STEPS centre

Politics of knowledge: Whose knowledge matters in trypanosomiasis policy making in Zambia?

Catherine Grant

Tsetse

Dynamic Drivers of Disease in Africa

Working Paper Series:
Political Economy of Knowledge and Policy

STEPS centre

Politics of knowledge: Whose knowledge matters in trypanosomiasis policy making in Zambia?

This paper explores the framings of trypanosomiasis, a widespread and potentially fatal zoonotic disease transmitted by tsetse flies (Glossina species) affecting both humans and livestock. This is a country case study focusing on the political economy of knowledge in Zambia. It is a pertinent time to examine this issue as human population growth and other factors have led to migration into tsetse-inhabited areas with little historical influence from humans. Disease transmission in new human-wildlife interfaces such as these is a greater risk than in historically populated areas, and opinions on the best way to manage it are deeply divided. Diverse framings are held by key actors looking from, variously, the perspectives of wildlife and environmental protection, agricultural development, poverty alleviation, and veterinary and public health. From these, four narratives about trypanosomiasis policy were identified. These are focused around four different beliefs: that trypanosomiasis is protecting the environment; that it is causing poverty; that it is not a major problem and, finally, that it is a Zambian rather than international issue. Within these narratives there are also conflicting views on the best control methods to use and different reasoning behind the pathways of response. These are based on incompatible priorities of people, land, animals, the economy and the environment. These diverse perspectives are examined through interviews with key actors and analyses of how these narratives have shaped policy decisions and funding.

About the Author

Catherine Grant is a Research Officer at the Institute of Development Studies. She is part of the Dynamic Drivers of Disease in Africa Consortium, where her focus is participatory and interdisciplinary research and the political economy of knowledge and policy.

About the Dynamic Drivers of Disease in Africa Consortium

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.

The Consortium (NERC project no. NE-J001570-1) is funded with support from the Ecosystem Services for Poverty Alleviation (ESPA) programme. The ESPA programme is funded by the Department for International Development (DFID), the Economic and Social Research Council (ESRC) and the Natural Environment Research Council (NERC).

www.driversofdisease.org

Follow us on Twitter @DDDAC_org

About the STEPS Centre

Today's world is experiencing rapid social, technological and environmental change, yet poverty and inequality are growing. Linking environmental sustainability with poverty reduction and social justice, and making science and technology work for the poor, have become central challenges of our times. The STEPS Centre (Social, Technological and Environmental Pathways to Sustainability) is an interdisciplinary global research and policy engagement hub that unites development studies with science and technology studies. We are developing a new approach to understanding and action on sustainability and development in an era of unprecedented dynamic change. Our pathways approach aims to link new theory with practical solutions that create better livelihoods, health and social justice for poor and marginalised people. The STEPS Centre is based at the Institute of Development Studies and SPRU Science and Technology Policy Research at the University of Sussex, with partners in Africa, Asia and Latin America. We are funded by the ESRC, the UK's largest funding agency for research and training relating to social and economic issues.

www.steps-centre.org

Follow us on Twitter @stepscentre

For more STEPS Centre publications visit:

www.steps-centre.org/publications

This is one of a series of Working Papers from the STEPS Centre www.steps-centre.org.

ISBN 978-1-78118-201-7

Politics of knowledge: Whose knowledge matters in trypanosomiasis policy making in Zambia

Catherine Grant

STEPS Working Paper 73

Correct citation: Grant, C. (2014) *Politics of knowledge: Whose knowledge matters in trypanosomiasis policy making in zambia?* STEPS Working Paper 73, Brighton: STEPS Centre

First published in 2014

ISBN: 978-1-78118-201-7

Author's acknowledgement: I would like to thank all the people that were interviewed for this paper, all the time you took to talk to us about trypanosomiasis in Zambia (and especially those who invited me into your homes, drove out to meet me and helped me travel around) was much appreciated and I enjoyed meeting you all. I would also really like to thank Dr Neil Anderson and Professor Peter Atkinson for providing helpful reviews of the paper and Dr Noreen Machila for being a great host during my visit to Zambia and for her support with some of the interviews.

This work, Dynamic Drivers of Disease in Africa Consortium, NERC project no. NE-J001570-1, was funded with support from the Ecosystem Services for Poverty Alleviation (ESPA) programme. The ESPA programme is funded by the Department for International Development (DFID), the Economic and Social Research Council (ESRC) and the Natural Environment Research Council (NERC).

For further information please contact: STEPS Centre, University of Sussex, Brighton BN1 9RE

Tel: +44 (0) 1273915673; Email: steps-centre@ids.ac.uk; web: www.steps-centre.org

Other STEPS Centre Working Paper titles in the Dynamic Drivers of Disease in Africa Consortium Political Economy of Knowledge and Policy Series:

One Health	*The political economy of One Health research and policy*, Victor Galaz, Melissa Leach, Ian Scoones and Christian Stein
Networks	*Towards One Health? Evolution of international collaboration networks on Nipah virus research from 1999-2011*, Sophie Valeix
Henipa	*Responding to uncertainty: Bats and the construction of disease risk in Ghana*, Linda Waldman, Audrey Gadzekpo and Hayley MacGregor
Lassa fever	*Lassa fever: The politics of an emerging disease and the scope for One Health*, Annie Wilkinson
RVF	*Rift Valley fever in Kenya: Policies to prepare and respond*, Erik Millstone, Hannington Odame and Oscar Okumu
Trypanosomiasis	*The politics of trypanosomiasis control in Africa*, Ian Scoones

Contents

Acronymns

AIDS	Acquired Immune Deficiency Syndrome
AAT	African Animal Trypanosomiasis
COMACO	Community Markets for Conservation
DFID	Department for International Development
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GMA	Game Management Area
HAT	Human African Trypanosomiasis
HIV/AIDS	Human immunodeficiency virus infection/acquired immune deficiency syndrome
IDS	Institute of Development Studies
MMD	Movement for Multiparty Democracy
PATTEC	Pan African Tsetse and Trypanosomiasis Eradication Campaign
UNDP	United Nations Development Programme
UNIP	United National Independence Party [Zambia]

Abstract

This paper explores the framings of trypanosomiasis, a widespread and potentially fatal zoonotic disease transmitted by tsetse flies (*Glossina* species) affecting both humans and livestock. This is a country case study focusing on the political economy of knowledge in Zambia. It is a pertinent time to examine this issue as human population growth and other factors have led to migration into tsetse-inhabited areas with little historical influence from humans. Disease transmission in new human-wildlife interfaces such as these is a greater risk than in historically populated areas, and opinions on the best way to manage it are deeply divided.

Diverse framings are held by key actors looking from, variously, the perspectives of wildlife and environmental protection, agricultural development, poverty alleviation, and veterinary and public health. From these, four narratives about trypanosomiasis policy were identified. These are focused around four different beliefs: that trypanosomiasis is protecting the environment; that it is causing poverty; that it is not a major problem and, finally, that it is a Zambian rather than international issue. Within these narratives there are also conflicting views on the best control methods to use and different reasoning behind the pathways of response. These are based on incompatible priorities of people, land, animals, the economy and the environment. These diverse perspectives are examined through interviews with key actors and analyses of how these narratives have shaped policy decisions and funding. The extent to which a One Health approach has been embraced and the potential usefulness of this as a way of reconciling the aims of these framings and narratives is considered throughout the paper, with particular benefits highlighted in the Conclusions chapter.

One Health is a strategy for expanding interdisciplinary collaborations and communications in all aspects of health for humans, animals and the environment. It involves crossing professional, disciplinary and institutional boundaries, to work, challenging as this may be, in a more integrated fashion. Especially in the context of reduced state intervention in public health, a One Health approach can be of great importance to the health of populations as it can increase understanding and the economic benefits of sharing of resources. Zoonotic diseases provide an archetypal illustration of the utility of the One Health approach, as they are shaped by complex interactions amongst humans, animals and the environment and, thus, between epidemiological, ecological, social and technological processes which affect vulnerabilities to, and risks of, transmission influenced by wider socioeconomic and environmental drivers (Leach and Scoones 2013).

While there has historically been a lack of One Health working in this context, the complex, interacting factors that impact on the disease show the need for cross-sector, multidisciplinary, decision making to stop rival narratives leading to competing actions. Additional recommendations include implementing: surveillance to assess under-reporting of disease and disease risk; evidence-based decision making; increased and structurally managed funding across countries; and focusing on interactions between disease drivers, disease incidence at the community level, and poverty and equity impacts.

Introduction

The focus, support and funding for trypanosomiasis has changed over the years, but not necessarily for scientific reasons. This paper explores the narratives taken by different actors in the field, and looks at why different ones have become dominant at different points in history. It also considers the power relations of stakeholders. This is all reflected on from a One Health perspective, with opportunities for interdisciplinary working, missed as well as taken, considered. This is a crucial area of reflection as disease narratives shape disease policy, with consequences for disease eradication and resulting impact on livelihoods, health and poverty. The flow of historical, political, social and economic knowledge and policy have influenced the ecology of trypanosomiasis vectors and its prevalence, and this study, by focusing on Zambia, adds to the evidence base on knowledge flows between different stakeholders across time. This knowledge pathway is crucial down to the local level. It has been shown in other parts of Africa that the prevention and control of trypanosomiasis depends on community members and other relevant stakeholders applying knowledge and appropriate technologies to modify tsetse ecology (Rutto *et al.* 2013). Although evidence should be the basis for policy making, factoring in value for money and other priorities, this paper indicates that the dominance of different viewpoints driven by competing power plays overshadows the possibility of truly, balanced evidence-based policy. This paper examines the politics behind the interactions between science and policy controversies, and examines the different perspectives.

Two dominant narratives have emerged regarding trypanosomiasis in Zambia. Firstly, the 'protection narrative' maintains that the disease is protecting the national parks surrounding game management areas (GMAs) and gazetted forest reserves invaded by people and livestock, and that policy decisions which prioritise the environment, but which support inaction in relation to eradicating the disease are seen as important (e.g. preventing the effects of deforestation for charcoal, poaching and killing of wildlife and destruction of the natural environment). Secondly, the 'poverty narrative' maintains that trypanosomiasis is causing poverty in areas which could be made productive and that the parks, GMAs and forest areas must be cleared of trypanosomiasis to protect the livelihoods of the people and allow poverty alleviation. The resulting policy aim is for eradication over control. However, a lack of focus and funding for trypanosomiasis was identified as a major barrier to progress. There is a key tension between the two narratives because an ecosystem of human settlement, cultivation and livestock keeping opposes the wildlife, woodland savannah and tsetse ecosystem that naturally sustains the persistence of trypanosomiasis (Lawton 1980). Competing ideologies will push for differing policies, which will have a vastly differing impact on tsetse, human and livestock populations, thereby affecting disease levels.

Two alternative views have also been identified. The 'Zambian narrative' maintains that the international community had put a lot of emphasis and effort into eradicating trypanosomiasis in the past, but now responsibility for this has been passed over to the Zambian Government as constituted, which should take full control and put in place measures to deal with the problem. This has provided international agencies with a justification for withdrawing funding, without the gap necessarily being filled by the Government. The final narrative identified is the 'wider health narrative', which maintains that Zambia has multiple health and environmental issues and, at the same time, many people do not know about trypanosomiasis and consequently feel that the limited available funding should be not focused on this specific disease system. Within these narratives there are also conflicting views on the best control methods to use and different reasoning behind the pathways of response.

Diverse actors and stakeholders have held differing opinions over time and the power of these actors has affected various policies influencing both the strategies for dealing with the disease and the very

dynamics of the disease itself. Some policies, such as those aiming to protect the environment, wildlife or change land use, have had unintended consequences on factors influencing tsetse populations (host availability, climate, and vegetation), or on the interaction between people, livestock and tsetse, thus affecting disease levels (Robinson 1965).

1. **Methodology**

A qualitative case study methodology was used to examine the narratives on trypanosomiasis in the Zambian policy context through a series of key informant interviews. Interviewees included officials from international organisations, researchers and local activists from a variety of perspectives acknowledging the need to explore the relationships between the human, animal and ecosystem sectors. The choice of stakeholders was based on a literature and Internet search, recommendations from experts in the field and those with experience of working in this area, and they represent a broad range of perspectives. Verbal consent was obtained prior to commencing all interviews, with the resulting transcripts entered into Microsoft Word and coded manually. Examining the narratives within specific social and institutional frameworks allowed for critical analysis of the policy processes involved. The resulting observations and recommendations will potentially increase our understanding of trypanosomiasis thinking and policy, as well as how One Health concepts can be applied, which then may be able to be extended to a wider variety of national contexts. In addition, a review of the literature on trypanosomiasis policy and its history in Zambia was conducted and analysed in relation to the interview content, and this is considered next.

2. Trypanosomiasis

Trypanosomiasis is a zoonosis. Zoonoses are animal diseases transmissible to humans and vice versa. Caused by blood parasites of the genus *Trypanosoma*, trypanosomiasis affects both animals and humans. The disease is mostly transmitted by tsetse fly (*Glossina* genus) bites that have acquired their infection from humans or animals harbouring the human pathogenic parasites (mother to child, mechanical transmission and laboratory accidents are less common ways) (Steverding 2008). Salivarian trypanosomes are always transmitted by tsetse except for vivax (may also be transmitted mechanically by tabanids in some regions), evansi and equiperdum[1] (Uilenberg 1998). Human African Trypanosomiasis (HAT), or sleeping sickness, is always tsetse-transmitted and cannot be mechanically transmitted (Brun *et al.* 2010). Records of transplacental transmission are rare. HAT is widespread in 36 sub-Saharan countries and African Animal Trypanosomiasis (AAT), or *nagana*, in 37 countries. AAT occurs in area of over 9 million km^2, approximately one-third of Africa's total land area (Cecchi and Mattioli 2009). The infection threatens an estimated 60 million people and about 50 million head of cattle (Cecchi and Mattioli 2009). At present there are around 50,000–70,000 cases per year worldwide, but because it mainly affects remote rural communities in regions with poor health infrastructures, it is certain that many cases remain undiagnosed or unreported. The true burden of disease in Africa remains unknown. In addition, the focal distribution of the disease can have a great socioeconomic effect on villages (Brun *et al.* 2010).

Although the zoonotic *Trypanosoma* has been isolated by different scientists from different wildlife species in the area, its prevalence in humans is highly variable. In part, the problem lies in the disease's easy confusion with other infections. In its early stages patients are often thought to have malaria, and in its later stages, HIV/AIDS. Thus, an important proportion of patients are repeatedly treated for the wrong disease and some die, undiagnosed, of HAT. Research results suggest that up to 90 per cent of HAT deaths in Africa go unreported (Odiit *et al* 2005). This is a key point to consider when assessing the roots of the wider health narrative. With better monitoring and surveillance, an evidence base could be provided to accurately assess the validity of their claims.

HAT takes two forms depending on the parasite involved. In Zambia, HAT is found in its more acute Rhodesian form. There are two stages of the disease: the haemolymphatic phase, which entails bouts of fever, headaches, joint pains and itching; and the neurological phase, including changes of behaviour, confusion, sensory disturbances, disturbance of sleep cycle and poor coordination. HAT is fatal if left untreated and involves a prolonged recovery period when it is (WHO 2013). Additionally, a significant proportion of HAT patients are active adults, often because their work brings them into contact with tsetse flies. Their prolonged illness, need for care and possible death have a major effect on their families and livelihoods.

AAT causes severe production losses and sometimes death in livestock. The costs of living with trypanosomiasis among pastoralists or small-scale mixed farmers are many and diverse because of the multiple functions of livestock in these livelihood systems. They include milk and meat for a household's own consumption; cash through sale of livestock or livestock products; manure; draught power; social values; and the costs of treatment with trypanocides. These functions will be ranked very differently in different livestock-producing societies (tsetse.org 2014). Thus, the impacts of the

[1] Vivax - a protozoal parasite and a human pathogen; tabanids - flies of the family of *Tabanidae*, eg horse flies: evansi - protogoan trypanosome: and equiperdum - a protozoan parasite.

animal form of the disease can also be devastating for the affected households and livelihoods. This has implications for poverty levels as it is estimated that one third of the continent's agricultural Gross Domestic Product (GDP) is obtained through livestock production and in Zambia it is worth over US$1.5 billion, with approximately 50 per cent of the rural population depending on livestock for their livelihood (Government of Zambia 2012). This sector has experienced steady growth in recent years, growing between seven and 10 per cent annually (Muntanga *et al* 2012). Despite this, huge potential for development of the livestock sector in Zambia has been stifled by barriers, including livestock disease outbreaks. Significant economic as well as health gains could be realised in Africa through control of production-limiting zoonoses, including trypanosomiasis.

2.1. History of trypanosomiasis in Zambia

Trypanosomiasis has been endemic in wildlife in Zambia for more than a century. It is widespread in the Eastern and Northern Provinces as ecological factors, including climate, rainfall and vegetation, in these areas allow a favourable interplay between wild reservoir hosts and vector tsetse flies (Munang'andu 2012). This may have been amplified by Government conservation strategies aimed at turning all game reserves into state-protected national parks and GMAs. This section will now explore some factors that affect disease risk in this area, followed by an analysis of disease control efforts.

In terms of land cover, Zambia has a vast wildlife estate encompassing 20 national parks (64,000 km^2), three wildlife and bird sanctuaries (33.5 km^2), 36 GMAs (167,000 km^2) and several other protected area categories, comprising equivalent to 40 per cent of the nation's land area (Government of Zambia 2010). GMAs differ from national parks in that they are zoned for wildlife utilisation, mainly hunting, and also allow human residency, and there is a large and expanding human population in many of them, which is accompanied by widespread habitat loss (Lindsey *et al*. 2014). However, in both zones wildlife is, by the Zambian constitution, the property of the state, and hunting in GMAs requires expensive licences. The Wildlife Act 1998 fails to recognise communities as the rightful owners of the land or wildlife in GMAs, despite some laws in the 1980s introduced to partially decentralise authority over wildlife to communities (Fernandez *et al*. 2010). This denial of access to animals used for protein causes negative feelings towards Government wildlife policies among local residents (Lewis *et al.* 1990).

There are differing views on trypanosomiasis risk in this area, some have claimed that these policies have led to an increase in wildlife and tsetse and the area now has the highest tsetse population density in southern Africa (Munang'andu 2012). However, these statements must be questioned as there is little or no evidence to support this. Others claim that habitat destruction is exacerbated by shifting agriculture, charcoal production and, in some cases, mining (Simasiku *et al*. 2008; Lindsey *et al*. 2014). In both national parks and GMAs, wildlife is under immense pressure from poaching for bushmeat and for trophies such as ivory, and data from aerial censuses indicate that wildlife populations in Zambian protected areas are relatively low (Becker *et al*. 2013; Lindsey *et al*. 2014).Therefore, there is evidence that the conservation policy has likely not been very effective, and certain wild species may have declined, although monitoring has been too inadequate to know for sure. In addition, change in tsetse densities may not be great as the Luangwa Valley has had among the highest tsetse densities in southern Africa since before the creation of game reserves.

The risk of trypanosomiasis is increased by migration of people and their livestock onto previously untouched tsetse-prevalent land, as well migration into GMAs which generally had low human population densities with livelihood strategies that did not involve cattle. These alternatives to livestock keeping which have been used successfully in the Luangwa Valley by local inhabitants, for example the Bisa, are threatened by outsiders that are introducing cattle and new agricultural practices into tsetse areas. This potentially adds to marginalisation of local inhabitants. However, some anthropogenic activities potentially reduce the tsetse and wildlife habitat in the area because

when woodland savannah is cleared and land is burned for livelihood activities, tsetse and wildlife retreat due to loss of habitat. This interaction is described further in the environmental section of this paper. Nevertheless, this transition period is particularly risky as the flies are still prevalent and opinions on the best course of action are extremely divided. Given the wide host range of species, the Luangwa and Zambezi valley ecosystems are likely to sustain trypanosomiasis for a long time.

2.2. Trypanosomiasis control

Efforts to control trypanosomiasis have varied in intensity over the past hundred years since they became institutionalised in the colonial era. During that time, trypanosomiasis control was a priority issue and around a quarter of the colonial research budget was focused on sleeping sickness control through major treatment campaigns for people, or wider efforts to push back the fly belts (Rogers and Randolph 2002). The need for a One Health approach was apparent even then, as the differing approaches of the French and British showed a lack of multidisciplinary thinking, with the British focused on tsetse and the French on medical issues (Scoones 2014). Since this time, there has been no major progress in One Health thinking and commitment levels in terms of financing have waned. Trypanosomiasis is now classified as a neglected disease, considered lower priority than other global health problems (Aksoy 2011).

Despite the lack of historical use of multiple approaches, trypanosomiasis could be dealt with effectively using a One Health approach due to the complex, interacting factors affecting its prevalence. The different fly vectors are highly dependent on particular habitats for their survival, and so ecological and land-use change have major impacts on fly populations and the associated disease risks (Scoones 2014). This is a major issue in Zambia as farmers move into previously uninhabited land to start cropping, particularly cotton farming. They are changing the land use and bringing their cattle into areas where they have not previously lived. This transition period is a risky time for the farmers. The flies are still prevalent because enough of their habitat remains, and humans and cattle have moved into a new area and are vulnerable to infection, particularly where they must enter the risky areas to gather resources. This area is also home to wildlife and many game reserves, and equally the probabilities of infection by cattle and people are influenced by the presence and distribution of hosts, including wildlife. Therefore, disease dynamics are affected by ecology, but also the social, economic and cultural habits of people and their livestock.

This complex system of interacting environmental, human and animal health components, each operating in ways that are highly dynamic and uncertain, is exemplified in the Zambia situation. This paper will now continue to analyse the different perspectives to this situation. Interventions are difficult to design and, as the different narratives show, are open to controversy about which offer the best control. The example of trypanosomiasis in Zambia can be applied more widely as Africa is a relevant continent for the examination of One Health policy, particularly for the control of endemic and neglected zoonotic diseases (Okello *et al*. 2014). Some of the most prominent examples of disease spillover from animals, including HIV, Rift Valley Fever and Ebola, have occurred in Africa.

This paper argues that One Health is theoretically and economically a useful approach, but significant political will and state capacity is required to overcome existing institutional and financial barriers to its implementation. This is particularly the case in developing countries, where numerous health and development priorities compete for attention and programme funding. In Zambia, institutional structures and capacity are not set up to work in a One Health way and, in the absence of a specific disease threat, cooperation between international organisations and different government departments is hard to find. The argument for inter-ministerial platforms to coordinate policy and action for zoonoses control is well founded (Okello *et al*. 2014). Additional barriers in the Zambian context to adopting a One Health approach are competing narratives and the resulting ideas on control options as well as funding issues.

3. Political structure

The interviews conducted confirmed that there has been a failure to manage how things should be done on the ground, and there have been several changes to the system and political structure which affected tsetse control and environmental and local policies and organisation. 'From the 1970s until now there have been no rules about what people can do in rural areas. People do whatever they like and take land, shoot animals, burn trees and there's no effective system to manage them. This is having grave ecological effects.' (Interviewee)

Examples of these effects include destruction of the black rhinoceros and significant reduction of the elephant population (Douglas-Hamilton 1987). From the 1960s interviewees commented that:

> In Zambia there was a native autonomy system based on local chiefs, and then when [Kenneth] Kaunda came into power in 1964 he wanted to get rid of chiefs and replace this with village development committees affiliated to the party. This replaced traditional power structures with political ones but this did not work well.
> (Interviewee)

Kaunda was the major figure in Zambian politics from 1964 to 1991. He led the United National Independence Party (UNIP) and the fight for independence, and successfully bridged the rivalries among the country's various regions and ethnic groups. Until 1972, there were three significant political parties, but in February 1972 Zambia became a one–party state and other political parties were banned. Kaunda, the only candidate, was elected president in the 1973 elections.

Increasing opposition to this situation led to the rise of the Movement for Multiparty Democracy (MMD) in 1990. Kaunda initially agreed to a referendum but he was further pressured and signed a constitutional amendment for a multi-party state. Zambia's first multi-party elections since the 1960s were held in 1991. MMD candidate Frederick Chiluba won the presidential election over Kaunda with 81 per cent of the vote.

> This new multi-party state led to another change in the political structure and there was a proliferation of committees, different committees for every different area of life. However it is always the same people on each committee, and they need to harmonise them in order to make them effective.
> (Interviewee)

In 2001, MMD presidential candidate Levy Mwanawasa won the elections by a narrow margin and remained president until his death in 2008. Interviewees described this time as a period of mismanagement:

> In the mid-2000s it was really wild. The Chinese came in and they went everywhere and exploited the system and lack of controls and oversight. It is really bad. They use chainsaws to mow down entire forests in a week. They get licences from headquarters which are corrupt and no one can stop them once this has happened. The forestry department is corrupt.
> (Interviewee)

After Mwanawasa's death, the Vice-President Rupiah Banda succeeded him temporarily until an election later that year which he won by a narrow margin. More recently, Banda lost re-election in

2011 to Michael Sata of the Patriotic Front, bringing an end to a total of 20 years' rule by three presidents from the MMD. Currently:

> The Government are putting in the local structures and have been trying to do this for 10 years. It's only this year that it's become effective at the sub district level'. 'With funding being distributed regionally, this has a huge impact on tsetse control and any recommendations and planning from trypanosomiasis must take this context into consideration. In addition, the spreading of financial resources to as many cost centres as possible has resulted in finances being spread thinly with little impact on tsetse and trypanosomiasis control.
> (Interviewee)

4. Views on tsetse and trypanosomiasis

Stakeholders' varying views of trypanosomiasis are at the heart of the different disease narratives in Zambia. International organisations, the cotton sector and most other stakeholders focused on animal trypanosomiasis rather than human trypanosomiasis, and so the focus of this paper is often on AAT rather than HAT. The main emphasis from the interviewees' responses was the disease's economic impact on the country and the agricultural sector. This single focus seemed prevalent, rather than a holistic take on the issue. The tsetse control and ecology section of Government stated. 'The major emphasis is on cattle, this is the biggest threat. Most cases of human trypanosomiasis are not confirmed. The Ministry of Health deals with these, we don't look into this. Our big focus is that tsetse-free areas stay tsetse free.' (Interviewee)

In terms of One Health working this seemed limited to occasional contact. 'We collaborate with the Ministry of Heath but our role is limited to animals. If we get human cases then we work with the Ministry of Health, University of Zambia (UNZA), Tropical Diseases Research Centre and scientific research organisations. We all meet together from time to time to exchange notes.' (Interviewee)

This collaboration could be expanded if trypanosomiasis and its affects were looked at from a One Health perspective.

The tsetse control and ecology section, and also the cotton industry, in particular focused on the poverty narrative. They believe that it is in the economic interests of farmers to expand the areas within Zambia that can be used for animal rearing and they want to help this process as it will be beneficial for people. It was noted that:

> […] there are very few operations going on though. We can only treat the animals, but it would be much better to control the vector of the disease, but we do not have the finances. The fly population has been expanding. In the south, areas that were once tsetse free are now tsetse infested. This is a great shame as these were previously very productive cattle-rearing areas.
> (Interviewee)

The Tsetse Section, part of the Government Veterinary Department, explained the importance of this:

> When the fly spreads to these areas, people and their livestock are forced to move out to relatively tsetse-free areas, thereby rendering such areas unproductive. People have to move away into marginal and unproductive areas. This means that poverty increases and livestock numbers go down. This is a vicious circle and poverty will go up if people cannot own livestock. Livestock is very critical for livelihoods for the following reasons. First, livestock act as a buffer in times of need as they can be sold for cash. Second, livestock provide draught power for ploughing fields and transportation of produce and farming inputs. Third, livestock produce manure to fertilise crops, and, fourth, livestock can be used as a source of protein through provision of meat and milk. Without them farmers will be poverty-stricken and dependent on the Government. They need help and are dependent on food relief. Fertile areas become no-go areas because of trypanosomiasis. If we don't deal with this problem we will depend on donors to feed our citizens.
> (Interviewee)

Critics of this approach state that there is insufficient evidence of tsetse or wildlife expansion due to a lack of data and monitoring, so it cannot be concluded that Government policy has had such an impact. In addition, many other stakeholders indicated a belief in the wider health narrative, stating that:

> The main health problems are HIV and malaria. Trypanosomiasis isn't on the radar. Desmond Lovemore got rid of the tsetse and lots of cattle were moved into the area. The Zambian Government do not have the resources to keep areas tsetse free and we should focus on more prevalent diseases.
> (Interviewee)

When we interviewed hunters and those working in the hunting industry, and environmentalists and environmental activists, they maintained the protection narrative perspective that 'tsetse are keeping the area natural and wild.' (Interviewee) One interviewee stated:

> Tsetse are still the biggest obstacle to wild areas being taken over by farmers and cattle. Tsetse protect the environment and stop farmers encroaching on land so I don't want tsetse control. Farmers move into areas and then hit the tsetse zone and cattle die. This protects the land. The flies move though, so this affects the way things operate.
> (Interviewee)

Others, for example hunters, believe wildlife are unaffected by trypanosomiasis and that, 'all the policies are about economic revenue for the veterinary department for disease control. There is unregulated informal trading going on in the background, only big industry has to get permits and do things properly, it is a money making scheme. They charge for the tests.' (Interviewee)

They believe much Government policy has been bad economically for hunting in the country. For example, the recent law (in early 2013, a moratorium was imposed on hunting in GMAs making hunting on state land illegal, Lindsey *et al.* 2014) means fewer people visit Zambia as they do not want to hunt in game farms. 'Less people come to Zambia because of this. This is the big issue, not sleeping sickness; sleeping sickness does not affect tourism.' (Interviewee)

5. Views on control

These differing views on the importance of trypanosomiasis mean there has been, and there remains, great controversy about how to control the disease, and on what it is best to focus. Methods and views depend greatly on the narrative and perspective of stakeholders. The scientific community has debated these issues since tsetse and trypanosomiasis control became institutionalised in colonial times, but the validity of these debates is often not what drives policy and programming. Therefore, the focus of this paper is the views on control in Zambia by stakeholders involved in decision making, lobbying and industry.

The history of trypanosomiasis and other diseases goes some way to explain policy and decision making in relation to control options, and also shows the grave effects control options can have on the population. Elimination of wildlife was once seen as a favourable policy due to the 'Great Rinderpest Epizootic' of 1889–1897, which reached Zambia in 1892 and which contributed to the decline of the wildlife population and a significant reduction in tsetse distribution, bordering on eradication from extensive areas (Van den Bossche *et al.* 2010). Eastern Zambia was mainly free of tsetse, making cattle rearing more viable in the Luangwa valley towards the end of the nineteenth century. Around this time, from 1897, the first game reserves were set up by the British to, 'save Africa's game,' due to the destruction of wildlife by disease (Vail 1977). This greatly affected poverty levels, as laws preventing the hunting and trapping of animals and forbidding the sale of gunpowder to Africans were made at the same time as their cattle had been killed by disease or seized, cutting off livelihood options and causing poverty (Vail 1977). This illustrates the economic and community benefits gained from wildlife.

Despite these outbreaks, small, relic populations of tsetse survived and spread into suitable areas once hosts became available due to the quick repopulation of wildlife. This led to an increase in the tsetse population density in the Luangwa valley, which then expanded southward and eastward on to the plateau areas, resulting in new outbreaks of bovine trypanosomiasis (Munang'andu 2012). In a good example of how policy is made based upon the experience of recent history and also showing the competing aims of different groups depending on whether their focus is disease control or wildlife protection, the Government of Northern Rhodesia blamed the wildlife movement for this outbreak, and they created the Department of Game and Tsetse Control in 1942. The main aim assigned to them was to eliminate the wildlife hosts of tsetse as a control strategy. There was public opposition to this strategy and it was abolished in 1960.

Wildlife groups still criticise what has been done in the past to control tsetse and trypanosomiasis. For example the policy of introducing game fences following the recovery of game and tsetse fly, after the previously described outbreaks which left these areas under threat. One interviewee disparagingly referred to this policy as ineffective, stating that there were, 'game and cattle fences where […] a hunter [was] stationed every mile to unnecessarily shoot everything that came over the line' (interviewee). There was also some anger at a failure to use evidence available at the time showing this.

> A German vet took blood samples from the tsetse and this opened up a new world. He worked out which animals the tsetse feed on. The G. morsitans on warthogs and the G. pallidepes on bushbucks. Nothing ever feeds on some animals, e.g. baboons, so shooting all these animals was irrelevant as the tsetse didn't feed on them.
> (Interviewee)

However, there were other experiments in Zimbabwe including the Nagupande experiment. Nagupande, in the western part of Zimbabwe, was the site of an experiment where only four species of animal were shot: warthog, bushpig, bushbuck and kudu (Hargrove 2003). Good control was achieved but it was not sufficient for eradication of tsetse, regardless of the desirability of the method. This showed that selective culling fails to control tsetse as they simply change host. In other words, host preferences are not as strong as early authorities believed (Hargrove 2003).

Barriers were instituted to contain wildlife and flies, and some attempts were made to reverse the reinvasion and prevent the expansion of the wildlife population. Several people agreed with the interviewee who stated that, 'tsetse barriers only have a social function, like a marketplace, and they are also a reference point for people, but there is no use or point of them for tsetse flies. Fly gates are completely useless and are only there so people can show that they are doing something.' (Interviewee)

Despite this, fly gates still nominally exist in Zambia today, with one interviewee stating that he had stopped a guard at a gate and was told they had only found one tsetse fly this year. Research has also acknowledged the technical difficulties and expense associated with the construction and maintenance of the barriers which were not totally effective due to the subsequent reinvasion of tsetse in the reclaimed 'tsetse-free' areas. The advent of new control technologies subsequently led to a reappraisal of tactics (Alsop 1993).

By 1968, spraying using endosulfan began. Odour-baited targets were introduced to reduce tsetse infested areas in 1970. Together, game fences, aerial spraying, bush burning, and use of odour-baited targets all aimed to reduce the expansion of tsetse further away from the Luangwa and Zambezi Valley ecosystems. These control strategies were confined to communal areas, while in the national parks in the valleys wildlife and tsetse were left to interact freely (Munang'andu 2012).

During the interviews we ascertained current views on control. The Tsetse Section, coming from a poverty narrative believe that eradication of the tsetse fly is key and that, although there are effective methods to do this, it is impossible with the financing available. They believe that,

> The best method for dealing with tsetse is aerial spraying–this is very expensive but very effective. Targets work quite well but they only suppress the fly. When you go for control you go back to where you started from. We need to eradicate the fly, so we can clear areas and do surveillance. We really want to start aerial spraying in the next few years. We want to do 5,000 sq km to 10,000 sq km annually. We just need to get the funding to do this.
> (Interviewee)

They believe it is necessary to utilise tsetse free areas because keeping them productive for livestock rearing and farming helps to stop the fly thriving, 'if an area is eradicated from flies, we must use it to ensure it stays tsetse free.' (Interviewee) The Tsetse Section of the Government Veterinary Department has a three-year strategic plan but not the funding to implement it. Most other interviewees also agree this is the most effective method, but warned that, 'if you leave any pockets of tsetse, you would experience re-infestation.' (Interviewee) International organisations mentioned that they support the use of insecticide-treated targets with nets to clear the flies and ensure no reinvasion. This can reduce the tsetse population to one per cent and chemotherapy reduces trypanosomiasis in animals. Other issues include that, 'in the southern province there are huge herds of animals and due to sporadic disease outbreaks, there is need to impose a ban on movements. Difficulties faced stopping these movements […]reflects some form of failure at senior level.' (Interviewee)

Everyone interviewed stated that at the moment it is only the Government trying to clear tsetse, no outside organisations are working in this area. Many were critical of this Zambian narrative emphasis and felt that more funding was needed. 'Another issue is that retired professionals have not been replaced. These were people that were highly regarded. There is a big human-resource issue in trypanosomiasis control.' (Interviewee) The only Government motivation for control is to clear the tsetse so they can use the area for settlement and for cattle. It was suggested that, 'Population growth is one of the main drivers – if not the driver – of what's going on.' (Interviewee) Some issues and unintended consequences of this approach were described. For example: 'If the trees are cleared then you get grasses. This is the main diet of the warthog, so if you get more grasses then you get more tsetse as they like warthogs.' (Interviewee). Animal host species are important to consider when making policy decisions, as some host species are widely distributed while others are highly restrictive in their habitat requirements and frequently hunted. For example, the warthog is a widely distributed species in the Luangwa and Zambezi Valleys and it is one of the major sources of blood meals for tsetse, while others animals such as crocodiles and hippopotamuses are highly restrictive in their habitat requirements and are not commonly associated with trypanosomiasis (Munang'andu 2012).

If land use is changed, for example by clearing forested areas to provide land for cotton growing as sanctioned by the Government, it can be a control measure in itself as it disrupts the ecosystem needed to provide a habitat for the tsetse. The cotton sector emphasised that:

> There have been changes to the environment. Cotton growing has increased. This means that vegetation that supports the fly and where it lives goes away and is replaced by farmland and this pushes the fly away. There is a link between an increase in farming and fly reduction. With new settlements, the fly is pushed further away from people. There is less trypanosomiasis now because the flies have gone.
> (Interviewee)

There were further critics of the Zambian narrative, who explained that, 'projects can keep systems going but when they leave everything stops working. When donor funding runs out and everything is handed to the Government it stops functioning. The history of livestock development is better when there is external help.' (Interviewee)

Another criticism of government management was that, 'in Zambia they do big schemes and if they don't work then they just carry on. There is no evaluation.' (Interviewee) However, those advocating the Zambian narrative emphasised the need to look at how disease control priorities affect communities. As an example:

> They used the national parks legislation which came at the same time as tsetse control. Both came from outsiders and had colonial influence. Neither is Zambian. Hunters wanted to protect the land and their businesses and this is why the national parks were made. It is useless for outsiders to come in and say, don't use the trees. Local people know the importance of not depleting their resources and they have the knowledge to protect them and not overuse. Outsiders do not have this knowledge. Zambians need to develop policies and know what is best for Zambia.
> (Interviewee)

Those coming from a protection narrative actually seek different funding and control options to protect the land, therefore potentially keeping the tsetse population high. While conservation of wildlife and biodiversity is an important preservation strategy of natural resources, it could serve as a long-term reservoir of wildlife trypanosomiasis because, it has been pointed out, the principal factors that influence tsetse populations are host availability, climate and vegetation (Robinson *et al*. 2002).

Current conservation strategies, such as those aimed at reducing poaching in order to increase the wildlife population in these areas, favour enrichment of the wildlife/woodland savannah/tsetse ecosystems that sustain the persistence of the disease. Other Government policies, including turning all game reserves into state-protected national parks and GMAs, have led to the expansion of the wildlife and tsetse population in the Luangwa and Zambezi valley ecosystems, leaving it with the highest tsetse population density in southern Africa (Munang'andu 2012), with potential serious consequences for people living in this region.

6. Funding

Funding issues are looked upon differently by each of the different narratives. This is has a major impact on how much work can be done, and what kind of interventions are possible. The international organisations, generally looking from the Zambian narrative, believe that the Zambian Government should have the power and responsibility to decide how to use funding and that international organisations are simply there to support what the Government wants. However, with this power comes the responsibility for decision making and finding funding for control of diseases, including trypanosomiasis. This seems in part to be a justification for withdrawing funding and the gap does not seem to have been filled by the Government.

From 1986 donor assistance towards control was directed through the Regional Tsetse and Trypanosomiasis Control Programme of Malawi, Mozambique, Zambia and Zimbabwe. This programme operated under the Southern African Development Council funded by the European Commission. The original objective of the regional programme was to eradicate tsetse from the common fly belt (Jordan 1985) and the control methods were initially aerial spraying, then later odour-baited, insecticide-impregnated target technology (Vale *et al.* 1988), with targets progressively deployed to 'roll back the carpet' of tsetse. However, in the years since, economic instability and donor fatigue have led to a shortage of operational funds, resulting in a swift decline of available resources. This, combined with a relative lack of success in 'area-wide' control, has resulted in a change in emphasis from widespread eradication towards smaller-scale, community-based interventions that require disease management rather than purely vector control (Robinson *et al*. 2002). Soon after the initiation of the community control programme activities began to decline and eventually closed down (Robinson *et al*. 2002). This seems to be partly due to restricted finances and a belief in a need to focus on the wider health narrative, as well as international donors passing over the responsibility to the Zambian Government.

This was confirmed by the Tsetse Section, which explained that in the past they relied on donor funding but the projects have all come to an end.

> By 1992 a lot had been achieved but funding ran out and the project was handed over to the Government. An example, which shows the dwindling interest and funding, is the fate of one of the projects which was funded by the European Union. It was a trypanosomiasis and tsetse control programme and aimed to eradicate the fly from the common fly belt. It involved Zambia, Zimbabwe, Malawi and Mozambique. Then this programme changed to control rather than eradication of the tsetse fly and subsequently trypanosomiasis, and after this it was stopped altogether. The EU pulled out. The Dutch Government did fund a three-year project after this. We had funding until 2006 from the Zambian Government then this came to an end. Now we can only do surveillance. We try to target the vector with very little funding, but it's hard. It is hard to undertake sustainable tsetse control under these conditions and the Government can't fund programmes adequately … This means that areas where the fly was eradicated have become populated by tsetse flies again. We know of better control methods but we can't afford to use them.
> (Interviewee)

This lack of government funding causes frustration to those within the ministries in charge of dealing with trypanosomiasis as, considering the issue from the poverty narrative, they believe trypanosomiasis affects livelihoods and causes poverty. They believe funding issues to be a major problem and explain that it is a challenge to provide services to farmers, where a quarter of the animals – totalling 500,000 animals – have trypanosomiasis. Additionally, only 30 per cent of the

budget they asked for was approved, and they only received 10 per cent of this. This affects the control options available to them and they cannot meet their obligations for control, instead they have to rely on surveillance. There are a few other options for funding and the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) is active in Zambia. There is a PATTEC coordinator for Zambia whose work is captured under the Government's national strategic plan, and is also trying to obtain funding from the African Development Bank.

Another issue brought up by interviewees was that government funding is now on a regional basis. Funding is decentralised down to the lowest level. This has resulted in spreading of meagre financial resources with little impact on tsetse and trypanosomiasis control. As mentioned above, the local political structures are not effective at managing programmes and enforcing regulations about what is done with the land and animals, with important disease, ecological and poverty affects for the rural population. As stated by an interviewee of the tsetse control section: 'This makes implementing tsetse control programmes difficult as you are at the mercy of regional decision making; it makes it very difficult to make an impact'.

Challenging the perspective that more funding is needed for trypanosomiasis is the wider health narrative, which is argued by several groups. They state that Zambia has multiple health issues. As many people do not know about trypanosomiasis they do not feel that the available limited funding should be focused on this area. Government priorities, they say, should be on prevalent diseases, such as HIV/AIDS and malaria, and increasingly people focus on cancer and lifestyle diseases such as diabetes and high blood pressure. During the interviews it was mentioned that the diseases focused on,

> […] are not based on research but on the issues important to those in power. For example, when the president's son died of AIDS, it was talked about more and there was lots of donor funding. People are interested in whatever issue donors want to give money for. The donors control what issues are seen as important.
> (Interviewee)

It was also mentioned though that if people have a fever they automatically say it is malaria. Trypanosomiasis is not publicised or talked about. Some even questioned if it really exists in humans. 'If you asked urban people about trypanosomiasis they would not know about it.' (Interviewee) This may be affecting the narrative that Trypanosomiasis is not important. The disease is neglected because people are ignorant about its affects.

An alternative view is held by those coming from the protection narrative. They believe the disease is protecting the forests from being invaded by people and livestock, and they support the policy decisions resulting from those holding this belief which is based on inaction around eradicating the disease. They cited the effects of deforestation for charcoal, poaching and killing of wildlife, and destruction of the natural environment as areas that were being protected by a lack of funding on trypanosomiasis.

Everyone seemed to agree that trypanosomiasis control used to be higher on the agenda than it is now, better funded and the subject of more programmes. Most people looked to other countries, especially Zimbabwe, and felt these had a better model for dealing with the disease. There is currently a tendency for responses to be reactive to crises. The Tsetse Section felt that Trypanosomiasis is regarded as, 'a forgotten disease because of the way it manifests. It takes a long time to see any effects, whereas other diseases you see [effects] straight away. Trypanosomiasis is chronic. Therefore it has not gotten the attention it deserves.' (Interviewee)

During the interviews this was confirmed by those working for international organisations. They emphasised that should there be a disease outbreak, extra funding is available to assist. As each new disease threat emerges, prior threats are easily forgotten.

However, planning and long-term strategies for disease control are key. Resources also need to be made available to control and manage endemic diseases, even when the threat is not visible. Many diseases are possible to control if this advice is followed. An example of this is the management of brucellosis in livestock. In most developed countries, programmes, compensation and financial incentives for disease-free herds have more or less eliminated the disease, but in developing countries it remains a neglected endemic zoonosis (Grace *et al.* 2013). There needs to be greater multidisciplinary working, considering all the sectors that need to be involved in management for diseases of global importance. Investments need to be made with general, rather than specific, disease use in mind. This will save money and resources and, as clustered diseases are easier to control, transform geographical weaknesses into strengths. International platforms and structures need to be strengthened and funded to enable cross-country working. With their remit broadened, they could establish the basis needed for surveillance and management of both endemic and epidemic disease.

7. Poverty alleviation

As shown in previously in this paper, trypanosomiasis control is believed to be an important contributor to poverty alleviation by those coming from the poverty narrative. Trypanosomiasis has a disproportionate impact on poor people.

> When the fly spreads it stops areas being productive. People have to move away into marginal and unproductive areas. This means that poverty increases and livestock numbers go down. This is a vicious circle and poverty will go up if people can't own livestock. Livestock is very critical for livelihoods. Without them farmers will be poverty stricken and dependent on the Government. They need help and are dependent on food relief. Fertile areas become no-go areas because of trypanosomiasis. If we don't deal with this problem we will depend on donors to feed our citizens.
> (Interviewee)

Those coming from the poverty narrative believe in moving people on to tsetse-free areas to utilise the land and keep them tsetse free.

Others pointed to further issues outside this debate within Zambia which affect poverty alleviation more. These come from the wider narrative, and a belief in connectivity in the same way as One Health, and the need for multidisciplinarity and sectors working together.

> We could become prosperous if we could sell beef. People could help themselves. There is unrealised potential of beef and livestock. However, there is no motivation to want to move on from traditional herd management to record keeping, dipping, vaccinating, cross breeding […] there is no one to change them to the modern way of thinking. Disease cannot be stopped by being bought. It knows no corruption.
> (Interviewee)

The Cotton Association of Zambia pointed to services that the land could provide to help improve poverty levels, but blamed big industry and the international system for this not being possible.

Some examples of more complex issues, beyond trypanosomiasis, include, according to one interviewee:

> Animals can be fed leftovers from cotton production but the farmers can never buy this as they can't separate it from the cotton at farm level. This waste product from the cotton would be really useful for the farmers. We could have active villages within the cotton industry. We need oil-extraction plants. We could crush the cotton seed for cooking oil and have the cake. This is sold to big dairy companies. Smallholders don't have access to it. When they sell it they get a premium of 10 cents, but this doesn't come back to the farmer.
> (Interviewee)

Another interviewee said, 'Zambia was paid the lowest price for cotton, Malawi got better. Farmers got 24 per cent of the value of the crop. The Government isn't useful for helping with these issues.' Additionally:

> The textile industry has collapsed […] All the cotton is exported to other countries with little or no value addition[…]Farmers' children cannot get jobs but cotton has produced jobs for the next generation in Bangladesh. The textile industry is high-tech and too expensive to set

> up. The Chinese control the international cotton market. Bangladesh produced fabrics and the cotton growers in Zambia have to wear second-hand clothes even though they produce the cotton.
> (Interviewee)

These issues point to a belief in a fundamental need for change, not something that can be solved on a project-by-project basis. 'Multinational companies are powerful and we depend on their honesty and transparency. Farmers are not happy with the prices. There is volatility of prices and farmers can't understand why they are different one year to the next.' (Interviewee)

Examples were also given of how disease affects cotton farming, and of the interconnectivity between livestock, farming, health and poverty.

> When livestock disease strikes, a lot of farmers lose out and hectares of cotton grown is reduced because farmers do not have cattle to till the land. If you have more cattle it is easier in terms of labour. If you don't have them then you have to rely on tractors which are expensive and difficult to maintain. If an animal falls sick from anything then you get a lower cotton yield and are forced to reduce the hectares you can grow on.
> (Interviewee)

The link with other diseases was also made clear. For example, 'HIV/AIDS is an important health issue. If the husband is sick then the woman can't go and work in the fields as she has to look after him. If the woman gets sick and dies then you lose the cotton producer. So both is bad. If you lose a woman to any illness then you lose a cotton farmer.' (Interviewee)

Thus the livelihoods and poverty levels of households are affected.

Those from the protection narrative also believe that eradicating the tsetse fly is not key to poverty alleviation. Instead, people and animals should be kept away from uninhabited land, which should be protected and left to wildlife. Some coming from this perspective have financial gain in mind, for example, from hunting and tourism, while others are environmentalists. In reality, the link between humans, animals and the environment is key, as the welfare of each is interrelated with the others. In many areas, for example the Luangwa valley, the population depends on wildlife as a source of their livelihood, particularly in the form of illegal hunting and poaching. In the 1940s ownership of wildlife changed from traditional to state control. Now, in both GMAs and national parks wildlife are constitutionally the property of the state, and hunting in GMAs requires expensive licenses, restricting traditional hunting. This has led to an increase in the wildlife population in the area despite continued poaching from local tribes. However, legal denial of access to protein resources causes negative sentiments among local residents towards Government wildlife policies and has not helped the poverty levels in the area (Lewis *et al.* 1990). Related to this issue is that, as a result of hunting, many wild animals retreat to the national parks, accounting for the high density of the tsetse population there. However, low human population density in the valleys (10 or fewer persons per square kilometre) means there are not high levels of competition for natural resources between humans and wildlife, so they also have a tsetse population density nearly as high as the national parks (Munang'andu 2012).

8. Environment

There are further examples of how disease and poverty are intricately connected with environmental issues and ecosystem services. Due to the political structure in Zambia the use of ecosystem services is not regulated. Increasing population growth, along with internal migration to new areas, has led to increased pressure on ecosystem services, with resulting effects on the environment, disease and livelihoods. Government motivation for clearing the tsetse is affected by population growth and the need for more areas for settlement and for cattle. Additionally, in terms of the focus of those in power it was mentioned by interviewees that the Government overrode the Environmental Council's decisions and cared more about disease control than environmental issues.

However, there are examples of policies aimed at environmental protection which have affected disease levels adversely. These include a 1972 government policy to turn game reserves into national parks. The aim of this was to decrease illegal hunting and develop conservation strategies in order to recover the lost wildlife population (Munang'andu 2012). However, another effect of this policy has been to increase food for tsetse flies, meaning that the Luangwa and Zambezi valley ecosystems have the highest tsetse population density in southern Africa (Munang'andu 2012; Robinson *et al*. 1997). This area is a good habitat for the fly but was not heavily populated. However, another policy, in 1978, led to the creation of GMAs surrounding the national parks, which meant humans and wildlife lived in the same area, leading to, 'collision of the expanding tsetse fly belt with the expanding human population' (Buyst 1977). This made trypanosomiasis a threat to livestock and humans in the boundary areas and has been described as one of the three main reasons for the occurrence of endemic sleeping sickness in the Luangwa valley, alongside a lack of game animals in the northern edge forcing tsetse to feed on human and game movement patterns. This means that tsetse thrive and increase in numbers in the rainy season but then starve in the dry season leading them to accumulate in villages and depend heavily on its residents (Buyst 1977). This change is important as cattle potentially have a role in maintaining tsetse populations. Tsetse will feed readily from cattle and if cattle densities become high enough there will be no need for wildlife to maintain fly populations.

There are ways in which local people's activities reduce the tsetse population too, pushing back against nature. Human encroachment of protected areas in Zambia is worse than in most other African countries, and 2,500–3,000 km^2 of land are deforested annually (Lindsey *et al*. 2014). Deforestation due to charcoal extraction, clearing of land for cultivation and livestock production, burning for wild honey collection, and hunting are contributing to loss of habitat for wildlife and tsetse (Lewis *et al.* 2011). When trees are cut down people plant cotton and conduct other livelihood activities, which have a resulting impact on tsetse, human and livestock populations, thereby affecting disease levels. Every interviewee stated that the biggest ecosystem issue is deforestation and that there was a need for, 'socially sustainable charcoal [...]and reforestation,' (Interviewee) which is increasing. Currently, it is exported to neighbouring countries, as well as urban Zambia, yet Zambia imports from South Africa. 'Zambia has one of the highest deforestation rates in the world and this is driven by charcoal.' (Interviewee) It is an urban fuel. 'Urban dwellers are driving deforestation […] people in urban areas are not connected to electricity so they use charcoal. The end users get the benefit but the producers make very little profit. There is not much economic benefit for them.' (interviewee)

This has been confirmed as an important issue by studies which have shown that more than 31,000 tons of charcoal is extracted annually in the Nyimba and Petauke GMAs (Lewis 2007). However, whilst often blamed as major contributors to Zambia's 0.3 per cent per annum forest loss, the largely undocumented charcoal and timber trade nevertheless makes meaningful contributions to

livelihoods and national income (Gumbo *et al.* 2013). Additionally, in the Chinsali GMAs, more than 21 per cent of the forest cover in Lundazi has been cleared for crop cultivation (Lewis 2007). However, this research still found that of the anthropogenic activities in the Luangwa and Zambezi valleys adversely affecting the ecosystem, illegal hunting is the most important (Munang'andu 2012).

Further land-use changes have an impact, include mining which brings roads and new people. This is what causes the problems, not the mining.

> For example, 3,000 people suddenly arrive and create a village with no clinics or services. These must be built. This will happen in lower Zambezi. If you have a project, then people are going to start a township and come with their families and start cultivating. This means that you'll never be able to get rid of them from the area afterwards. It fundamentally changes the landscape and mines affect local hydrology.
> (Interviewee)

Bringing people into new areas also affects trypanosomiasis incidence as people are more at risk when they move into tsetse prevalent areas which were not previously inhabited.

Another complex element of the ecosystem is wildlife which may be an ecosystem service, but can also be a disservice. Hunters and those in the wildlife industry pointed out the benefits of wildlife in terms of hunting. They were looking from a protection narrative and complained that, 'local people believe that the animals belong to the country, so they can use them. They believe that no one can own the animals' (Interviewee). However, in terms of government policy, as stated, the ownership of wildlife changed from traditional to state control in the 1940s. This is not well regulated and:

> Police often benefit from poaching so they don't prosecute people. There's corruption, and even though the law provides good punishment it is very seldom applied […] In African parks there's still lots of poaching and so there's constant problems. Private investors can help to rehabilitate and game parks bring millions of dollars.
> (Interviewee)

This has an impact, 'as poaching is so severe the Government buy and move animals from game farms to the national parks. This is very random wildlife management and not well thought through. There are no effective policies.' (Interviewee)

However, when we conducted some participatory workshops with local people in the Eastern Province, there existed what the villagers described as an effective anti-poaching system. Villagers said, that although there were a few areas with poaching issues, they do not hunt in the GMAs and one of the women in the village used to be a scout to try and catch those hunting there. She used to camp up to 10 nights at a time and if the group heard guns they would chase towards the poachers. It was mentioned what has been pointed out in other research, which is that, due to competition for space and resources, there is increasing interaction between people and wildlife which increases human-wildlife conflicts. Wildlife crop damage has a negative effect on rural food and livelihood security due to shortages of nutritional supplements and inadequate food reserves. This loss of crops often leads to negative perceptions of wildlife among farmers, potentially leading to retaliatory killings. Farmers' perceptions are, therefore, a critical social dimensional component of human-wildlife conflicts (Nyirenda *et al.* 2013).

The complex interplay between policies protecting wildlife and the environment, providing land for people and controlling disease, has led to close contact with wildlife and tsetse during many socioeconomic activities for the local people in the area, predisposing individuals to HAT. This is an issue not just for hunting, but also for other activities such as herding, fishing, collection of firewood,

producing charcoal and crop farming. Gender roles are often clearly defined and each gender has assigned duties such as livestock herding, fishing, crop farming, and collection of firewood. Culture determines learned social behaviour, occupation and knowledge, which are often gender-specific and could alter interactions between hosts, parasites and vectors, thus impacting on vector-borne diseases (Rutto *et al.* 2013).

9. Conclusions

Each of the narratives described in this paper have different perspectives on disease, development and the relative importance of environmental, health related, poverty related and economically influenced issues, or a combination of these, in affecting control options and, therefore, disease incidence. These compete in an environment where data on incidence and impact are uncertain, funding is limited and there are debates among the scientific community about the best course of action. Decision makers are influenced by the fashions of donors, scientific debates and the political environment. Recognising and understanding different perspectives is important and can contribute to the understanding of trypanosomiasis control decisions and their impact on disease, poverty and the environment.

It is clear from interviews and research that there are complex interacting factors affecting trypanosomiasis, supporting the need for joined-up working. This system of interrelated environmental, human and animal health components, each operating in ways that are highly dynamic and uncertain, is exemplified in this Zambian case study. The different fly vectors are highly dependent on particular habitats for their survival and so ecological and land-use change has a major impact on fly populations, and the associated disease risks (Scoones 2014). This knowledge has led to the conclusion that trypanosomiasis in Zambia could be dealt with very effectively using a One Health approach, with increased interdisciplinary collaborations and communications in all aspects of zoonotic disease management and policy involving those working for the benefit of humans, animals and the environment. This approach may be able to offer potential solutions through cross-sector working, in particular, the effects of policies by different government departments can be assessed for their impact on disease, so they can be managed to work in synergy. Especially in the context of reduced trypanosomiasis funding, a One Health approach can be of great importance to the health of populations as it can increase understanding and the economic benefits of sharing of resources. Additionally, as trypanosomiasis disproportionately affects the poor, poverty reduction must be integrated into policies and strategies. Too often, disease control impacts on people's lives and livelihoods are not assessed, and these may be greater than the costs of the disease. A One Health approach must be justice-based and incorporate a balanced assessment of the pros and cons of disease control.

While One Health is theoretically and economically attractive, significant political will and state capacity is required to overcome existing institutional and financial barriers to its implementation, particularly in developing countries, such as Zambia, where numerous health and development priorities compete for attention and programmatic funding (Okello *et al.* 2014). Broad institutional changes, capacity building and dissemination of information forming the evidence base on trypanosomiasis are required as well as inter-ministerial platforms to coordinate policy and action for zoonoses control. Cross-sector working ensures better preparedness and contingency planning, cost-sharing between sectors, increased health equity, and improved sharing of logistics and costs for service provision. Representations from different sectors in a One Health department, or similar forum which has overarching control over decisions related to land management in the human-wildlife-tsetse interface could be useful, but there are difficulties involved in enacting this. However, without such a structure different departments could end up in a power struggle, where those with ultimate power over different areas continue to act the way they feel is best, without considering the One Health approach. Additionally, there must be added value to working together and increased benefits for all sectors, and with appropriate management as suggested, this is possible.

Looking from some of the narratives identified in this paper, particularly the protection narrative, the Zambia narrative and the wider poverty narratives. It is clear that increased disease measurement

and surveillance from a One Health approach is essential. There is still a massive under-reporting of trypanosomiasis and without accurate information on disease burden and impact it is difficult for decision makers to plan and manage disease control, identify hotspots and allow for prioritisation. In the current funding climate this is especially important as areas identified as high risk can be focused on. This monitoring needs to shift from a focus on a disease to whole-system surveillance, looking at interactions between disease drivers, disease incidence at the community level, and poverty and equity impacts. A stronger evidence base could lead stakeholders to reassess their perspective and views on trypanosomiasis control. Although, even with this information, disease emergence is inherently uncertain and requires an approach centred on adaptive management, combining surveillance and careful experimentation. This better monitoring should allow increased understanding of the impact of policy options and greater motivation for control, as well as allowing narratives to be based on a solid evidence base (Grace *et al.* 2013).

To be able to achieve this, new organisational arrangement, diverse expertise and the direct involvement of local people affected are needed. The interviews conducted showed that the debate is centred on certain professional and bureaucratic interests, and that those living with the disease in poor and marginal areas have little or no say in what priorities are decided upon. Most mention of local people was centred around complaints about their impact on wildlife and the environment. However, assessing their interests is critical to the continuation of activities beyond the lifetime of projects and for providing incentives and guarantees that all, or a sufficient number of people, will contribute towards the creation of a public good (Mitti *at al.* 1997; Uphoff 1996). This assessment could be achieved through participatory approaches, especially in areas where detailed data sources are often unavailable. Until now, little attention has been paid to the possible gains from community participation as most projects are designed by veterinarians or entomologists with little, if any, input from social scientists. Some reluctance stems from fears of local populations changing the implementation of the technology in line with local objectives and understanding, away from technical advice. There appears to be little intention of addressing this shortfall (Barrett and Okali 1998). Even where there has been some local involvement and projects focusing on creation of local awareness about the issues, this has stopped short of including local communities' knowledge and expertise as evidence for decision making and involving them in policy decisions.

To be able to implement these recommendations, increased and better-managed funding is needed. Trypanosomiasis control used to be higher on the agenda, better funded and with more programmes. There is currently a tendency for responses to be reactive to crises, but trypanosomiasis is a forgotten disease partly because of the way it manifests. It is chronic and may take a long time to see any effects, although once the effects manifest they are severe and the lag is irrelevant. However, this could be a reason why it has not received the attention it deserves. Planning and long-term strategies for disease control are key. Resources also need to be made available to control and manage endemic diseases, even when the threat is not visible. Many diseases can be controlled if this advice is followed. There needs to be greater multidisciplinary working, considering all the sectors that need to be involved in management. For diseases of global importance, investments need to be made with general, rather than specific, disease use in mind. This will save money and resources and, as clustered diseases are easier to control, transform geographical weaknesses into strengths. International platforms and structures need to be strengthened and funded to enable cross-country working. With their remit broadened they could establish the basis needed for surveillance and management of both endemic and epidemic disease. To do this government funding is insufficient but there is a need to balance external agendas with national ownership of institutional change (Okello *et al.* 2014). Knowledge on disease control is available and we should not wait for a human epidemic to come before implementing these changes.

References

Aksoy, S. (2011) 'Sleeping Sickness Elimination in Sight: Time to Celebrate and Reflect, but Not Relax', *PLoS Neglected Tropical Diseases* 5.2

Alsop, N. (1993) 'A Review of Recent Approaches to Sustainable Control and an Analysis of the Potential of Modern Techniques for Large Scale Use', Chapter 15 in *A Systematic Approach to Tsetse and Trypanosomiasis Control, Proceedings of the FAO Panels of Experts*, *1–3 December 1993,* Rome: FAO

Barrett, K. and Okali, C. (1998) 'Partnerships for Tsetse Control—Community Participation and Other Options', *World Animal Review* 90: 39–46

Becker, M., McRobb, R., Watson, F., Droge, E., Kanyembo, B., Murdoch, J. and Kakumbi, C. (2013) 'Evaluating wire-snare poaching trends and the impacts of by-catch on elephants and large carnivores', Biological Conservation 158: 26–36

Brun, R., Blum, J., Chappuis, F., Burri, C. (2010) 'Human African Trypanosomiasis', *The Lancet* 375.9709: 148–59

Buyst, H. (1977) 'The Epidemiology of Sleeping Sickness in the Historical Luangwa Valley', *Annales de la Societe Belge de Medecine Tropicale* 57.4-5: 349–360

Douglas-Hamilton, I. (1987) 'African elephants: population trends and their causes', *Oryx* 21: 11–24

Cecchi, G. and Mattioli, R. C. (eds) (2009) *Geospatial datasets and analyses for an environmental approach to African trypanosomiasi,* PAAT Technical and Scientific Series 9, Rome: FAO ftp://ftp.fao.org/docrep/fao/012/i0809e/i0809e.pdf

Fernandez, A., Richardson, R. B., Tschirley, D. L., Tembo, G. (2010) *Wildlife conservation in Zambia: Impacts on rural household welfare*, Working Paper 40, Lusaka: Food Security Research Project

Government of Zambia (2010) *Reclassification and effective management of the national protected areas system*. Ministry of Tourism, Environment and Natural Resources: Lusaka

Government of Zambia (2013) 'Report of the Committee on Agriculture for the Second Session of the Eleventh National Assembly 27 September 2012, Lusaka: Government of Zambia

Grace, D., Holley, C., Jones, K., Leach, M., Marks, N., Scoones, I., Welburn, S. and Wood, J. (2013) *Zoonoses – From panic to planning*, IDS Rapid Response Briefing 2, Brighton: Institute of Development Studies

Gumbo, D. J., Moombe, K. B., Kandulu, M. M., Kabwe, G., Ojanen, M., Ndhlovu, E. and Sunderland, T. C. H. (2013) *Dynamics of the charcoal and indigenous timber trade in Zambia: A scoping study in Eastern, Northern and Northwestern province,* Occasional Paper 86, Bogor, Indonesia: CIFOR

Hargrove, J.W. (2003) *Tsetse Eradication: Sufficiency, Necessity and Desirability*, Report of meeting 9–10 September 2002 of DFID Animal Health Programme, Edinburgh: Centre for Tropical Veterinary Medicine, University of Edinburgh, available at http://r4d.dfid.gov.uk/PDF/Outputs/RLAHtsetse_Erad.pdf (8 October 2014)

Jordan, A.M. (1985) 'Tsetse eradication plans for southern Africa', *Parasitology Today* 1: 121–123

Lawton, R.M. (1980) *Browse of Miombo Woodland*, London: Land Resouces Development Centre, Overseas Development Administration, Foreign and Commonwealth Office

Leach, M. and Scoones, I. (2013) 'The social and political lives of zoonotic disease models: Narratives, science and policy', *Social Science and Medicine* 88: 10–17

Lewis, D.M. (2007) 'Opportunities and Constraints for Protected Area Management through Increased Connectivity to Local Livelihood Needs in Surrounding Border Areas: Lessons from Luangwa Valley, Zambia, pp.38–49 in K. H. Redford and E. Fearn (eds) *Protected Areas and Human Livelihoods*, Working Paper 32, New Nork NY: Wildlife Conservation Society

Lewis, D., Bell, S. D., Fay, J. Bothi, K., Gatere, L., Kabila, M., Mukamba, M., Matokwanu, E., Mushimbalume, M., Moraru, C. I., Lehmann, J., Lassoie, J., Wolfe, D., Lee, D. R., Buck, L. and Travis, A. J. (2011) 'Community Markets for Conservation (COMACO) Links Biodiversity Conservation with Sustainable Improvements in Livelihoods and Food Production', *Proceedings of the National Academy of Sciences of the United States of America*, 108.34: 13957–13962

Lewis, D., Kaweche, G.B. and Mwenya, A. (1990) 'Wildlife Conservation Outside Protected Areas—Lessons from an Experiment in Zambia', *Conservation Biology* 4.2: 171–180

Lindsey, P. A., Nyirenda, V. R., Barnes, J. I., Becker, M. S., McRobb, R., Tambling, C. J., Taylor, W. A., Watson, F. G. and t'Sas-Rolfes, M. (2014) 'Underperformance of African Protected Area Networks and the Case for New Conservation Models: Insights from Zambia', *PLoS ONE* 9.5, e94109. doi:10.1371/journal.pone.0094109

Mitti, G., Drinkwater, M. and Kalonge, S. (1997) *Experimenting with Agricultural Extension in Zambia: CARE's Livingstone Food Security Project*, Agricultural Research and Extensions Network Paper 77, London: Overseas Development Institute

Munang'andu, H.M., Siamudaala, V., Munyeme, M. and Nalubamba, K. S. (2012) 'A Review of Ecological Factors Associated with the Epidemiology of Wildlife Trypanosomiasis in the Luangwa and Zambezi Valley Ecosystems of Zambia, Interdisciplinary Perspectives on Infectious Diseases', 2012, http://dx.doi.org/10.1155/2012/372523

Nyirenda, V.R., Myburgh, W. J., Reilly, B.K., Phiri, A.I. and Chabwela, H.N. (2013) 'Wildlife Crop Damage Valuation and Conservation: Conflicting Perception by Local Farmers in the Luangwa Valley, Eastern Zambia', *International Journal of Biodiversity and Conservation*, 5.11: 741-750

Odiit, M., Coleman P.G., Liu W.C., McDermott J.J., Fèvre E.M., Welburn S.C. and Woolhouse M.E. (2005) 'Quantifying the Level of Under-Detection of Trypanosoma Brucei Rhodesiense Sleeping Sickness Cases', *Tropical Medicine and International Health*,10.9: 840-9

Okello, A. L., Bardosh, K., Smith, J. and Welburn, S. C. (2014) 'One Health: Past Successes and Future Challenges in Three African Contexts', PLoS Neglected Tropical Diseases 8.5: e2884

Rogers, D.J., Randolph, S.E. (2002) 'A Response to the Aim of Eradicating Tsetse from Africa', *Trends in Parasitology* 18.12: 534-536

Robinson, G.G. (1965) 'A Note on Nocturnal Resting Sites of Glossina Morsitans Westw. in the Republic of Zambia', *Bulletin of Entomological Research*, 56.2: 351–355

Robinson, T., Rogers, D. and Williams, B. (1997) 'Univariate Analysis of Tsetse Habitat in the Common Fly Belt of Southern Africa using Climate and Remotely Sensed Vegetation Data', *Medical and Veterinary Entomology* 11.3: 223–234

Robinson, T.P., Harris, R.S., Hopkins, J.S. and Williams, B.G. (2002) 'An example of decision support for trypanosomiasis control using a geographical information system in eastern Zambia', *International Journal of Geographical Information Science* 16.4: 345-360

Rutto. J. J., Osano, O., Thuranira, E. G., Kurgat, R. K. and Odenyo, V. A. O. (2013) 'Socio-Economic and Cultural Determinants of Human African Trypanosomiasis at the Kenya – Uganda Transboundary', *PLoS Neglected Tropical Diseases* 7.4: e2186

Scoones, I. (2014) *The Politics of Trypanosomiasis Control in Africa*, STEPS Working Paper 57, Brighton: STEPS Centre

Simasiku, P., Simwanza, H., Tembo, G., Bandyopadhyay, S., Pavy, J. (2008) *The impact of wildlife management policies on communities and conservation in game management areas in Zambia,* Lusaka: Natural Resources Consultative Forum

Steverding, D. (2008) 'The History of African Trypanosomiasis', *Parasites and Vectors* 1: 3-3

Tsetse.org (2014) 'Management and socio economics of tsetse control', http://www.tsetse.org/FAQ/costs.htm (accessed December 2013)

Uilenberg, G. (1998) 'African animal trypanosomes', Chapter 1 in G. Uilenberg, A Field Guide for the Diagnosis, Treatment and Prevention of African Animal Trypanosomiasis, Rome: FAO

Uphoff (1996) *Learning from Gal Oya: Possibilities for Participatory Development and Post-Newtonian Social Science,* London:Intermediate Technology Publications

Vail, L. (1977) 'Ecology and History—Example of Eastern Zambia', *Journal of Southern African Studies* 3.2: 129–155

Vale, G.A., Lovemore, D.F., Flint and Cockbill, G.F. (1988) 'Odour baited targets to control tsetse flies in Zimbabwe', *Bulletin of Entomological Research* 78: 31–49

van den Bossche, P., de La Rocque, S., Hendrickx, G. and Bouyer, J. (May 2010). 'A Changing Environment and the Epidemiology of Tsetse-Transmitted Livestock Trypanosomiasis', *Trends in Parasitology* 26.5:236–243

WHO (2013) 'Trypanosomiasis, Human African (sleeping sickness)', Fact Sheet 259: Geneva: WHO