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The politics of trypanosomiasis control in Africa

Ian Scoones

Trypanosomiasis

Dynamic Drivers of Disease in Africa

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The politics of trypanosomiasis control in Africa

African trypanosomiasis is a devastating disease, both for humans and animals. Over the last 100 years huge efforts have been made to control it. This paper explores the scientific and policy debates surrounding the control of the disease and its vector, the tsetse fly. The paper focuses particularly on East and Southern Africa, and so the savannah tsetse flies and Trypanosomiasis brucei rhodesiense. Based on an extensive review of documentary material, combined with a series of interviews with scientists and policymakers, the paper offers an assessment of the changing institutional politics associated with tsetse and trypanosomiasis control. The paper investigates in particular the controversies surrounding a range of control methods, including bush clearance, game culling, baits and traps, sterile insect release, animal breeding, drugs and vaccines, among others. The focus on particular control methods has meant that alternatives have often been overlooked, and the perspectives of livestock keepers living with the disease have not been taken into account. In addition, competition for dwindling research and operational funds, combined with a lack of institutional coordination, has resulted in the failure to develop an integrated approach; one that links ecological and disease dynamics with socio-economic conditions. The conclusion discusses why such a 'One Health' approach is required, and why addressing the politics of science and policy is essential.

About the Author

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The Dynamic Drivers of Disease in Africa Consortium is a multidisciplinary research programme designed to deliver much-needed, cutting-edge science on the relationships between ecosystems, zoonoses, health and wellbeing with the objective of moving people out of poverty and promoting social justice. It is focusing on four emerging or re-emerging zoonotic diseases in four diverse African ecosystems – henipavirus infection in Ghana, Rift Valley fever in Kenya, Lassa fever in Sierra Leone, and trypanosomiasis in Zambia and Zimbabwe.

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Acronyms

AU	African Union
AU-IBAR	Interafrican Bureau for Animal Resources
CGIAR	Consultative Group on International Agricultural Research
DALY	Disability Adjusted Life Years
DFID	Department for International Development
ESPA	Ecosystem Services for Poverty Alleviation Programme
EIA	Environmental Impact Assessments
ESRC	Economic and Social Research Council
FAO	Food and Agriculture Organization
GMO	Genetically Modified Organism
GAVI	Global Alliance for Vaccines and Immunisation
HAT	Human African Trypanosomiasis
IAEA	International Atomic Energy Authority
ICIPE	International Centre for Insect Physiology and Ecology
ILCA	International Livestock Centre for Africa
ILRAD	International Laboratory for Research on Animal Diseases
ILRI	International Livestock Research Institute
ISCTR	International Scientific Committee for Trypanosomiasis Research
NERC	Natural Environment Research Council
OAU	Organisation of African Unity
PAAT	Programme Against African Trypanosomosis
PATTEC	Pan African Tsetse and Trypanosomiasis Eradication Campaign
PACE	Pan-African Programme for the Control of Epizootics
PARC	Pan African Rinderpest Campaign

RTTCP	Regional Tsetse and Trypanosomiasis Control Programme
SACEMA	South African Centre for Epidemiological Modelling and Analysis
SARS	Severe acute respiratory syndrome
SAT	Sequential Aerosol drift Technique
SIT	Sterile Insect Technique
UDI	Unilateral Declaration of Independence
UN	United Nations
USDA	United States Department of Agriculture
WHO	World Health Organization

1. Introduction

African trypanosomiasis is a devastating disease, both for humans and animals. It is in fact multiple diseases, involving various trypanosomes, protozoan parasites carried by multiple variants of the tsetse fly (*Glossina* spp.). It appears in different forms, is affected by different epidemiological and ecological processes, and so is difficult to pin down. One major consequence of this is that there has been, and remains, great controversy about how to control the disease, and what to focus on through what methods. This paper examines the politics of these science-policy controversies, and attempts to pick apart the different debates at play.

Over the last hundred years there has been a massive effort to fight the fly and control the disease (Maudlin 2006). Colonial authorities were horrified by the consequences of human trypanosomiasis, or sleeping sickness, and invested huge effort and resources in trying to tackle it. Around a quarter of the colonial research budget was focused on sleeping sickness control, either major treatment campaigns for people, or wider efforts to push back the fly belts (Rogers and Randolph 2002: 534). Today it is claimed that 50 million cattle are potentially at risk from animal trypanosomiasis, and that the economic losses of the disease amount to US$4.75 billion per year, suggesting there are massive gains to be made for development of control operations[1]. As the Secretariat Focal Point of Programme Against African Trypanosomosis (PAAT) put it, 'We don't just want to fight tsetse; we want development, to support poverty alleviation. That's our objective.'[2]

However since the peak of colonial efforts, human African trypanosomiasis has slipped down the list of priorities. Today it is classified as a 'neglected disease', one that is underreported, poorly understood and not allocated significant global resources, and so of lower prestige than other current priorities in global health (Maudlin *et al.* 2009). That said, there is still plenty of action around trypanosomiasis control – global coordination groups, pan-African initiatives, national programmes and dedicated branches, commercial public-private partnerships for drug and vaccine development, and research projects galore on facets of vector and parasite biology. This paper will explore some of the institutional politics behind trypanosomiasis and tsetse research and control, examining how power, prestige, funding and institutional politics create a heady, and highly conflictive, mix.

Trypanosomiasis is an ideal candidate for what some have called a 'One Health' approach, especially given the interaction of human, animal and ecosystem health aspects (Coker *et al.* 2011; Zinsstag *et al.* 2011). The different fly vectors are highly dependent on particular habitats for their survival, therefore ecological and land use change has a major impact on fly populations and the associated disease risks. Equally the probabilities of infection by people and livestock are influenced by the presence and distribution of hosts, including wildlife, and so disease dynamics are equally affected by ecology, as well as the social, economic, and cultural habits of people and their livestock. It is a highly complex system with interacting environmental, human and animal health components, each operating in ways that are highly dynamic and uncertain. This makes designing interventions very difficult and open to controversy about what is the best approach. This paper examines the on-going, and long-running debates about vector and parasite control methods, tracing the histories and associate politics of each.

At the root of the challenge is a debate about the nature of the problem. Is the tsetse fly the cause of underdevelopment – low productivity of agriculture without animal traction, sickness of animals and people –

[1] http://www.fao.org/ag/againfo/programmes/en/paat/disease.html

[2] Interview, Raffaele Mattioli, FAO, Rome (see also Hursey and Slingenbergh 1995; Mattioli *et al.* 2004).

meaning the challenge is to control (or ideally eliminate or eradicate) the fly, and so the disease, from an area (the larger the better) to avoid reinvasion? Or does underdevelopment – poor infrastructure, low market opportunities, sparse populations, limited cattle populations, small arable areas, large areas of un-cleared bush – create the conditions for the fly, and with it the associated depredations of the disease?

This rather fundamental quandary was posed most articulately by John Ford in his 1971 book, *The Role of the Trypanosomiases in African Ecology. A Study of the Tsetse Fly Problem* (Ford 1971). Ford was a brilliant, lateral-thinking, big picture ecologist who was committed to a style of development in ways that many other colonial administrators were not. He argued that wider development was the answer to the tsetse problem, and that pre-colonial, indigenous systems were highly effective. He strongly objected to the *Pax Britannica* thesis, that peace brought by colonialism had improved development. Indeed he argues that the early colonial epidemics of trypanosomiasis were a direct result of changing ecological dynamics influenced by colonial conquest, as well as the patterns of recovery following the rinderpest pandemic. They were not the consequence of 'barbarism' or lack of law and order needing to be controlled by 'civilised' colonial science and administration. He argued instead that colonial science, 'almost entirely overlooked the way considerable achievements of the indigenous peoples in overcoming the obstacle of trypanosomiasis to tame and exploit the natural ecosystem of tropical Africa by cultural and physiological adjustment both in themselves and their domestic animals' (Ford 1971: 9).

While some of Ford's assumptions can be challenged today thanks to our access to sophisticated genetic profiling techniques and a better understanding of disease ecology, and aspects of his assessment of local practice were probably excessively romanticised, some of the more basic questions he posed are still deeply pertinent. In particular, his argument that disease, ecology, human practices and wider processes of development are deeply intertwined, and that narrowly focused efforts to eliminate the vector or parasite are doomed to failure. He argued that, 'the relief obtained by very heavy expenditure on tsetse control is only temporary' (p.490) and 'what ought to be avoided are all forms of mass treatment' (p.492). Echoing some contemporary controversies (see below), he argued that, 'a policy based on elimination is not a practical one' (p. 10). Also, in his advocacy of a 'systematic' integrated approach based on 'joint investigation', he was in many ways an inspired forerunner of the One Health argument of today.

For a number of reasons touched on below, Ford's argument, while influencing many of the key Anglophone researchers and practitioners, however, did not gain wider purchase. As shown below, the focus remained firmly on narrow 'techno-fix' narratives centred on a set of control methods and the big picture was often lost. In part, as this paper goes on to show, this was due to the narrow control of the mainstream policy narratives by particular networks of professionals and policymakers. In 1971, Ford argued that, 'knowledge of tsetse borne infections in nature is largely confined to a dwindling group of ex colonial civil servants, who tend to look on each epidemic as a consequence of the too hasty granting of political freedom and the collapse of control services' (p.488). This framing of the problem and solution that he identified over 40 years ago had a huge influence on how policy and practice has unfolded since.

This paper offers an overview of the competing arguments about tsetse and trypanosomiasis control, particularly focusing on the savannah tsetse species and *Trypanosomiasis brucei rhodesiense*, most common in East and Southern Africa. In particular, the paper focuses in on Zambia and Zimbabwe as case studies, although wider experiences from across Africa are drawn upon. The paper is based on a close reading of a range of

material, including archival documents, classic papers and books, and is complemented by a set of 20 interviews with key actors in the complex drama that is tsetse and trypanosomiasis science and policy today.[3]

[3] Interviews were carried out largely by Skype during June and July 2013, with a review process during October 2013. Informants were predominantly based in Europe, the US and international organisations, and thus represent those with power and influence over research agendas, policy and funding in global arenas. Follow-up work will explore more Africa perspectives, particularly in Zambia and Zimbabwe. Informants largely remain anonymised in the text that follows. Given the controversies, this allowed informants to speak more freely.

2. Institutional politics of trypanosomiasis control

There has been a long history of tsetse and trypanosomiasis control in Africa (see Giblin 1990; Hoppe 2003; Jordan 1986; Kjekshus 1977; Matzke 1983). As long ago as 1860, Richard Burton had identified the problem and had plans to release insectivorous birds in tsetse infested areas to control fly populations (Ford 1971: 1). This was not the first ambitious, slightly far-fetched, and ultimately failed, attempt at control. The successors have been many and varied and will be discussed in the next section. First, however, it is worth placing the various control attempts within a brief assessment of the institutional politics of trypanosomiasis control.

Trypanosomiasis and tsetse control became institutionalised in the colonial era. With livestock and wildlife populations recovering from the rinderpest pandemic that swept through Africa from its introduction into Eritrea in 1887, there was great concern that the economic benefits of colonialism were going to be undermined. There were strong positions adopted, reflecting the considerable resources invested by the colonial authorities. Very different traditions evolved in Francophone and Anglophone Africa. 'The British focused on tsetse and the French on medical issues. Both thought the other was stupid. But actually it made sense, as they were tackling different things,'[4] explained one informant.

This diversity in part reflects the assumed differences between *T. brucei gambiense* and *T. b. rhodesiense*, respectively in West and Central Africa and East and Southern Africa, and so matching French/Belgian and British colonial authorities. As one informant commented, 'Tryps is complicated. Different parasites, flies and environments, some zoonotic, some not. Not really one disease at all [...] It has created lots of researchers, as associated cliques. All are passionately involved, pushing a particular approach.'[5]

T.b. gambiense, a chronic disease, was thought to be endemic, circulating particularly in humans and, separately, in livestock and not with intermediate wildlife hosts. The control strategy focused on detection, isolation and treatment of human populations, as well as compulsory prophylaxis.[6] The drugs used to treat human trypanosomiasis were heavily toxic, sometimes fatal, and the approach was brutal and demeaning. 'They effectively imprisoned the infected person,' explained one informant.[7] Protecting the health of the labour force in the new colonies was however paramount and reducing infections was seen as a major priority. In East and Southern Africa, responding to the more acute and zoonotic character of *T.b.rhodesiense* strains, with wildlife known to be an important host, the response was more focused on the vector and the fight against the fly, using a barrage of techniques from bush clearance to game elimination and later intensive spraying campaigns, mobilised thousands of staff and huge resources.

The colonial state and tsetse and trypanosomiasis control were thus co-created in terms of both discourse and practice (Giblin 1990; Hoppe 2003; Lyons 2002). Taming the wilderness, conquering the fly, pushing back disease, all provided the discursive frame for a modernisation rhetoric, centred on the economic potentials of

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[4] Interview, researcher, Edinburgh, 6 June 2013

[5] Interview, researcher, Cumbria, 6 June 2013

[6] Eugene Jamot's approach in Cameroon was particularly celebrated at the time, see: http://www.asnom.org/oh/en/0541_trypanosomiase.php?PHPSESSID=ae629fb09017c051eba6ce41ae8fd119#f. Of course isolation was widely used in Europe as a means to control diseases such as tuberculosis, especially when transmission mechanisms were poorly understood.

[7] Interview, researcher, Germany, 24 June 2013

colonialism, such as mobilising labour for plantations in West Africa or creating large-scale settler agriculture in cleared land in East and Southern Africa. The East Africa Commission of 1925, for example, claimed that, 'The ravages of the tsetse fly are the greatest menace to the development of tropical Africa,' (quoted by Ford 1971: 1). The practices of control that evolved reflected the top-down, technocratic approach of colonial states. Control measures required mobilising subservient labour forces in often highly dangerous ground spraying campaigns or instituting draconian containment and treatment regimes on labour forces with no opportunity to object. One informant observed, 'Under colonialism, you could tell people what to do – without masks, without gloves, in the sheer heat of the dry season. Who cared, because you could get the people. There were armies of people with knap-sacks on their backs. They were used as slaves [...] It was strict, top-down control.'[8]

The scale, depth and organisation of such efforts were witness to the disciplining power and control of the colonial state, and the institutionalisation of tsetse control branches, often the prestige section of the agricultural ministry with the most resources and personnel, was reflective of the ambition. This created in turn professional cadres, and associated career trajectories, committed to such a control response, and the funding and operation of control branches was thus dependent on justifying a particular style of response. An international conference was held in 1907 in London to discuss control strategies by colonial authorities across Africa. This established a scientific community that become consolidated through further conferences in Paris (1928) and Brazzaville (1948). Subsequently the International Scientific Committee for Trypanosomiasis Research (ISCTR) was established, which became the basis for extensive exchanges from 1949 onwards (Bourn *et al.* 2001; Duggan 1970).

Such scientific networks were intimately linked to political power. As one informant commented, 'The colonial powers profiled themselves as credible fighters of the tsetse fly. You could show your status as a good colonial power by the effectiveness of your control efforts.'[9] This colonial legacy, different across countries of course but with important parallels, is important to recall if we want to understand the contemporary institutional politics of tsetse and trypanosomiasis control, as it set the pattern of tsetse and trypanosomiasis control as a form of colonial governmentality – the power and practices of the state – firmly in place, and has created associated expectations ever since.

While control measures have changed, and with them styles of intervention, the importance of tsetse and trypanosomiasis, especially for veterinary departments, is still significant. The justificatory narratives that attempt to mobilise resources – if not to return to the glory days of the colonial era, at least to sustain a commitment to control – are important. Informants identified a number of justifications. 'The selling basis? It has to be it kills people. Fly bites man, man dies, we should do something.'[10] The role of funders is clearly important. 'Donors want a success story,'[11] 'You get a problem, you move in, you strike, you move out. It's so appealing.'[12] Success st**o**ries are especially significant, 'The key is generating success stories. Everyone wants to be part of a success. Then donors will want to be involved. And governments. Research is needed to demonstrate tangible successes.'[13]

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[8] Interview, researcher, Germany, 24 June 2013

[9] Interview, researcher, Germany, 24 June 2013

[10] Interview, researcher, Edinburgh, 21 June 2013

[11] Interview, UN official, Rome, 20 June 2013

[12] Interview, researcher, Germany, 24 June 2013

[13] Interview, researcher, Vienna, 10 July 2013

The standard narratives start with the argument about the potential loss of cattle in tsetse infested areas. In turn this is translated into economic losses, or potentials of gain for development, if tsetse control is affected. The basis of the figures is always somewhat obscure. As someone put it, 'if that many die from tryps, it doesn't leave many deaths to be allocated to tick borne diseases, lorry drivers, grazing shortages etc!'[14] Of course there are all sorts of reasons why animals do not die in the numbers suggested, ranging from management practices, to changing habitat, to differences in fly species' infection capacities, to resistance of local breeds, but it is of course the headline figure that remains important. Today such statements are offered by the Food and Agriculture Organization (FAO), the African Union (AU) and numerous researchers looking for funds, sometimes elaborated in the form of models (cf. Kristjanson *et al*. 1999; Swallow 1997). The same arguments were used in the colonial era, and justified the interventions then.

Similar arguments are made about the human impacts of sleeping sickness (Simarro *et al.* 2011a; Simarro *et al.* 2008; WHO 2012). The World Health Organization (WHO) and the FAO invest considerable resources in the construction of a Human African Trypanosomiasis (HAT) Atlas[15] that shows the distribution of disease incidence (Cecchi *et al.* 2009; Simarro *et al.* 2010, 2011b, 2012), while public health economists translate impact data into Disability Adjusted Life Years (DALY) calculations that offer estimates of the overall effect of the disease as part of 'burden of disease' studies.[16] That sleeping sickness comes out rather lower than many 'competitor' diseases[17] is down to what some have called the 'tyranny of DALYs',[18] because, as the preferred measures of impact, they do not account for underreporting, or indeed the devastating impact of occasional epidemics. As a focal disease, impacts can be very concentrated with huge effects in a particular area (cf. Fèvre *et al.* 2008; Lutumba *et al.* 2005). There is also the fear factor with human disease epidemic potential. As someone put it, 'There are lots of politics involved because of the fear [...] Sleeping sickness comes out of nowhere. It is a frightening disease.'[19]

Thus there remains much uncertainty about the distribution, impact and importance of human and animal trypanosomiasis, and so the justificatory narratives often stretch the available facts to the limits. As someone put it, 'you can justify anything with estimates of the probability of success multiplied by the benefits, especially if you don't discount! Research prioritisation is fraught with difficulties.'[20] The same applies with distribution estimates and models of infection and their economic impacts (cf. McDermott and Coleman 2001), as there are just so many variables, with complex, non-linear dynamics, at play. This puts the tsetse and trypanosomiasis research and control community at a disadvantage. Funds have to be competed for in a shrinking pool, especially after the squeeze of structural adjustment that decimated tsetse control divisions along with the wider government infrastructure in Africa. Advocates for the 'big three' – tuberculosis, malaria and HIV/AIDS – have made their case effectively and volubly, and trypanosomiasis as an African disease – a disease of the poor at the margins living in far-away places – cannot compete with the likes of avian or 'swine'

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[14] Interview, consultant, UK, 6 June 3013

[15] See: http://www.who.int/healthinfo/global_burden_disease/about/en/index.html; http://www.who.int/trypanosomiasis_african/country/risk_AFRO/en/index.html

[16] http://www.healthmetricsandevaluation.org/search-gbd-data?s=trypanosomiasis

[17] World Health Organization (2003) Global Burden of Disease (GBD) 2000:
version 3 estimates. Available: http://www.who.int/healthinfo/global_burden_
disease/estimates_regional_2000_v3/en/index.html

[18] (Simarro et al. 2011) also email interview, UN official, Geneva, 9 July 2013

[19] Interview, researcher, Edinburgh, 6 June 2013

[20] Interview, CG director, Washington DC

influenza, Severe Acute Respiratory Syndrome (SARS) and other high profile zoonoses that might have a big impact in rich countries in the West. While a few tourists and the odd western hunter may get affected, human sleeping sickness, and certainly animal trypanosomiasis, is just not on the political radar. As one informant put it, 'It's not a global disease. It's endemic, chronic and in Africa. It is neglected. It's not FMD, avian 'flu or coronavirus. It doesn't affect the developed countries. It cannot survive in those climates. It's their problem – Africa's problem.'[21] Another commented, 'They throw billions of pounds at anything that might vaguely affect the West. Anything that causes panic. And they ignore the rest.'[22] More bluntly, 'It's exposing people in Africa. But it doesn't matter because they are black.'[23] Unlike in the colonial period, the rich West's relationship with Africa is different today, black labour and white settlers do not need to be protected in the same way. Today the justification must be in terms of improving livestock production, and so livelihoods, as a contribution to sustainable development and poverty reduction.

This does not mean that since the end of colonialism, tsetse and trypanosomiasis control has disappeared. Far from it. Millions have been spent, and a whole industry of research activity has continued. Although, as I will show below, this community is riven with factions and disputes, they all agree that their work is important and that more priority needs to be given to what has now been labelled a 'neglected' disease in need of more attention.[24]

Who then are some of the key players? What are some of the institutional politics that drive their engagement in this area? In later sections of this paper the way some of these actors interact around particular vector control or disease management solutions is discussed, here I concentrate on offering a short profile of some of the regional and international players that have shaped the debate over the past decades.

The international research system through the Consultative Group on International Agricultural Research (CGIAR) has had a long interest in livestock trypanosomiasis. The International Laboratory for Research on Animal Diseases (ILRAD) for example, spent the best part of 30 years working on a vaccine, while the International Livestock Centre for Africa (ILCA) worked intensively on trypanotolerant breeding from the 1980s. When ILRAD and ILCA were incorporated into the new Centre, the International Livestock Research Institute (ILRI), in 1994 some of this work continued, although the vaccine work came to an end in the early 2000s (see below). In this period a number of UK universities (notably Edinburgh) and research institutes (particularly the Natural Resources Institute) became heavily involved in tsetse/trypanosomiasis research, funded by the UK aid programme in large part, often with strong links to the CGIAR, and firmly part of the international research network.

The approaches used were very much in the spirit of the CGIAR system, working on technical solutions to trenchant problems. The internationally funded CG system was established following the Asian Green Revolution, aiming to produce global public goods around key agricultural challenges. ILRAD and ILCA had an Africa focus and disease issues in livestock were seen as important, and with this being the only area of work across the CGIAR on livestock, it attracted top scientists, including those associated with the veterinary community who had been involved in earlier colonial efforts. Today, trypanosomiasis work in ILRI is not a major priority, and the technical research work around vaccines in particular has passed on to new players, such as GALVmed who are attempting to develop new products through brokering alliances between university based

[21] Interview, UN official, Rome, 20 June 2013

[22] Interview, researcher, Edinburgh, 6 June 2013

[23] Interview, researcher, Edinburgh, 21 June 2013

[24] http://whqlibdoc.who.int/publications/2010/9789241564090_eng.pdf

research departments and private sector drug and vaccine manufacturers, heavily funded by the new philanthropic funders, notably the Bill and Melinda Gates Foundation, as well as traditional donors, such as the United Kingdom's Department for International Development (DFID).

Beyond the international research system, large regional projects have been the focus for both research and implementation activity that have shaped the field significantly, often taking on a regional flavour. The Regional Tsetse and Trypanosomiasis Control Programme (RTTCP) operated in southern Africa (Malawi, Mozambique, Zambia, and Zimbabwe) from 1986 to 1998,[25] and was supported by the European Union with significant funds, with complementary funds for tsetse control coming from the UK government, among others. This provided a lifeline to the veterinary departments of the region whose budgets were being savaged by economic restructuring. The RTTCP fitted a number of political objectives too, and this shaped its focus. First, it was an opportunity to support the newly independent Zimbabwe, and to capitalise on the very considerable research and operational expertise developed there. The end of the Zimbabwean liberation war meant that there was an opportunity to invest in control measures linked to a process of re-establishing national control and the demining of borders. Second, a grand mission to push the fly belt back over an area of over 300,000km^2 was a sellable proposition. The key person in Brussels at the time had two big projects, the Pan African Rinderpest Campaign (PARC) succeeded by the Pan-African Programme for the Control of Epizootics (PACE) and RTTCP. Both provided ample opportunity to sell a big eradication story to the politicians and bureaucrats, and so mobilise funds to sustain the network of veterinarians, epidemiologists, entomologists and others linked to the tsetse and tryps community, both in Europe and Africa. It was a large aid commitment and, with hindsight, some have questioned its focus, 'That many euros! What were they thinking? They were just chasing the fly.'[26]

As discussed at some length below, the RTTCP became a platform for the rolling out at large scale the odour bait trap technology developed in pre-Independence Zimbabwe and presented as an alternative to aerial spraying. It was thus presented as a pro-development operation (creating economic opportunities in the then 'front line states'), with technologies that were environmentally sound, cheap and efficient. As a flagship programme it had enormous influence on the policy debate, and the associated institutional politics in the region and beyond, even if the impacts on the ground were rather more modest.

During the late 1980s and into the 1990s, as the odour bait technology became more widely popular, a key challenge was how to sustain the operations and stop communities destroying the traps. The International Centre on Insect Physiology and Ecology (ICIPE,) based in Nairobi, but outside the well-funded CGIAR network and often seen as an outsider, championed a community approach. ICIPE has also been involved in technology development, including, as discussed below, insect repellent collars, for use on livestock[27].

From the 1980s, and coming from a completely different angle, the International Atomic Energy Authority (IAEA) entered the scene (Lundquist 1987).[28] The IAEA, based in Vienna, has a UN mandate and promotes the 'peaceful use of nuclear power.'[29] It has strong backing from the United States, and in its entomology work, using the sterile male insect technique with mass-irradiated flies released,[30] built on successes in the Americas

[25] http://www.sacema.com/uploads/tsetse/tsetse-project/tsetse-project-final-report-summary.pdf

[26] Interview, researcher, Germany, 24 June 2013

[27] http://aasw6.wordpress.com/2013/07/18/kill-the-killer-fly/; see also: http://www.icipe.org/index.php/animal-health/307-validation-and-initiation-of-diffusion-of-pro-poor-and-poor-environment-tsetse-repellent-technology.html

[28] Early IAEA work on trypanosomiasis had focused on diagnostic testing.

[29] See 'Atoms for Food', http://www.iaea.org/Publications/Booklets/Fao/fao0910.pdf

[30] http://www-naweb.iaea.org/nafa/ipc/sterile-insect-technique.html

with screw worm. Area based eradication is the mantra, and a particular approach is at its centre. This relatively well funded operation, with a clear goal and technology focus, has had a major impact on the debate and created much controversy, and with this some fairly brutal institutional politics. Seen as a competitor to other approaches there has been sustained warfare between different control factions that has heavily influenced patterns of publishing, flows of funding, membership of advisory committees, and networks and alliances within the field. From the outside the conflicts look rather trivial, sometimes absurd, but from the inside, they are clearly very real, as discussed further below.

A very particular influence of the IAEA and the SIT approach has been on the pan-African African Union (AU) vision of a complete eradication of the tsetse fly put forward as the overarching vision of the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) hosted by the AU. At the 36th summit of the then Organisation of African Unity (OAU) in Togo in 2000 heads of state resolved to 'act collectively and rise to the challenge of eradicating tsetse flies from the African continent in the shortest time possible.' John Kabayo, the then PATTEC Coordinator, articulated his vision in a paper in 2002 He argued for, 'the application of the area-wide principle that is planned, and the goal to continue the interventions in each identified area until confirmation of local elimination of the tsetse populations.' (Kabayo 2002: 474) As one commentator recalled, 'PATTEC provided a renewed spurt of interest. It was like Godzilla rising out of the ashes.'[31]

This brought uproar from elsewhere in the tsetse and trypanosomiasis community (and by the tenor of some of my interviews still does). David Rogers and Sarah Randolph from Oxford University responded to the paper in scathing terms, 'PATTEC's proposals ignore the lessons of history, deny certain undeniable ecological facts, require a degree of coordination that seems unlikely, and will surely lead to increasing foreign exchange debt with very little to show for it.' (Rogers and Randolph 2002: 534) In interviews, others observed, 'SIT was not technically feasible. It was not economically feasible either;'[32] 'It's careers for people in well-funded labs.'[33] Since its launch, and the mobilisation of considerable loan funds by a number of countries from the African Development Bank, the PATTEC pitch has become more muted. Control or selected area based elimination are talked of, rather than eradication, and the wider ambitions of rural development are emphasised, rather than control seemingly for its own sake. Nevertheless, accusations still fly that PATTEC operations are 'corrupt', that funding 'has no justification', that projects are 'a scandal', that money is 'wasted in vast amounts', that 'white elephants' are being created and that the valuable pan-African vision is being 'distorted' and 'manipulated' by certain groups who have 'captured' the agenda. One scandalised commentator observed, 'It's loan money. They took money from poor countries. They got Ethiopia to borrow the money to put into a massive white elephant.'[34] Accusations of any wrong-doing remain unsubstantiated, but whether true or not, they are vehemently held by some, and this has resulted in an intensive, and often rather vitriolic, debate among different groups about the implications of these often very substantial investments.

As someone put it, much of the story of trypanosomiasis control has been centred on the survival of veterinary departments, particular research efforts and professional careers. Someone argued, 'Those who are committed to a certain disease or control technique hate an honest appraisal. They want their disease to be the biggest and worst, and so in need of funding.'[35] 'They wanted to eradicate the fly...The idea was that this was the next

[31] Interview, CGIAR researcher, Nairobi, 12 July 2013

[32] Interview, CGIAR director, Washington DC, 10 July 2013

[33] Interview, consultant, Triana, 19 June 2013

[34] Interview, researcher, Harare, 24 June 2013

[35] Interview, consultant, UK, June 2013

rinderpest. This was the cash line from the 1970s and 80s. Now they needed something else. Then came PATTEC, and of course avian influenza later on. Each one, the vet community needed to milk it for everything it was worth.'[36]

Often enlisted as part of these debates are the core UN agencies with mandates in this area, the Food and Agriculture Organization (FAO) and WHO. The FAO has long had a coordinating role, with the establishment of Programme Against African Trypanosomosis (PAAT) in 1997.[37] PAAT is an inter-agency alliance involving various players, including FAO, WHO, IAEA, AU-IBAR and others, and is chaired by Professor Ilemobade from Nigeria. FAO and PAAT provide support to the AU PATTEC initiative, and there have been efforts to harmonise efforts[38].

The PAAT Secretariat Focal Point at FAO emphasises the importance of providing technical data, information on regulation issues, and guidance to member states, as well as policy work in alignment with the African Union. This is standard UN fare, but underneath (as ever) there is hot politics, reflecting the disputes hinted at above. As a number of informants reflected, the tryps/tsetse 'community', despite the narrow focus of work, has been so fractured, and bitterly divided that joint work has been extremely challenging, certainly in the recent past, although reportedly things have improved of late. This seems more the case for animal trypanosomiasis and tsetse control where the turf wars over control techniques are extreme. On the human health side, WHO has clear focus on ways forward, at least as expressed in expert reports,[39] and with greater resources, successfully mobilised from the Bill and Melinda Gates Foundation, there is renewed emphasis on drug treatments for HAT.[40] This is dominated more by the Francophone community, and those with West African expertise, reflecting the focus on *T.b. gambiense* noted earlier.

There are of course many other players, including independent scientists based at universities, private pharmaceutical companies producing treatment and prophylactic drugs for both animals and humans, and national agencies – the health ministry, the veterinary department, the tsetse control unit – each with different perspectives, and angles. But most of these other players are also connected in different ways to the groupings above – for funding, for professional connections – and so the networks that are formed reflect the wider fault lines and intense debates about what to do where and how.

And of course there are those who are not part of the rather inward looking trypanosomiasis and tsetse community itself, including; the often poor and marginalised people living in disease-affected areas who hunt, gather and herd livestock in tsetse infested areas; environmentalists who have a particular view about the value of wilderness and the ravages that might result from tsetse clearance, and the movement of people and domestic animals into such areas; as well as those who make a lucrative living from selling wilderness, and its abundant wildlife, to tourists, trophy hunters and others but who also want to avoid sleeping sickness for their clients as well as workers. Each of these groupings, as the paper shows later, have different narratives about the problem and solution, challenging the mainstream 'techno-fix' narrative centred on different technological control techniques that dominates the debate.

Just as in the colonial era, although now with a very different configuration of actors and interests, the institutional politics being played out reflects access to money, power, authority and prestige. While moving

[36] Interview, CGIAR researcher, Nairobi, 10 July 2013

[37] http://www.fao.org/ag/againfo/programmes/en/paat/home.html

[38] http://www.fao.org/ag/againfo/programmes/en/paat/documents/tsetse_ag.pdf

[39] http://apps.who.int/iris/bitstream/10665/79689/1/WHO_HTM_NTD_IDM_2013.4_eng.pdf

[40] http://www.who.int/trypanosomiasis_african/partners/gates/en/index.html

down the priority list, resources are still there to be captured and many believe passionately that trypanosomiasis and tsetse work needs greater emphasis in international efforts. There is thus, as in any area, a particular political economy, embedded in institutions and networks of actors, that fosters a series of narratives that frame the debate. Some of these are more dominant than others, and there are many nuances and variations between them. Just as John Ford challenged the mainstream colonial view in the 1960s, there are some who dispute some of the claims of the dominant approaches today. And even if committed, say, to tsetse control, there are numerous ways of going about it, each with different combinations of technologies and practices, with strong advocates for each.

A window on this, and so a perspective on the wider debate from a political economy of science and policy angle, is through the often intense competition over scientific 'facts' about disease and vector control and management, usually in the context of deep uncertainty, and how these are resolved, or not, within the expert community. Linked to this is the often rather vicious debate about the appropriateness or otherwise of different treatment and control technologies, and their costs and benefits (Shaw 2009). In the next section, focusing in particularly on East and Southern Africa, this paper offers a brief history of these varied efforts from the colonial era to the present, analysing the intersections of science, power and politics, and the way these have shaped intervention narratives, and so pathways of response over time. The end of the paper tries to make sense of these, and looks at why the very particular political economy of tsetse and trypanosomiasis control has limited the possibilities of a more joined-up 'One Health' approach.

3. A brief history of trypanosomiasis and tsetse control: science, power and politics

Beyond the wider institutional politics we can read the contests of power and politics, and the associated narratives of disease control, through a more detailed reflection on the competing approaches to trypanosomiasis and tsetse control. As a window on the process by which science, politics and development are co-constructed it is revealing. For debates about which vector control or disease management options make sense reflect broader visions of what development is for, what landscapes should look like and how people and diseases are seen within them. This section, then, offers an overview of the various approaches proposed from the colonial era to the present.

Colonial scorched earth policies

Following the recovery of cattle and wildlife populations after their decimation by rinderpest, trypanosomiasis in both humans and animals became a major concern for colonial authorities. In southern Africa for example, tsetse fly infestations were hampering colonisation, especially the expansion of settler agriculture and large-scale ranching. Colonial authorities ordered large scale bush clearance and wildlife extermination programmes. These were major efforts, involving armies of people, clearing bush with machetes and trapping and shooting wildlife. The scale was phenomenal. For example around 750,000 animals were shot in Zimbabwe between 1932 and when the game destruction policy was stopped in 1961 (Ford 1971: 322). A close alliance between veterinary departments and hunters was struck as the bounty of wild Africa was systematically exterminated. Presented as a project of taming, conquering and transforming wilderness into a productive alternative, these efforts were very much coincident with the colonial effort, and were allocated substantial resources.

They met with some success, especially where focal points of reinvasion following rinderpest existed. In Zimbabwe, for instance, the fly belts were pushed back significantly due to control efforts (Lovemore 1994).[41] The settler population backed these efforts as land became available and was cleared. Yet local people were not part of the picture, except as enlisted workers for the huge operations. The memories of these campaigns are often evoked, with strong nostalgia by some, 'It was a really massive effort. There were thousands of people, tens of trucks, dozers. If you lead the department you imagine that you can revive the department to that level of capacity. But it won't happen.'[42]

These approaches were not without their critics. While an environmentalist lobby did not exist as it does today, many white settlers and colonial officers had a romantic attachment to wilderness, wildlife and remote Africa, and so for these people the clearance policies were seen as unreasonably destructive.

Even within the ranks of the veterinary establishment there were debates. Most vocal of course was John Ford mentioned earlier. One informant described him, 'He was a giant. He moved away from the crowd and climbed the summits. He could always look at the big picture.'[43] As discussed earlier, he argued against the mass eradication campaigns and made the case that local, indigenous systems of disease management of the pre-

[41] http://www.sacema.com/uploads/tsetse/tsetse-project/tsetse-project-reprint-1387.pdf

[42] Interview, researcher, Warwick, 19 June 2013

[43] Interview, researcher, Germany, 24 June 2013

colonial period offered a more sustainable solution, complemented by less extreme forms of external intervention. Regular, but low, levels of challenge, he argued, fostered trypanosomiasis resistance among both cattle and people[44] and when combined with vegetation management, settlement site choice and herding behaviours, this offered a better route to a longer-term solution. This did not go down well with the more macho, scorched earth advocates in the colonial veterinary service, and his views were widely dismissed or ignored. In the end he was expelled from Rhodesia for his more moderate views, and returned to the UK to write his book.

The chemical revolution

Overlapping with this period was the promotion of insecticide applications, both from the air and through ground spraying operations. The chemical revolution accelerated following the Second World War when new chemicals, notably the organochlorines, DDT and dieldrin, became available thanks to the war effort. This was also a period when new settlers were arriving and the land allocated to white settlement began to be claimed in earnest. War veterans from the UK and elsewhere were offered land, often in the more marginal areas, and colonial authorities needed to expand 'African' land to accommodate them. Tsetse clearance thus became a greater imperative. As one informant explained:

> In the 50s and 60s tryps was a serious veterinary problem. In Zimbabwe they were looking to open up new places for communal areas. When the flies came back after rinderpest, it was a problem. The white famers of Matabeleland North put serious pressure on the government.
> [Interview, researcher, Pretoria, 20 June 2013]

The ground spraying operations followed a similar pattern to the earlier bush clearance and wildlife extermination campaigns, and were often combined. Again vast numbers of people were mobilised, often in very unsafe working conditions, to spray huge areas.

Air spraying was initiated in South Africa in the 1950s, especially in and around Kruger National Park, where a post-rinderpest focal point still existed. Huge quantities of toxic chemicals were dumped on the bush, mixed with the fuel and ejected from the exhausts of low flying aircraft. 'The amount of dieldrin they put on was extraordinary […] It was mixed with fuel and came out of the exhaust of the planes. It was in quantities that were unimaginable. They were so enthusiastic.'[45]

Here again, this was presented as human mastery over nature, the deployment of technology to conquer a scourge that lay in the way of a colonial vision of modernisation. The military scale of the operations, and the involvement of former armed forces personnel as pilots, logistics operators and so on, gave a particular image and flavour to these efforts, reflected in turn in the language used – campaign, front, operation. This was the full force of colonial power being exerted, confronting and taming a dangerous and threatening Africa.

Both the intensity and scale of these efforts did, again, have results, boosting the argument for a top-down, hierarchically organised, military style operation. For example, tsetse was eliminated from the Kruger area, and the area has remained clear to this day. In other areas the fly belts were pushed back into the valleys and off the more productive farm and ranch lands. But it all came at a cost: in terms of human health and well-being

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[44] The idea that 'healthy carriers' of human trypanosomiasis explained the relatively low incidence among the local population in the Zambezi valley, for example, had been a subject of discussion over many years (see Ford 1971: 358-66)

[45] Interview, researcher, Germany, 24 June 2013

(for ground spraying operators with backpacks of chemicals); the risk of death (for pilots flying in low in difficult country); and for the environment (in terms of the impact of residual chemicals).

Colonial authorities were not well known for their concerns for work health and safety for their black workers, but when a white pilot died in Zambia in the 1980s, this put a stop to low level air spraying under the RTTCP. However it was the rising environmental concern with the use of organochlorines that had the greatest impact. Rachel Carson's book, *Silent Spring*, published in 1962, raised the consciousness of a nascent environmental movement (Carson 1962). DDT in particular became a watchword for environmental destruction. 'There was quite heavy opposition to insecticide use. It was a hangover from Carson. Organocholorines had real concerns.. But the conservationists were mostly concerned about changing land use […] They objected to insecticides because they didn't want the areas cleared.'[46] Extensive studies, particularly in Zimbabwe, had shown the negative impacts of the use of residual chemicals as part of spraying campaigns (Douthwaite and Tingle 1994; SEMG 1997). But Grant (2001: 10) feared that the efforts of the African Union to exterminate the tsetse fly were likely to be stymied by unfounded concerns. 'We can contemplate a suffocation of implementation caused by environmental risk perception than by technical and economic issues,' he thought. 'There were negative impacts from all the chemical-based techniques – not just residual ones - it was a question of scale and acceptability of impacts. The AU wanted to employ all the available techniques for their "eradication goal".'[47]

Even though, over time, air spraying switched to endosulfans and other less toxic chemicals, such as synthetic pyrethroids, with lower residual effects, the image of aircraft releasing gallons of chemicals on the African bush was not good public relations. Ground spraying as well was seen as too expensive, dangerous and environmentally damaging, even if, again, the approaches to chemical application had become more and more selective and targeted. By the 1980s, ground spraying had become much more discriminatory and focused (although more expensive) and air spraying used a sequential aerosol drift technique (SAT) to reduce chemical impacts on wildlife.

In Zimbabwe ground spraying with DDT continued until 1991, and in the Okavango delta of Botswana a major air spraying operation continued through the 80s and 90s using endosulfans. 'There were 17 successive years of spraying. It did not work. They couldn't get enough of it. It went on and on. It was just madness. They could have done it for centuries.'[48] commented one observer. Eventually the Botswana efforts had success thanks in particular to another technological development – the emergence of GPS systems for highly site specific spraying (Kgori *et al.* 2006). 'You could then do precision air spraying. They were able to wipe out *morsitans* in one dry season.'[49] explained one informant. The Okavango too was a relatively easy place to navigate and therefore to spray accurately, being large and flat. The Botswana Government made it very clear to environmentalists that the aim was to remove the fly to protect tourists, not to allow encroachment of cattle and agriculture. Elsewhere it was more difficult, although air spraying operations still continue, with recent efforts in Ethiopia and Ghana for example.

Spraying efforts today are limited, and subject to much more exercising of controls than in the past. Environmental Impact Assessments (EIAs), toxicity appraisals and health and safety procedures are all part of the new requirements (Grant 2001). Today spraying operations are not part of large government led, military-

[46] Interview, consultant, UK, 24 June 2013

[47] Ian Grant (pers.comm., 7 October 2013)

[48] Interview, researcher, Germany, 24 June 2013

[49] Interview, researcher, Germany, 24 June 2013

style campaigns. The veterinary departments simply do not have the resources or expertise. Instead, private contractors have taken on the role, often crop spraying companies from southern Africa, with highly expert pilots. However, without the capacity to regulate operations, and with EIAs often being perfunctory exercises in box ticking, there are concerns about the impacts of such efforts.

An alternative use of chemicals has evolved in parallel, however, particularly following the development of low toxicity pyrethroid compounds, and this involves application on animals. Insecticide treated cattle approaches can be highly effective against tsetse, particularly as the knowledge about fly behaviour has evolved (Hargrove *et al.* 2012; Hargrove *et al.* 2003; Torr *et al.* 2011; Torr *et al.* 2007). This means that pour-on application techniques can be highly targeted and managed by herders (Swallow *et al.* 1995). With the flies having such low reproductive rates, the kill rate needs only to be relatively low in order to have a major control effect. 'Actually it's quite simple. Look after your cattle, spray the front legs, perhaps once a month, even every three months. It might cost two cents to spray,'[50] explained one researcher.

Such approaches can involve individual farmers, as well as more systematic applications through livestock dipping systems. The approach can also be combined with tick control, thus making any investment much more cost-effective. Concerns have been raised though about resistance, and on-going research on this continues.

A rather lower profile effort led by ICIPE involved the development of repellent collars. Rather than killing the flies, the idea was to repel them, and this involved fitting collars to the animals. This has involved research over a number of years, but the efficacy of the technology is disputed.[51] The approach is still being promoted (see above), but has not seen much uptake. As a marginal player, without the funds or the scientific clout, ICIPE has been unable to push its solution more broadly, and repellent collars are seen by many as a rather eccentric, and ineffective, alternative to the mainstream chemical solutions focused on suppressing fly populations.

Baits and traps

As a direct response to the destructive land clearance, wildlife extermination and chemical spraying alternatives, trap technologies were developed. The earliest 'Harris traps' were used in South Africa (Swynnerton 1933). They did not use odour baits but simply used visual stimuli. It was only through the work on fly behaviour and how they are attracted to odours in particular that new more effectively technologies were developed. This particularly took place in Zimbabwe (then Southern Rhodesia) from the mid 1960s through the persistent and innovative scientific efforts of Glyn Vale (although there were parallel efforts in the Francophone parts of Africa, with the Laveissiere trap being a prime output, (cf. Laveissiere and Couret 1981)).

Vale came to Southern Rhodesia in 1965, and was given the freedom to work on tsetse fly behaviour by the then head of veterinary services, Desmond Lovemore. He explained, 'Nobody knew what was going on with tsetse flies […] I was given free rein. He said he [Lovemore] would do what he would do to help. The resources were there. He said go out there. Give me an answer in three years. I went off and played a bit.'[52]

The Rukomichi research station in the Zambezi valley became a hub of activity, attracting other scientists such as John Hargrove, and later, after Independence, Steve Torr. An incredible body of research was developed, based on detailed studies of fly movement, population ecology and disease epidemiology (see for example

[50] Interview, researcher, Edinburgh, 6 June 2013

[51] Interview, researcher, 12 July 2013

[52] Interview, Glyn Vale, Zimbabwe, 24 June 2013

Esterhuizen *et al.* 2011 among many, many others; Hargrove 1988, 2000, 2005; Lindh *et al.* 2009; Vale 1974a, 1974b; Vale and Hall *et al.* 1988; Vale and Lovemore *et al.* 1988; Vale and Torr 2005a). 'They had some very clever people who worked there – Vale, Hargrove, and so on. They could do experiments on a gargantuan scale. They had money to support them. Vale had hundreds of people working for him, collecting flies and so on,'[53] explained one informant. 'Zimbabwe was the epicentre of the tsetse world.'[54] As someone else observed 'Glyn is a quite remarkable scientist.'[55] His close colleague John Hargrove explained, 'He revolutionised our knowledge of tsetse behaviour, and the role of odours in flies finding their hosts. Glyn has enormous energy. He had brilliant field techniques. He wanted to make better targets.'[56]

Vale explained, 'We wanted something that was non-polluting. We didn't want to use DDT or dieldrin, to plaster tonnes and tonnes across the bush. The environmental people didn't like it, nor indeed the tsetse people. Shooting all the game animals was another option. Some of the wildlife people liked this. They were keen on hunting. Bush clearing was highly destructive. We wanted something else.'[57]

In the early days resources were no object it seemed, and huge numbers of people were employed to collect data, dissect flies and test the traps. Through much of the liberation war the work continued with everyone from the Prime Minister, Ian Smith, to various ministers and dignitaries visiting the research station. This was cutting edge Rhodesian research, funded by the UDI Government in the face of international sanctions, focused on fighting the fly, just as they were then fighting the 'terrorists' in the bush.

When Zimbabwe became independent in 1980 the basic infrastructure, and many of the former staff, including Vale, remained. The veterinary department remained 'very white' for a long period, with the same mentalities, convictions and associated plans retained. Recalling this period in southern Africa, someone joked, 'It was white guys in baggy shorts and knee length socks. A particular type of science. A great gig. You could be in the bush, drive around in land rovers. They have a belief that they have the answer. But they are in their own little bubble. They don't even touch the socio-political aspects. It was a very British, ex-colonial scene.'[58] Another informant observed, 'It was all very top down. And it was dominated by whites. For a long time it was always whites at the top in Zimbabwe, even after Independence.'[59] Another commented on the social dimension, 'The white males stuck together. They were a tribe.'[60] The gendered nature of expertise was also commented on, 'It was white males, mad on flies.'[61] Yet despite the racialised and gendered context for science and policy in the transition to independence, in southern Africa at least, there was also continuity in the science, and the unquestionably high quality work on fly behaviour and traps continued.

This was given a massive boost with the inception of the RTTCP (see above), seen by the European Union (EU) as part of the support to the front-line states, but suitably 'apolitical', focused as it was on flies, cattle disease and development. Significantly, the RTTCP also supported the bureaucratic and professional interests of

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[53] Interview, researcher, Germany, 24 June 2013

[54] Interview, researcher, Germany, 24 June 2013

[55] Interview, researcher, Warwick, 19 June 2013

[56] Interview, John Hargrove, South Africa, 20 June 2013

[57] Interview, Glyn Vale, Zimbabwe, 24 June 2013

[58] Interview, researcher, UK, 6 June 2013

[59] Interview, consultant, Triana, 20 June 2013

[60] Interview, researcher, Sussex, 25 June 2013

[61] Interview, researcher, Edinburgh, 21 June 2013

veterinarians (and, to a lesser extent, entomologists), 'It was led by vets. This was a time when veterinary services were being privatised, and they were fighting for funds. They needed the funds to continue to justify their own existence. They wanted funds for vaccination, for mass prophylaxis. They didn't always see the broader goal.'[62] Yet the whole operation was highly dependent on external funds and longer-term sustainability became an issue. 'After 1980 Zimbabwe was swimming in funds. Once something is moving you don't stop it. So all these people were hired after 1980s to do tsetse control […] But when the cash started to dry up […]you now have a huge tsetse department, but no operating funds.'[63]

As noted already, there was a strong distaste in Brussels for a return to spraying campaigns, despite the advocacy of many of the veterinary officials, and it was the bait technology that attracted the funders. This was 'simple, elegant and clean,'[64] and was to be rolled out across the whole southern African region. Bait technology really grabbed the EU.

Vale was not so sure that his technology had been perfected, and recalled, 'I didn't want to get it going. More research was needed. I always want to travel hopefully, but not arrive. I wanted to tie up loose ends to my satisfaction. But they said the regional programme would not happen unless you get started […]It made me get off my backside, and get something going.'[65]

RTTCP was a massive experiment, and a real test to this approach. Thousands of traps were distributed across vast areas. Again, because of the reproductive biology of the tsetse fly, killing very few flies could result in a diminution of populations in a relatively short period. When well organised, again with a top-down, hierarchical approach in the tradition of past colonial campaigns, the trapping worked reasonably well. This was the case in parts of Zimbabwe for example, where a high capacity veterinary service in the colonial tradition was retained for a period. As Vale explained, 'It has to be organised and planned properly. When it first started in the1980s it worked magnificently.'[66]

Elsewhere, however, particularly as structural adjustment began to bite, the capacity of government services to implement and sustain such a large-scale programme was weaker, even with the considerable resources available from the RTTCP. Local people often did not understand what the traps were for, and did not in any case rate trypanosomiasis as a major problem. One observer commented, 'Trapping – it's more trouble than it's worth. It's a logistical nightmare. There are all sorts of other uses for blue or black cloth.'[67] Another recalled that villagers found better uses for the traps, 'The netting used on some designs was perfect for fishing nets. The blue cloths were good curtains. And the aluminium frames were perfect for door posts and window frames.'[68]

Community compliance and sustainability became a big issue. In the Lambwe Valley of Kenya, a site of extensive and long term research on tsetse and tryps, community programmes facilitated by ICIPE took off (Barrett and Okali April 1998; Ssenyonga *et al.* 1996). These involved community participation from the start,

[62] Interview, consultant, Triana, 20 June 2013

[63] Interview, researcher, Pretoria, 20 June 2013

[64] Interview, consultant, Triana, 20 June 2013

[65] Interview, Glyn Vale, Zimbabwe, 24 June 2013

[66] Interview, Glyn Vale, Harare, 24 June 2013

[67] Interview, researcher, Edinburgh, 6 June 2013

[68] Interview, consultant, Triana, 20 June 2013

from trap construction to placement to management. This had a great effect, but required local level community organisation and buy in. Participatory development, even by the 1990s when these approaches became more and more in vogue, was not a strong point of the average veterinary department. The institutional culture and the professional training ran against interacting with people. As a researcher involved in that initiative put it, 'Vets.. vets […] they are not terribly participatory. They saw it all as a vet problem […] The vets just wanted to get the last fly. There was a total obsession […] If the community could do it, could they do it for long enough? They just could not hand over. Because it's about power and status. It's about their own training. "We are vets, we don't deal with people," is the line. The training curricula haven't changed in 40 years. They think they are doctors.'[69]

With the trap technologies, there were always challenges of reinvasion. Trapping was a long term solution that had to be sustained, particularly in border areas for years. Some suggested that this was a 30-40 year challenge. As African governments became more and more reliant on donor support, projects would not last for more than a few years. Even a massive prestige project such as the RTTCP had only one renewal, and was wound down in 1998-9. As one informant explained, 'In retrospect, the targets didn't produce the results that they hoped for. In the end, RTTCP was a lot of money down the drain.'[70] Perhaps this assessment is too pessimistic. Vale counters, 'If we didn't have the bait system, the whole of Zimbabwe would have gone down. All gone down.'[71]

Such efforts were thus subject to the whims of aid industry fashions. In some people's views, the RTTCP morphed into a generic rural development programme, so losing the focus on tsetse control, much to the chagrin of those who saw this is as the only priority. And in respect of government support, political change, external conditionalities from international finance institutions and the wider political economy of development, all had effects. Despite the special pleading of the veterinarians and the entomologists, it was not possible to sustain funding for pet projects supporting pet technologies for ever.

The nuclear solution

However, in the tsetse control field there seems to be always some group somewhere who has managed to convince someone that 'their' solution is going to work, and should be the next big thing. The Sterile Insect Technique (SIT) promoted by the International Atomic Energy Authority gained prominence through the 2000s (Feldmann and Parker 2010), just as other options and their funding were faltering.[72] This came from an unusual source and was presented as part of the IAEA's advocacy of 'peaceful uses' of nuclear technology. 'Every country that signed the non-proliferation treaty would like some benefits from signing,' explained IAEA's Udo Feldmann.[73]

As discussed earlier, irradiating male insects and releasing them in very large numbers had worked for fruit flies and screw worms, particularly in the Americas. The US Government, through the United States Department of Agriculture (USDA) support to IAEA, heavily backed the idea that this technology could be used to conquer at

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[69] Interview, researcher, Sussex, 25 June 2013

[70] Interview, researcher, Germany, 24 June 2013

[71] Interview, Glyn Vale, Zimbabwe, 24 June 2013

[72] SIT had of course been tested on tsetse populations before, both in Nigeria and in Burkina Faso from the 1980s (see above).

[73] Interview, Udo Feldmann, IAEA, Vienna, 10 July 2013

last the tsetse fly in Africa. As someone put it, 'The males would come in like knights in shining armour and take all the females!'[74]

This was presented as part of a strong narrative of eradication by the African Union (see above). The idea of eradication goes down well with veterinarians and policymakers. Getting rid of a vector of a disease is a great achievement, as has been the case with smallpox and rinderpest. These are the iconic disease eradication campaigns that everyone wants to replicate. Selling the potential of this is very much part of the rhetoric, even if the likelihood of this ever happening is exceedingly slim. 'SIT needs to be seen as part of a success story. This is what attracts people,' explained Feldman. He went on, acknowledging the limitations, 'Of course it depends on the situation […] SIT is not applicable everywhere […] It is always part of an integrated approach.'[75]

The IAEA had tested their approach on the island of Zanzibar – in fact in a fairly isolated patch of forest – and through prior suppression of the population by 95 per cent and the repeated release of sterile males over several years, and with the expenditure of perhaps millions of dollars, they had managed successfully to eliminate the tsetse fly from this area (Vreysen 2001; Vreysen *et al.* 2000). This was written up and promulgated as a massive military-style success story, glorified as 'winning the battle' and 'waging a war',[76] the final solution to the scourge of the tsetse fly across Africa, with this case deployed to justify the roll out of the approach across Africa.

But as a consultant commented, 'SIT in Zanzibar worked. It was one species, on an island, with 1000km^2 of infestation. But on the mainland it's a different story. You can see all of Africa as 'pocket' if you like, but you have game areas without access, large areas of forest with no access at all, and you have 23 different species. Surely Zanzibar is not a good model.'[77] Everyone of course likes a success story, no matter how peculiar, context specific and expensive. The details can be brushed under the carpet for the purpose of the big sell, and then the subsequent details worked out. The IAEA are not the only organisation, and SIT not the only technology, that has used such a tactic in the harsh world of competitive funding. Gaining a strong political ally in the African Union, deploying an articulate African advocate in John Kabayo, and inveigling your way into the international bodies was also part of the strategy. Again, the exact same tactics used by others, but perhaps not so effectively.

The SIT approach, and the role of the IAEA and PATTEC's advocacy of SIT, provoked massive controversy, outrage and anger among the small tsetse and tryps community. According to some, 'The SIT approach has been massively oversold.'[78] Some of this was of course jealousy, ' how dare they capture the increasingly scarce funds when we have worked so long and hard working out solutions?' But part of it was legitimate scientific concern. 'SIT is only applicable if eradication is the objective. It has no role in the tsetse and tryps control armoury, unless elimination is the goal, other cheaper methods don't work and reinvasion can realistically and economically be prevented.'[79]

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[74] Interview, consultant, UK, 6 June 2013

[75] Interview, Udo Feldmann, IAEA, Vienna, 10 July 2013

[76] http://www.iaea.org/Publications/Booklets/TcDevelop/one.html

[77] Interview, consultant, UK, 6 June 2013

[78] Interview, consultant, UK, 6 June 2013

[79] Pers.comm., UK consultant, 20 October 2013

A vicious war of words ensued, with a variety of papers, vitriolic responses and harsh critiques offered. My interviews almost inevitably turned to this subject. Views were heart-felt and strong. 'Now it's a big political thing. This is my view. It's a sexy way of giving nuclear power a jolly green ecological face. Nuclear power, as a green, alternative, clean solution,' argued one informant.[80] Another commented, 'IAEA is distorting what is happening. SIT is hugely expensive. It requires massive suppression to work at all. And why would you do SIT when you have other perfectly good and cheaper alternatives?'[81] Another observed, 'It's all ridiculously complicated and expensive,'[82] while another commented, 'Anyone who believes this can work is crazy,'[83] Accusations of skulduggery were often not far below the surface, 'It's a political game. It is the basis for an awful lot of corruption. SIT involves a lot of funds. The fly factory will come to your area, brings benefits, they say. But the Ethiopian one has not released a single fly.'[84] The wider politics of funding and control was often a subject of comment. 'The colonisation of the mind is a real problem in this field. Working just to the tune of the external expert or funder is a real syndrome […]Rinderpest has become iconic, part of the social fabric. But it's not the only way.'[85] Indeed, it was the apparent competition between control methods that was the most frequent subject of discussion. One dismissed SIT outright. 'They had a nice toy looking for another place to play.'[86] another was more compromising, 'I have nothing against SIT. A tool, we have it. Under certain conditions it can work. If the tsetse population is isolated, and the chance of reinvasion is zero, and suppression can be implemented, then, yes, SIT can work.'[87] Indeed the overall evolution of the debate was acknowledged by some, and heavily emphasised by IAEA. An outsider commented, 'PATTEC has evolved. They have been backing away from SIT. A shift from eradication to sustained control. They could not breed enough flies. It was a major setback for them. You still hear rumblings of eradication, but it's more sensible now.'[88]

All of this sparked big debates in the scientific literature. In particular there was a to-and-fro of different models, each arguing for and against the efficacy and efficiency of the SIT approach, especially in comparison to others (Barclay and Vreysen 2011a, 2011b; Hargrove *et al.* 2011 and more recently; Bouyer *et al.* 2013; Shaw *et al.* 2013a,b), (see also Vale and Torr 2005b). Commenting on the 2011 model by Barclay and Vreysen, one of the protagonists recalled:

> There was a huge scene. They tried to write to our funders. There were all sorts of red herrings. They said our model was no good. In order to show that SIT worked they had to make some horrendously bold assumptions [in their model]. We know they weren't true […] later it was acknowledged [that] it was a complete load of guff […] Tsetse lives a long time […] It's fundamental biology. If you live a long time, it doesn't matter a monkey's stitch if you have sterile males. SIT is fundamentally inappropriate.[89]

Much of this debate has, in my view, rather missed the point. Framed as a competition over techniques and tools – which one is 'better', mine or yours? – the bigger picture was often lost. What was all this effort for?

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[80] Interview, researcher, Pretoria, 20 June 2013

[81] Interview, researcher, Warwick, 19 June 2013

[82] Interview, researcher, Edinburgh, 6 June 2013

[83] Interview, CGIAR researcher, Nairobi, 12 July 2013

[84] Interview, UK, June 2013

[85] Interview, consultant, 20 June 2013

[86] Interview, researcher, Pretoria, 20 June 2013

[87] Interview, researcher, Triana, 20 June 2013

[88] Interview, CGIAR researcher, Nairobi, 12 July 2013

[89] Interview, 24 June 2013

And was it actually tackling a problem at all? In the end this dispute, still on-going and seemingly unabated, was about politics, funding and prestige. Who was going to capture and control the agenda? And with US backing, and new funds leveraged under the narrative of peaceful nuclear solutions, the SIT approach was always going to gain the upper hand compared to the low-tech, local solutions advocated by others, no matter what the debates about biology, economics, social acceptability and so on were.

Drugs and vaccines

Another suite of alternatives has focused not on the vector but on the parasite itself, through the development of prophylactic and therapeutic drugs for animals, as well as that ultimate Holy Grail, a vaccine. Here the argument suggests that treating the disease directly makes more sense, especially as the relationship between fly densities and disease incidence is not clear. A range of drugs were developed from the 1950s, and later came off-patent, and have been produced as generics for very low cost since the 1990s. Also, over the last 40 years, there have been attempts to produce an animal vaccine.

The drugs (notably diminazene aceturate (mostly for chemotherapy), isometamidium chloride (for chemoprohylaxis) and homidium salts (for chemotherapy)) are reasonably effective, relatively easy to administer, and especially as generics very cheap.[90] This can be, advocates argue, a livestock owner led solution, delivered through agro-vets and the private sector drug companies, and therefore not reliant on large-scale government led control campaigns. The big challenge is regulation, both of the quality of the products, particularly of generics, and the problem of counterfeits, and of the dosing regimes that may result in resistance to the current class of drugs (cf. Chitanga *et al.* 2011; Delespaux and de Koning 2007; McDermott *et al.* 2003; Mungube *et al.* 2012; Van den Bossche *et al.* 2000).

Others argue that a herder driven drug treatment approach may be alright in some areas, on the margins of tsetse distributions, but in the focal areas where tsetse challenge is high a more concerted fly control campaign is necessary. By not tackling the underlying cause of disease, they argue, the potential for epidemic outbreaks, potentially spilling over into humans, remains and the costs of not engaging in a proper vector control campaign may be disastrous.

Such debates of course are again about asserting control over the problem, and therefore over the solution too. While there is much rhetoric about integrated solutions, holistic approaches, and 'One Health' policies, the practice is very much about territory, control, and capturing resources. As resources have been increasingly squeezed, especially for government veterinary departments, local, private sector, solutions are not seen positively. The memory of the large-scale operations, with thousands of staff and huge levels of equipment and resources, is still relatively recent and formed the basis of the early careers of many current senior officials. Today the Land Rovers are out of commission and lying derelict around the offices and the droves of workers have been laid off.

A private sector solution, especially developed through 'public private partnership', is very much the flavour of the age, however, and some new players have entered the scene to advocate such solutions. GALVmed, for example, is modelled on the GAVI Alliance, that has been successful in the human health domain.[91] GALVmed articulated an argument for the development of a new class of trypanosome drugs and the development of a vaccine that would provide a medical solution to the problem using the latest recombinant genetics

[90] http://www.fao.org/docrep/006/x0413e/x0413e05.htm

[91] http://www.GALVmed.org/; http://www.gavialliance.org/

technologies, cutting edge drug development platforms, and novel approaches to private sector development and delivery. As a technology development broker and market initiator, GALVmed argued effectively that they could be the missing piece of the puzzle in the task of delivering new technologies to tackle neglected diseases in poor areas of the world. The UK Department for International Development (DFID) invited them to develop a flagship programme around animal trypanosomiasis, and offered £8million of support.[92]

As a counter to the old style of tsetse control, based on large scale government programmes, this was presented as a new, streamlined, and cutting edge technology driven solution, imbued with private sector values and efficiencies. This was very much in the vein of other solutions being promoted by GALVmed's co-funder, the Bill and Melinda Gates Foundation, whether around crop technologies to deliver the African 'green revolution' or health technologies for human disease, where private sector solutions are sought in a new vision of development. Such an approach certainly has, in theory, some clear advantages over the cumbersome, expensive, top-down approaches of the past, but there are also limits.

GALVmed argues that it has in the pipeline a new class of drugs. These are more efficient, less toxic and easier to administer than existing drug solutions, they claim. A low cost diagnostic tool is also in development to be used in field settings, again at low cost. They equally make the case that these new classes of drugs can meet the increasingly stringent regulatory requirements that national governments and international protocols require. Such regulations, they claim, will drive up the prices of competitors' drugs making their new products competitive in the market. While the market is relatively small it is not insignificant (estimated at EUR80million in total, adding in around EUR40million of lower quality or counterfeit products), and as producers have higher value animals to protect, the incentives to protect them will increase. With a new, more stringent regulatory regime in place, new products will fare well, they argue. A GALVmed representative explained:

> There are whole issues of quality control. A lack of regulation... Some people don't believe it's a problem. But we have been doing research which shows that 50 per cent are substandard or counterfeits. And there is more counterfeiting in the rural areas where there is less control […] Enforcement is the big challenge. We need good regulation. It's a big issue with human drugs. But the same with veterinary drugs too... The cost of drugs is driving the market. But they are cheap because of generics and counterfeits. They will definitely go up in price with greater regulation. The live weight of animals is increasing across Africa. Animals are worth thousands of euros. It is worth the producer investing. The problem is there is no incentive to stock the drugs by the better manufacturers, as they are undermined by others […] Currently commercial risk is heightened by the lack of regulation of the market. Effective regulation derisks the product.[93]

There are quite a few ifs and buts in this argument, however. Much relies on the control of the cheaper, lower quality generics (and counterfeit) market, and the convincing of producers that a higher quality product is worth paying for (if and when it is actually produced) (cf. Bardosh *et al.* 2013). Others question the push to greater regulation, arguing that the informal markets are actually providing reasonably good quality products:

> There is a real push back from vets and companies. The market is so small. There is just enough cash in trypanocides to attract the private sector, but only just. They want quality control. More vets, more cars. Our work showed in West African markets in the mid-2000s, formal and informal, we didn't find

[92] This was part of a wider package of support involving the Bill and Melinda Gates Foundation, as well as DFID: http://www.GALVmed.org/2012/03/gates-foundation-dfid-award-GALVmed-51-million-to-combat-livestock-disease-2/

[93] Interview, researcher, Pretoria, 10 July 2013

> anything bad. Counterfeits are rare. Generics are low price, so there's a low incentive. They have been off patent for 10-15 years, so there is a mature market now.[94]

Clearly much hangs on the extent of low quality and fake products in the market and the implications this has for longer-term problems of resistance, that is in turn compounded by widespread underdosing.[95] Labs developed by GALVmed in Senegal and Tanzania are currently testing drug quality across a number of countries. This remains a live debate, but one replete with political economy questions. There are pressures for increasing regulations from regulators (who need jobs and resources), from pharma companies (who can increase profits from new products), but also from those who make a living from the informal market. Diverse interests are at play, and disputes remain over the extent of the market for new products given the mature generics market, the level of local demand, and ability to pay, as well as the scale and impact of under-dosing, sub-standard products, and drug counterfeiting.

As with many technology driven efforts, the investment in drug development has gone into the upstream science, and not into the downstream market testing and delivery. As one informant noted, 'There is a gap. Ideas are developed in isolation of thinking about the delivery systems. Unless you develop the technology with a delivery system in mind, it will end up too expensive, and sit on the shelf. Tryps falls into this problem just like most other efforts.'[96]

In the GALVmed case much effort is being invested in exploring the market conditions and ensuring effective delivery mechanisms but what if the technology, developed at such expense, does not meet market demand? This would not be the first time a new technological solution, even if it worked well, met an early fate as the assumed mass of consumers refused to buy it. The real challenge, often poorly recognised and understood, is the social and political context of such markets. There are plenty of vested interests in not regulating drugs, and keeping poorly performing generics and counterfeits. Even if these were overcome, the ability to regulate drug markets in remote rural settings is very limited. And in any case the costs of off-patent drugs are so low that competitors would have to offer very substantial added value. While some claim that low quality, counterfeits and under-dosing is a real problem, others argue that it is not such a problem, and that livestock keepers have developed capacities to discriminate between drug types, and have good knowledge of application processes.

Most commentators regard the pursuit of new drug discovery channels as a useful thing to do, although questions are raised about how much de-risking support should be offered to large private pharmaceutical companies from public aid or philanthropic money. However the same view is not shared when the technology development is focused on a vaccine.

Vaccine development for trypanosomiasis has a chequered history. ILRAD spent the best part of 30 years from the early 1970s in pursuit of a trypanosomiasis vaccine (ILRAD 1991). The effort failed completely, and the work was finally shut down in the early 2000s after a thorough-going review (e.g. Budd 1999). An ILRI insider commented, 'There was good science, but it was a random walk. There is no point in fiddling around with more

[94] Interview, CGIAR researcher, Nairobi, 12 July 2013

[95] See Tettey et al (1999), Schad et al (2007), Karembe (2008), Teko-Agbo (2008) and van Gool and Mattioli (2010) for discussion of sub-standard and falsified trypanocide drugs.

[96] Interview, researcher, Addis, 6 June 2013

and more responses. There was not a rational basis for continuing.[97] Given this history, questions about new initiatives are inevitably raised:

> From 1972 to about 2002, there was high class science, good work on immunology and so on. But the practical outputs were nil. The tryps vaccine work was closed, after a very thorough review. And then along comes GALVmed. They are all new faces. A new generation of researchers. We've been asking the question – why are they going down the same track? It was the same old story. Selling a new hope, a new solution… How on earth was that allowed to happen?[98]

In a similar vein:

> We spent the whole of the twentieth century learning that vaccines don't work... donors don't have technical advisors who can say 'hang on a minute'. It's a tragedy of Shakespearean proportions. So much money wasted![99]

There are good reasons why vaccine development is difficult, if not impossible. This has to do with the way trypanosomes change their antigenic covering, making it virtually impossible to generate a vaccine response. As someone argued:

> Now we have the Gates programme, and silver bullets and grand challenges. Everyone wants a new vaccine or drug […]Ridiculous. GALVmed have got millions from Gates and DFID for work on a vaccine for tryps[100] […]There have been some very clever people over 20 years doing research on tryps showing that they change their coat – not even in response to antibodies. There are thousands of genes controlling the coat, and it changes all the time […] It will be a total waste of money.[101]

Parallels are drawn with the HIV virus and others where millions have been sunk into failed vaccine development efforts. Given the ILRAD story, it was with some surprise that funds were approved to work on a new vaccine under GALVmed's programme. In the end, only 9 per cent of the £8million DFID grant was allocated to vaccine development, and only one candidate was chosen as having potential. A development process was financed involving a collaboration between the University of Bordeaux and commercial partners. New laboratories have been developed in Mozambique, Ethiopia and Burkina Faso and animal testing has been underway. The rationale was explained by GALVmed, 'The potential is so big, and the effect so massive, it's worth trying. We wanted to stimulate interest in this area. There have been lots of past attempts. It may not work. But there have been advances in immunology since.'[102]

Even so the prospects of a commercialisable vaccine emerging look slight and vaccine development has not been included in refunding proposals. But, it is argued, the capacity for animal testing and the development of laboratories has been achieved, even if not a likely product. Others argue that this has been a monumental waste of money.

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[97] Interview, Washington DC, 10 July 2013

[98] Interview, Nairobi, 12 July 2013

[99] Interview, UK, 6 June 2013

[100] In the end, the amount allocated to vaccine development was £1million (see above)

[101] Interview, UK, 6 June 2013

[102] Interview, researcher, Pretoria, 10 July 2013

Certainly the allure of the technological silver bullet is strong and a good sell and, especially based on a private sector solution, is often one that wins the funds. However, the trypanosomiasis vaccine and drug story shows that there are other issues at play, beyond the simple 'derisking' of product development and market testing. Unregulated drug markets are difficult ones in which to compete, and the prospects for European or US style regulation are slim in Africa, for a number of economic and political reasons. Beyond the technical difficulties of achieving a vaccine solution there are other delivery questions that have yet to be addressed. These may be long-run options, but for poor livestock keepers in remote parts of Africa the prospects of such solutions delivering anything soon look unlikely. That the well-funded institute ILRAD failed over 40 years is witness to the steepness of the challenge. Sceptics (and I encountered quite a few) argue that there are cheaper, less sexy, solutions that are possible and the funds could be better invested elsewhere, while others counter that pursuing all options is essential.

Breeding resistance

Another long-running story in tackling the animal trypanosomiasis has been focused on breeding. There are number of indigenous cattle breeds, most notably the N'dama and West African Shorthorn breeds, that show characteristics of trypanotolerance (Roberts and Gray 1973; Strewart 1951).[103] The International Trypanotolerance Centre was established in the Gambia in 1982 to build on this.[104] Making use of this genetic material in cross-breeding efforts was, it was hoped, a route to producing better quality (larger, with greater meat and milk production potential) breeds that were also trypanotolerant. ILCA, and then ILRI, were engaged in this research in The Gambia and Senegal and had a number of core breeding herds across West and Central Africa that were integrated into the cattle breeding programmes over a number of years (Hoste *et al.* 1992; Murray *et al.* 1984). The results were mixed. As many have argued, small, indigenous, low productivity animals that have repeated tsetse challenges are often resistant to trypanosomiasis.

This is why trypanosomiasis is not regarded as a major animal health priority by people in tsetse areas, especially if the challenge is slight, occasional or can be avoided (cf. Torr *et al.* 2011). It is only when people and animals move in from outside, or when susceptible breeds are used as in large-scale ranching operations that it becomes a big problem, it is argued. This was of course John Ford's argument back in the 1960s (see above), and is repeated by many livestock keepers. It is therefore a question less of disease challenge, than of the type of production system. Indigenous systems, for a range of reasons, were always quite resilient and with a judicious combination of approaches, including the use of local breeds, this could be the same again.

This approach of course does not chime well with the objectives of technology centres who seek a technical solution, and see their role primarily as focused on milk and meat production. As a researcher put it, 'these resistant breeds are too small and unproductive for the breeders.'[105] Multiple use breeds that produce some meat and milk, but are also used for draft power and transport, and are disease resistant, are often not the priority. Size matters and volume matters. The N'dama breeding however did continue for many years, and still does under the auspices of a multi-million dollar biodiversity driven programme, protecting genetic diversity *in situ* supported by the Global Environment Fund and the African Development Fund.[106] Building on earlier

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[103] Of course the challenges of bovine trypanosomiasis can be traced much further back to the pre-colonial era and the introduction of *Bos indica* and its crossing with the much more tolerant indigenous *B. taurus*.

[104] http://www.itc.gm/

[105] Interview, researcher, Addis Ababa, 6 June 2013

[106] http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/MN-2005-144-EN-ADF-BD-WP-MULTINATIONAL-AR-PROJECT-FOR-SUSTAINABLE-MGT-OF-ENDEMIC-RUMINANT-LIVESTOCK-IN-W.A.PDF

initiatives, an ILCA/ILRAD programme (d'Ieteren and Trail 1987) continued in the forests of the Democratic Republic Congo, among other sites, for many years until closed down. Later N'dama cattle were moved to breeding programmes in East Africa in the hope of developing locally appropriate crosses, but they succumbed to East Coast Fever. As one scientist explained, 'With low persistent infection, they are reservoirs of the disease. But with high tsetse challenge, they die just like any other cattle. Or they get something else and die.'[107] Trypanotolerance evolves through co-existence with the disease, and so is not easily transferrable, 'Over time, trypanosomes become tamed, domesticated. They become used to domestic livestock. Where you give it time, where tryps and livestock live together in a farming landscape there is less of a problem; it goes away.'[108]

As Ford and many others have argued, animal breeds, diseases and production practices necessarily must co-evolve in particular places and transplanting solutions, especially attempts at universal solutions, simply do not work. And this is perhaps especially the case with a disease like animal trypanosomiasis that has so many different types of vectors with different behaviours and habitat requirements, a diversity of domestic and wild intermediate hosts, and a diversity of parasites that cause quite different types of disease symptoms.

The search for a generic technical solution however continues. Breeding in particular has been given a new lease of life by a new generation of biotechnology solutions, allowing genetic screening and the ability to insert transgenes and so speed up the process of selection dramatically. Despite the furore of 'Genetically modified organisms' (GMOs), and also the legitimate regulatory concerns about potential environmental and health impacts, the development of genetically modified animals has continued, at least in a low key way. From Dolly the sheep to Tumaini the cloned calf, some important scientific developments have occurred. A collaboration between ILRI, the Roslin Institute in Scotland, and Michigan State University has recently been announced, with a transgene from the trypanosomiasis resistant baboon to be inserted into a cow.[109]

The work is very preliminary and remains to be fully field tested, and it is not clear how broad a level of resistance will be conferred, or whether such transgenic animals will be acceptable to regulators and producers. Is this the genetic silver bullet everyone has been waiting for, or yet another interesting scientific diversion, involving lots of funds, plenty of papers but no useful product? Only time will tell. Certainly the motivation, and incentives, towards a technical solution remains strong, and the biotechnology advocates will not shy away from making massive claims about the potentials, or even the pipelines in development. In the GM crops field we have heard this incessantly for well over a decade now, yet the range of traits, and their efficacy is both limited and widely questioned, as is the potential for the narrowing of choice, and the dominance of particular commercial concerns in their marketing (Glover 2009).

[107] Interview, researcher, Edinburgh, 21 June 2013

[108] Interview, researcher, Germany, 24 June 2013

[109] http://www.ilri.org/ilrinews/index.php/archives/10937; see also: http://www.ilri.org/breadtrypanosome

4. Competing narratives: trypanosomiasis control and the politics of development

While there is unquestionably excellent science that continues, whether on fly behaviour and attractants, sterile insect techniques, drug discovery, immunology, animal breeding or genetic engineering, these efforts are largely focused on particular solutions to a problem framed in a particular way. The argument runs that tsetse and trypanosomiasis is a major scourge, and prevents development, keeping poor people and areas poor. Removing the fly and tackling the disease must result in improvements, sometimes substantial, and so justifies the control intervention. Any research and development that improves the situation is thus deemed a good investment, and the search for the ideal, hopefully generic, technical solution – that preferably eradicates but if not eliminates in areas, or if not controls to acceptable levels – is always worth searching for. This 'techno-fix narrative' as we have seen dominates the discussion, and most policy debates focus in on looking at different control measures, but all are framed by the same overarching problem-solution narrative.

Yet, as hinted at above, this is countered by what might be termed a 'conservationist narrative'. This posits that tsetse flies, and the associated disease problems, reside in marginal areas, often of little productive value for agriculture and livestock rearing. New settlement into these areas following tsetse clearance causes great environmental damage to the often fragile ecologies of such settings – such as river valleys or low lying valley areas. Furthermore, the value of such sites is not in small-scale peasant agriculture, but in the value of biodiversity, ecosystem services and 'existence values', requiring the conservation of these often unique environments. Such environments, the narrative posits, represent a global public good, and should not be transformed through disease control interventions. Indeed such wilderness areas can be 'sold' to protect them, to tourists interested to see, or hunters wishing to shoot, large game (cf. McAfee 1999). This, the conservationist narrative runs, is the true value of such areas, and investing huge effort in clearing flies makes little sense. People, except for tourists, game wardens and hunters, are not part of this landscape, and farmers and herders should be prevented from using such areas. They should be relocated through resettlement projects, and thus cleared from these vulnerable and valuable areas. As a conservation organisation official put it, 'If you get rid of tryps and tsetse, there could be large-scale land use change. Tryps keeps marginal areas marginal.'[110]

Recalling the concerns of John Ford, and indeed the perspectives of local livestock keepers, we might ask: is all this actually missing the point? Is there not an alternative narrative still? Is the problem not the fly and the disease but the lack of people, infrastructure, markets and wider development activity? The fly infested areas have retreated over time dramatically across the continent, contracting back to small areas that are often remote and usually very poor. Such areas are not being kept pristine by the fly but, according to this narrative, the lack of economic opportunity. Is the disease therefore the cause of such marginality or is it actually the result of it? Has the focus on technical solutions actually taken our eye off a discussion of what the actual problem is? Is all this effort at control missing the point? Such a 'developmental narrative', following John Ford, argues that in pre-colonial times, and in much of remote Africa today, a light, but frequent challenge may build up resistance. Vegetation management and herd control can act to reduce impact further. And if outbreaks occur there are cheap drugs to treat animals, and the impact on humans is small compared with many other health challenges. Singular technical solutions in any case do not work well, given the biological complexities of

[110] Interview, conservation organisation official, New York, 25 June 2013

the disease and its ecology. Countering trypanosomiasis involves fighting many different flies and different diseases, and spending huge resources supporting massive operations to push back fly belts is always vulnerable. There will always be reinvasion, and this may be more risky than leaving things at a low level anyway. And in the long term, land use removes tsetse habitat and more people, more livestock, more settlement, infrastructure, economic activity means less flies, less disease without going to the effort of control. As one informant argued, 'Without these big programmes, we are going back to what farmers always did. The farmers are doing their own thing. Selecting what cattle to use, selecting the drugs, choosing vector control methods […] Something simple is the answer. Farmers are going it alone pretty much.'[111]

Yet this is not an argument for doing nothing. It is more a reflection of the current situation in many places. And in some places there remains a worrying residual level of infestation: on the margins, in river valleys, in denser bush, in frontier lands, with trypanosomiasis affecting poor people and their livestock, including marginalised squatters, hunters, gatherers and herders. Such residual areas also affect tourists and trophy hunters, and those who bring resources to such areas. As one informant argued, 'The clients come to Mana Pools (a national park in the Zambezi valley of Zimbabwe), and they don't want disease. If you don't make cash out of game reserves, they are finished.'[112]

Also, if the status quo is accepted, human trypanosomiasis can rear a very ugly head, often very suddenly, as in Uganda in the 1990s. In addition, there is also a fear that systematic under-reporting and poor diagnosis (Odiit *et al.* 2005) means we do not have a clear picture of the problem anyway, even in other areas. A case history of a Tanzanian game warden is an alarming, but perhaps common, example, with a series of misdiagnoses and failure to treat with tragic consequences (see also Katsidzira and Fana 2010; Bukachi *et al.* 2009; Sindato *et al.* 2008). In a strange twist to the debate, it is the tourism, safari, and hunting communities who are perhaps some of the main advocates of trypanosomiasis control today, coming as they do with money and influence not available to those living in poverty in such marginal areas. Also, perhaps as a repeat of the white settler experience of the colonial era, there may yet be advocacy for tsetse clearance from investors wishing to develop large-scale farms, as part of what has been dubbed 'land grabbing'. As a consultant put it, 'The greed for land is not going to be offset by some tsetse flies.'[113]

These three narratives frame the problem and solution in very different ways. And the ascendancy of each depends on their advocates and their political weight. As discussed in previous sections, the 'techno-fix narrative' has been by far the most dominant over many years, although there are strong environmental lobbies for a conservationist compromise in some areas. This has given rise to some concessions towards a more integrative approach – what might be a nascent fourth narrative. Such a 'One Health narrative', highlighting integration, holism and multi-disciplinarity is frequently peddled, at least as a version of the 'techno-fix' narrative, around integrated control solutions. But, despite the nods towards broader systems understanding, integrating veterinary, medical and environmental disciplines and holistic solutions, the practice remains very compartmentalised. Everyone is fighting their corner, trying to get limited funds for their technologies, tied up with a particular narrative of vector and disease control that suits their technical solution, and, as the previous sections have shown, reflecting careers, disciplines institutions and funding streams.

[111] Interview, consultant, Triana, 20 June 2013

[112] Interview, researcher, Harare, 24 June 2013

[113] Interview, consultant, UK, 6 June 2013

Such competition can sometimes be healthy, part of a productive scientific debate. However, very often it is not. A number of informants reflected on this. One commented, 'In this field there is no honest broker. It is completely hijacked. There are conflicting interests. It's horrendous.'[114] Another observed:

> It would not be healthy if everyone agreed. But tsetse control is very controversial. There are lots of disputes. I wish that irrespective of which technique is preferred that we worked together to show success and when this generates funds, we all benefit. We support each other to raise funds, not just argue against each other. It's always going to be an integrated approach anyway.'[115]

Why then do people not come together and look at both problems and solutions in a more integrated fashion? Positions, as earlier sections of this paper have shown, are very entrenched. Claims of 'One Health' and 'Integrated Pest Management' are ever present, but most activities are fragmented, unconnected, poorly integrated, and too often based on limited data, evaluation and review. Attempts at integration and coordination either get captured or become talking shops of limited value, with warring factions often at each others' throats.

While coming from very different standpoints on particular issues, there was however agreement among informants that the current situation was, as one put it, 'a mess'. What, then, is the cause of this dysfunctionality, where both science and policy are negatively affected, and where a 'One Health' response looks a far-off dream? One informant argued, 'First, there's a shrinking resource base. This breeds competition and secretiveness. Second, there's no common language. They end up shouting at each other: one in Spanish, one in Italian! You need a common story to agree to. Currently there are just too many players.'[116] Another argued, 'There has been lots of cash flowing. It keeps the vets in their jobs […] There has been cyclical pattern of crisis, control, repopulation, crisis, control and so on […]The problem is that it's driven by vets and their pet solution. A solution at any cost.'[117] Yet another pointed out. 'We are dealing with politics. All politicians want success within a single legislative period. But tsetse/tryps control is expensive and long-term.'[118]

[114] Interview, researcher, Nairobi, 12 July 2013

[115] Interview, researcher, Vienna, 10 July 2013

[116] Interview, researcher, Washington DC, 12 July 2013

[117] Interview, researcher, Nairobi, 12 July 2013

[118] Interview, researcher, Vienna, 10 July 2013

5. Conclusion

Each of the narratives outlined above carry with them particular visions of development, located in assumptions about what development is about, what future environments should look like, and what production systems are best. These in turn reflect perspectives on the appropriate role of the state and the market, the role of livestock keepers and professional experts, and whether the best route to addressing the disease is via the vector or via the parasite. Narratives compete in a highly contested policy space, in contexts where data on incidence and impact remains highly uncertain and where the models are often flawed and limiting. Field experiments, demonstration cases, success stories and economic models all help to justify interventions. These combine with political manoeuvring, competition over funds and much hype and rhetoric around particular claims and counter-claims. In the aid-driven world of funding, there is often little rigour and accountability, and national governments in Africa, being so dependent on external funds, are too often swayed by fashions and fads. With the debate captured by certain professional and bureaucratic interests those living with the disease, in poor and marginal areas, whether herders, hunters or gatherers, have little or no say in what priorities are decided upon.

The story of tsetse and trypanosomiasis control in Africa over the last century is in sum a political story. It is often told in terms of scientific 'facts' or economic 'models', but it is one that is ultimately reflective of competing power, prestige, control and authority. As we have seen, the science is not dissociated from this; in fact it is deeply intertwined with such politics, and constructed with and by political processes that act to exclude and reinforce particular stances. As the paper shows, control options are driven by particular interests; they support careers, professional interests and institutional positions. Science and policy is inevitably dependent on the political and institutional setting. All research and intervention efforts are thus deeply political, and socially embedded in long histories that reflect how scientists and technicians see the world, both in terms of problems and solutions.

In seeking a more constructive way forward, and getting over the unhelpful competition between control approaches, recognising, naming and addressing these political and institutional barriers is, I believe, important, if sometimes a bit awkward. If the rhetoric of a more integrated One Health approach is to be realised in practice, then there needs to be a deeper reflexivity among both research and policy actors about the framing of issues, and the way this acts to construct particular narratives, and so guide interventions down particular pathways. An appreciation of the politics of science and policy, as attempted in this paper, will hopefully help recast the way tsetse and trypanosomiasis efforts are thought about and practised. And in so doing hopefully offer up alternative, possibly more effective, approaches that have to date been ignored and side-lined, as well as providing a firmer basis for collaboration across institutions and so realising the aims and ambitions of a One Health approach to which everyone subscribes.

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