Rajinder Saini: I will give an example from Narok, outside Maasai Mara. They have been using drugs for 40 or 50 years and they still don't know which drug to use. They mix them up and use them in the wrong way. We do need to sort out our messages if we want these new technologies to have real impact.

Bruno Minjauw: But is it technologies that will give the answer to tsetse control? We have been working on different technologies, but we all know they will never be perfect. Scientists are not supposed to be extensionists. We should be developing tools to help the farmers evaluate, test and adapt the technologies to their own situations. This is the only way to get integrated control. Technology is part of the answer but if we consider only the technology, then it will not work. We have to develop ways to help the extension of messages.

Nigel Campbell: So what can be done as a concrete next step?

Bruno Minjauw: I believe we need to take a new approach. We don't need to produce more technologies, we need better methods of reaching farmers. For the three technologies we have here, the next step is to try to get some groups of farmers who are interested in trying to improve their animal health, and who have access to the different technologies. FITCA for instance could make them available in a combined trial, where the farmers use their own knowledge and design their own tests. Our role should be one of facilitation to ensure their trial designs are appropriate and useful.

Nigel Campbell: If you could choose three competencies to design that programme, what would they be?

Bruno Minjauw: A social scientist, an agriculturalist, a group of farmers and, finally, a scientifically and politically enabling environment. If you have the right environment, it is more likely that farmers will be willing to try new approaches.

Keith Sones: Are the three champions happy to hand over control of these technologies to allow Bruno's proposal to happen?

Glyn Vale: My reaction to that is very favourable. It is, in fact, what we try to do, but I need someone to help me talk to farmers. I think the system you are talking about probably already exists but there is no clear channel and we don't get together enough. We do try to involve other people, but if you can make it more formalised and streamlined then be my guest.

Burkhard Bauer: Yes, I am happy with that, but remember we are not promoting any one technique on its own. We try to combine things as much as possible (as long as they are effective) and we want to be sure that farmers are not just using a new technique because it has been offered to them. We have to know they want to buy or invest in the technique.

Rajinder Saini: In the current project we already have the ingredients you are proposing, but the technology is still not reaching the end-users. Something is missing, but I don't know what. If you want to take these technologies to the farmers, I think that researchers will do it faster than social scientists. In my experience, social scientists talk too much and do too little. A catalyst is needed, but I don't know what it is.

Simon Gould: Do you think the catalyst could be the private sector? That's what we've been talking about and I think their involvement could make all the difference.

Bruno Minjauw: I think the catalyst is education. I haven't mentioned 'farmer field schools' but that's what I have described. The solution is all about people's education and people's development. The farmer field school is one model; it has been proven to work with crops and we are now adapting it for use with livestock. Winston Churchill said 'I like to learn but I hate to be told' and it's true, people like to learn, but for adults to learn effectively, they have to do it, they have to experience it. These are the kinds of programmes that researchers need to develop. I think it is time to reflect and invest more time and effort in

improving the way technologies reach farmers. Maybe one of the problems is that research is still very linear. We researchers need to be much more involved in the whole process if we are to understand what is going well and what is going wrong. With a livestock vaccine, the stuff in the syringe is only part of the story – how it is applied and why people want it are equally important. Vaccines are as close to a 'perfect' technology as you can get; they are cheap and easy to use, but farmers are still not using them. We need to ask 'why?'

Closing remarks

AHP Manager Professor Ian Maudlin made the closing remarks. He thanked everyone for attending and for displaying such energy and good grace during the two-day workshop. Given the recent history of disagreement within the tsetse and trypanosomiasis community, he considered the rapport to have been nothing short of remarkable. He observed that having an independent outsider, who was new to the subject, running the workshop and interviewing the technology champions had been very useful and he thanked Nigel Campbell, the workshop facilitator, for his input. The spectrum of opinion and the wide range of countries and disciplines represented at the workshop had also been valuable. In particular, having a sizeable contingent from the private sector had provided rapid feedback on the technologies under review. He acknowledged the generous sponsorship of CEVA Santé Animale for the eve of workshop cocktail party.

Ian thanked the three technology champions for their time and energy and for their willingness to take part in the interviews that took the place of conventional presentations. In doing so, he said, they had revealed the workings of their minds. He quoted Goethe: 'if you attack someone's ideas, you attack their soul', but he suggested that sometimes it was cathartic to expose one's ideas to scrutiny. He added that a key lesson he had learned, when moving from being a scientist to being a research manager, was that the social sciences had an important role. The real problem wasn't one of developing new technologies; it was one of ensuring that poor people in fragile economies (who are naturally risk averse) adopted them. Finally, he wished everyone a safe journey home.

Bruno Minjauw, on behalf of the participants, thanked Keith Sones for organising an excellent workshop.

Annexes

1. List of participants

Name	Organisation/title and country
Ian Anderson	AHP, Uganda
Burkhard Bauer	Project Manager, FITCA, Kenya
Bernard Bett	Graduate fellow, ILRI, Kenya
Peter Van den Bossche	Institute of Tropical Medicine, Antwerp, Belgium
Andrew Brownlow	PhD student, CTVM, University of Edinburgh, UK
Nigel Campbell	Facilitator, France
Joyce Daffa	National Tsetse Control Office and FITCA National Project Coordinator, Tanzania
Rosemary Dolan	Director, StockWatch Ltd, Kenya
Katy Downie-Ngini	PhD student, ILRI/University of Edinburgh, UK
Mark Eisler	Senior Lecturer, CTVM, University of Edinburgh, UK
Richard Emslie	Clinical R&D Manager, Bayer (Pty) Ltd, South Africa
Johan Esterhuizen	Onderstepoort Veterinary Institute, South Africa
Jenna Fyfe	PhD student, CTVM, University of Edinburgh, UK
Ambrose Gidudu	National Project Co-ordinator, FITCA, Uganda
Simon Gould	Technical Assistant, FITCA, Uganda
Tibebu Habtewold	PhD student, NRI, UK/Ethiopia
Solomon Haile Mariam	FITCA, Kenya
Patrick Harvey	WREN Media, UK
Ahmed Hassanali	ICIPE, Kenya
Patrick Irungu	Graduate fellow, ILRI, Kenya
John Kabayo	PATTEC Co-ordinator, African Union, Ethiopia
Freddie Kansiime	Deputy Director, COCTU, Uganda
Joseph Kariuki	Cartoonist, Kenya
Chesnodi Kulanga	FITCA, Tanzania
Chris Laker	Agricultural Economist, FITCA, Uganda
Joseph Maitima	Ecologist, ILRI, Kenya

Ian Maudlin	Manager, AHP, UK
Bruno Minjauw	ILRI, Kenya
John Morton	Associate Research Director (Social Sciences), NRI, UK
Francis Muchohi	Vestergaard, Kenya
Birgit van Munster	Capricorn Consultants Ltd/advisor FITCA Tanga, Tanzania
Grace Murilla	Trypanosomiasis Research Centre, KARI, Kenya
Martin Odiit	Research Officer, ILRI, Uganda
JJ Oduor	CEVA Santé Animale, Kenya
Pamela Olet	Senior Zoologist, Ministry of Livestock and Fisheries Development, Kenya
Francis Oloo	Liaison Officer, FITCA, Kenya
Frank O'Shea	Appropriate Applications Ltd, UK
Ralf Patzelt	General Manager, INTERVET East Africa Ltd, Kenya
Tom Randolph	Scientist, ILRI, Kenya
Harald Rojahn	FITCA Regional Project , Kenya
Rajinder Saini	ICIPE, Kenya
Ahmed Sidahmed	IFAD, Rome, Italy
Peter Sinyangwe	Dept. of Veterinary and Livestock Development, Ministry of Agriculture and Co-operatives, Zambia
Keith Sones	Workshop organiser, Kenya
Susanna Thorp	WREN Media, UK
Steve Torr	NRI, UK
Glyn Vale	NRI, Zimbabwe
Törben Vestergaard Frandsen	Director of Development, Vestergaard Frandsen A/S, Denmark
Sue Welburn	CTVM, Edinburgh, UK

2. Mini-biographies of 'technology champions'

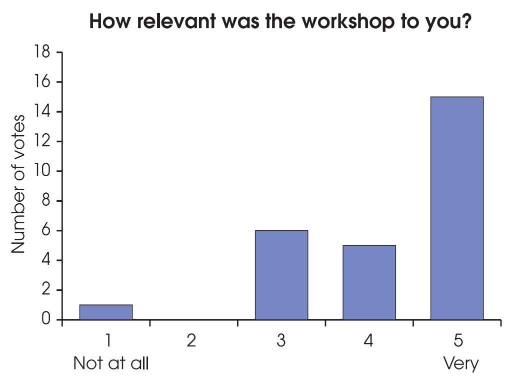
Burkhard Bauer attended Veterinary School in Hanover, where he studied the ecology of tabanids in northern Europe and methods for their control as his thesis. He was then seconded to the International Atomic Energy Agency (IAEA) to develop large-scale *in vitro* feeding techniques for tsetse flies. This work culminated in the development of the technique of feeding tsetse through silicone membranes. He then went to Burkina Faso where he established the country's first large-scale tsetse rearing facility and went on to undertake the first ever release of sterile tsetse. He remained in Burkina Faso for more than 20 years, working on the development of tsetse control techniques, with particular emphasis on the live bait technique. He also carried out epidemiological surveys, particularly on animal trypanosomiasis. From April 2000 to December 2003 he was Project Manager of FITCA, Kenya where his work included the development of impregnated netting to protect zero-grazed cattle.

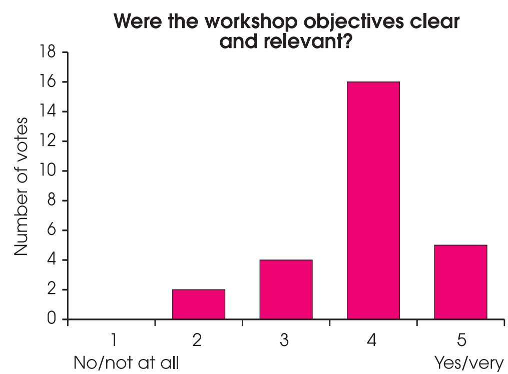
Rajinder Saini is Principal Scientist and head of the Animal Health Division, and Tsetse Programme Leader at the International Centre for Insect Physiology and Ecology (ICIPE). Rajinder obtained his PhD from the University of Wales, UK in 1983 and undertook his post-doctoral research at the US Department of Agriculture, Agricultural Research Service's Insect Attractants and Basic Biology research laboratories in Gainesville, Florida, USA. His specialisation is in insect behaviour and chemical ecology. He has worked on tsetse for over 25 years, and has published numerous papers and edited two books. He has also co-ordinated several research projects funded by, among others, the United Nations Development Programme/World Bank, the International Fund for Agricultural Development, the European Union and the Australian Development Corporation.

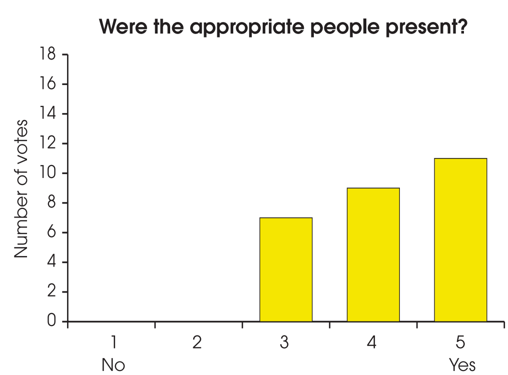
Glyn Vale graduated from Oxford in 1965, with a degree in plant breeding and physiology. He then joined the Department of Veterinary Services, Zimbabwe, where he investigated the behaviour, ecology and control of tsetse, eventually becoming head of the Branch of Tsetse and Trypanosomiasis Control. In 1989 he left the Branch to become Research Co-ordinator of the Regional Tsetse and Trypanosomiasis Programme, where he worked for nine years. He is now employed part-time on tsetse projects with the Natural Resources Institute, Greenwich, UK. Although he has worked to refine all the main methods of tsetse control, he has concentrated on developing bait techniques, believing these to be the most appropriate.

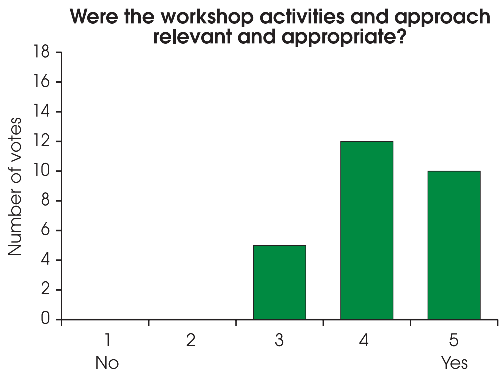
3. Workshop evaluation

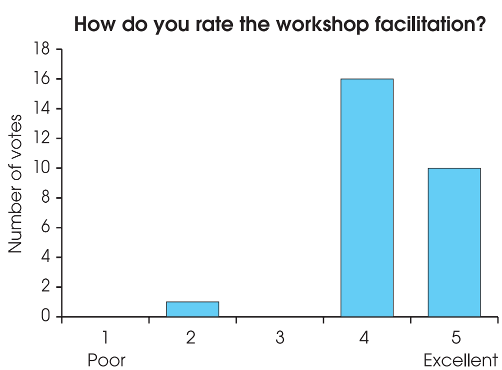
All workshop participants were invited to complete an evaluation form and 27 forms were returned. For each question, participants were asked to give a score ranging from 1 (no/not at all/poor) to 5 (yes/very/excellent).

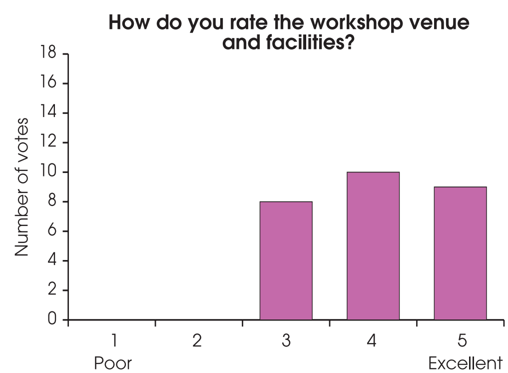












Additional comments on the workshop and suggestions for follow-up activities:

- field visits to see the technologies in action would have been useful
- there should have been more emphasis on how to improve extension services
- on balance, the interview format worked well
- government representation at the workshop was inadequate
- FITCA was over-represented
- presence of NGOs who work at field level and can disseminate information would have been beneficial.

4. Statement by the PAAT community

This statement reflects the consensus reached at the 8th Meeting of the Panel of PAAT Advisory Group (PAG) Coordinators, 24–25 September, 2002, Nairobi, Kenya, which included members from the mandated international organizations (AU/IBAR, FAO, IAEA, WHO)[1], tsetse-affected countries, national agricultural research systems, international research institutes and relevant international institutes (ILRI, ICIPE, CIRAD, IFAD)[2].

Following the decision of African Heads of State and Government, the broad Tsetse and Trypanosomiasis (T&T) community as represented by the Programme Against African Trypanosomiasis (PAAT) is united in its resolve to reduce and ultimately eliminate the constraint of tsetse-transmitted trypanosomiasis in man and animals.

The PAAT community believes that progress towards the final objective is best achieved through concerted efforts towards intervention, in a sequential fashion, with the focus on those areas where the disease impact is most severe and where control provides the greatest benefits to human health, well-being and sustainable agriculture and rural development (SARD).

It is recognized that the scale and impact of trypanosomiasis in man and animals varies between African countries and progress towards the ultimate objective will also vary.

It is also recognized that in the case of human trypanosomiasis, disease management will continue to depend on disease surveillance, detection and treatment as the principal priority for the foreseeable future, with tsetse suppression as a complementary tool. Tsetse intervention strategies need to be developed as a component of longer-term human trypanosomiasis prevention measures.

In animal trypanosomiasis, tsetse intervention has a key role to play in the effective control and eventual elimination of the disease. A significant stage in achieving this objective is the creation of

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[1] AfricanUnion/International Bureau for Animal Resources (AU/IBAR), Food and Agriculture Organization of the United Nations (FAO), International Atomic Energy Agency (IAEA) and World Health Organization (WHO).

[2] International Livestock Research Institute (ILRI), International Centre for Insect Physiology and Ecology (ICIPE), Centre de cooperation internationale en récherche agronomique pour le développement (CIRAD) and International Fund for Agricultural Development (IFAD).

tsetse-free zones through the integration of appropriate and environmentally acceptable technologies, including SAT and SIT, as economically justified. In this context, the PAAT community supports the outcome and the associated joint press release resulting from the PAAT–PATTEC harmonization workshop, Rome, 2–3 May 2002. The workshop identified criteria for selecting priority areas for joint international action. Governments, international and funding agencies are encouraged to also apply these criteria.

The PAAT community also recognizes the need to continue encouraging livestock producer-based practices against T&T wherever the diseases present themselves a problem.
In order to more effectively combat the diseases, both in man and animals and their vectors, further concerted efforts are needed with a view to develop and implement joint field programmes for sleeping sickness and animal trypanosomiasis interventions.

In this regard, it is opportune to consider refinement of T&T intervention policies, and enhance synergies and complementarities among all concerned international agencies and governments.

5. Acronyms

ADB	African Development Bank
AHP	Animal Health Programme
AU	African Union
AU/IBAR	African Union/Interafrican Bureau for Animal Resources
CIRAD	Centre de cooperation internationale en récherche agronomique pour le développement
COCTU	Co-ordinating Office for the Control of Trypanosomosis in Uganda
DFID	Department for International Development
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FITCA	Farming in Tsetse Controlled Areas
GM	genetic modification
IAEA	International Atomic Energy Agency
ICIPE	International Centre for Insect Physiology and Ecology
ICPTV	Integrated Control of Pathogenic Trypanosomes and their Vectors
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
ISCTRC	International Scientific Council for Trypanosomiasis Research and Control
KARI	Kenya Agricultural Research Institute
KETRI	Kenya Trypanosomiasis Research Institute
NEPAD	New Partnership for Africa's Development
NGO	non-government organisation
NRI	Natural Resource Institute
PAAT	Programme Against African Trypanosomiasis
PATTEC	Pan African Tsetse and Trypanosomosis Eradication Campaign
SARD	sustainable agriculture and rural development
SAT	sequential aerial technique
SIT	sterile insect technique
SP	synthetic pyrethroids
WHO	World Health Organization

Credits

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