

The *AHEAD* (Animal Health for Environment And Development) - Great Limpopo Transfrontier Conservation Area (GLTFCA) Programme: Key questions and conceptual framework revisited

by

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1. Introduction

The *AHEAD* (Animal **H**ealth for **E**nvironment **A**nd **D**evelopment) – GLTFCA (Great Limpopo Transfrontier Conservation Area) Programme had its origins in 2003 at the Vth World Parks Congress held in Durban, South Africa. During the Congress an initial project concept emerged at the Southern and East African Experts Panel on Designing Successful Conservation and Development Interventions at the Wildlife/Livestock Interface². Over the next few months, and following two Working Group meetings, the concept was developed into a more comprehensive concept paper³ in which the overall programme objective was stated as follows:

“Facilitate development and conservation success in the GLTFCA through integrated understanding based on innovative inter-disciplinary applied research, monitoring and surveillance at the interface between wild and domestic animal health, ecosystem goods and services, and human livelihoods and wellbeing”

The concept paper provided a modular framework based on six main **themes**, namely,

1. An overarching conceptual framework to facilitate integrated understanding through interdisciplinary approaches
2. Animal health and disease
3. Land use, ecosystem goods and services, and animal health
4. Human livelihoods, animal and ecosystem health
5. Policy support and capacity building at local, national and regional levels
6. Communications and outreach

¹ In particular we would like to acknowledge the input at framework meetings of Roy Bengis, Peter Buss, Markus Hofmyer, Nick Kriek, Michael Murphree and Kevin Rogers.

² Southern and East African Experts Panel on Designing Successful Conservation and Development Interventions at the Wildlife/Livestock Interface: Implications for Wildlife, Livestock, and Human Health, *AHEAD* (Animal Health for the Environment And Development) Forum, IUCN Vth World Parks Congress, Durban, South Africa, September 14th and 15th, 2003.

³ Cumming, D. H. M. and *AHEAD* Great Limpopo TFCA Working Group, 2004. “Sustaining animal health and ecosystem services in large landscapes-2nd draft-Concept for a programme to address wildlife, livestock and related human and ecosystem health issues in the Greater Limpopo Trans-frontier Conservation Area.” 24 pp. http://www.wcs-ahead.org/workinggrps_limpopo.html .

Three to five mostly research modules, which included monitoring and surveillance, were defined within each of the themes. The modules were designed to contribute to improved knowledge and understanding of the linked social-ecological systems that comprise the TFCA and the central role of animal, ecosystem and human health (the concept of “One Health”) in the sustainability of these systems.

Since the development of the primary concept paper in early 2004 the working group has held several meetings in which it deliberated on, and developed, specific concept papers and questions within each of the six themes in the overall programme. While the resulting modular structure to the programme serves to facilitate the initiation of particular projects within the overall framework (and some projects have begun) there was still a need for a more coherent, interdisciplinary, linking framework for the programme (i.e. Theme # 1). This paper presents the results of work by a smaller group on the overarching conceptual framework for the AHEAD-GLTFCA programme.

The framework was first examined at a meeting (“framework meeting”) held at Skukuza, in Kruger National Park, South Africa, in May 2005. The historical time lines that summarising major shocks and drivers of change in the GLTFCA over the last five hundred years, together with the frameworks and systems models, discussed at that meeting contributed towards the development of an overarching framework required under Theme #1 of the programme. However, the meeting did not get as far as developing a simple and operationally usable framework.

The problems of developing such a framework were brought into sharp focus at the 6th full Working Group Meeting¹ held at the Pestana Hotel (Malelane, Mpumalanga, South Africa) in March 2006 following an outline of the frameworks and models that were developed at the May 2005 Skukuza meeting. The nub of the problem was the absence of an overall research question, or linked set of research questions that might serve to provide a workable, interdisciplinary framework. This document attempts to achieve this, by defining clear, feasible starting points and central research questions.

Following on from the Pestana meeting a draft framework paper was circulated for comment and discussed by a small working group at Skukuza on the 23rd August, 2006². The draft document was revised in the light of those discussions and the updated set of research and development questions are presented here.

The focus of the overarching questions has shifted from an initial central focus on animal disease (i.e. wildlife and domestic animals) to *system sustainability* and the importance of wildlife/ livestock / human / ecosystem health (the concept of “One Health”) in sustaining large landscapes such as the GLTFCA. There is thus a shift from a central focus on disease to a focus on sustainability, with disease remaining a dominant “sub-plot” within the programme – a move that may make for a more coherent interdisciplinary programme and clearly place it within the integrated socio-ecological domain. This paper provides a brief rationale for taking sustainability as a central issue and then develops a set of key questions to provide an interdisciplinary framework for the research and development programme. The historical time lines on shocks to the system, developed at the earlier May 2005 meeting at Skukuza, are presented in Appendix I.

¹ AHEAD-GLTFCA Working Group reports and other documents are available at http://wcs-ahead.org/workinggrps_limpopo.html

² A revised conceptual framework for the AHEAD-GLTFCA Programme, 8th Aug 2006 draft by David Cumming

2. Sustainability of the GLTFCA

An initial overarching question is whether the establishment of a large transfrontier conservation area, centered on the recently created Great Limpopo Transfrontier National Park, is a viable and sustainable form of land use for the approximately 100,000 km² and more than ~500,000 people living within its tentative boundaries within Zimbabwe and Mozambique alone. Might not other development options be more appropriate or desirable? While the concept of a national park is reasonably well defined, that of a TFCA is not. Many people regard a TFCA as an extension of the protected areas that entails the development of a vast area in which wildlife based tourism is the dominant, if not only form of landuse. However, the reality is that the GLTFCA includes within its tentative boundaries land uses that range from fully protected national parks to highly intensive agro-industries based on irrigation. It is best viewed as coupled social-ecological system. A very large proportion of the area is, however, held under communal tenure where the dominant landuse is subsistence agro-pastoralism that is heavily subsidized by off-farm income and food aid. A central issue in the establishment and long term sustainability of the GLTFCA is its potential impact on the livelihoods of the people living in the communal lands and on the future development of these areas. In the opinion of the smaller working group on conceptual frameworks the disease questions only make sense when nested in this broader sustainability framework.

The 2004 concept document¹ offers some guidance on where we might start to re-focus our questions and the overall thrust of the programme, namely, page 4, paragraph 3, reads:

“The evolution of these large TFCAs and the coupled social-ecological systems (SES) they incorporate will result in benefits and losses (trade-offs) between their various components. Wild and domestic animal health, the sustainable delivery of ecosystem goods and services, and associated human health issues form an important component of this dynamic development.”

The key point here, and perhaps a more suitable focus for the programme, is the set of questions that deal with the likely or possible courses of TFCA evolution. **What are the alternative scenarios for the development of a semi-arid area of 100,000 km² covering a wide range of landuse and tenure systems?** Even if the TFCA proceeds as presently planned or envisaged, there are many uncertainties and possible paths of development as it unfolds. Some of these paths are more likely than others, but all reasonably plausible alternatives - and even fairly unlikely but influential ones - should be considered and examined. More specifically, these questions relate to the various potential consequences in terms of synergies, costs and benefits, and trade-offs between: (i) alternative land uses and patterns of land use, (ii) alternative production and livelihood options, and, (iii) alternative disease management strategies.

Further important questions will arise concerning (i) the effects of alternative development options on biodiversity and ecosystem goods and services, (ii) the implications of alternative investment strategies, and, (iii) the risks of alternative development choices or paths to achieving sustainability.

These considerations suggest a shift away from a central focus on disease to a focus on sustainability, with disease remaining a dominant “subplot” within it. One of the conceptual diagrams developed in the

¹ Cumming, D. H. M. and AHEAD Great Limpopo TFCA Working Group, 2004. “Sustaining animal health and ecosystem services in large landscapes-2nd draft-Concept for a programme to address wildlife, livestock and related human and ecosystem health issues in the Greater Limpopo Trans-frontier Conservation Area.” 24 pp. http://www.wcs-ahead.org/workinggrps_limpopo.html

May 2005 Skukuza meeting partly captured this (See **Fig. 1**) and the overall programme could be expressed as **“Sustainable futures in the GLTFCA”** or, to place it in a more general framework, as **“Sustainable futures in the marginal dry lands of southern Africa”**. The following paragraph from the March 2004 concept paper lends support to this approach and takes up the suggestion¹ made at the 6th Working Group Meeting, at the Pestana Lodge in Malelane, that the balance between research and development in the programme may need to be reconsidered.

“During the period 1961 to 1994 cereal production *per person* declined by nearly 30% while protein (meat and milk) production declined by more than 50% in southern Africa (Cumming 1999b) resulting in much of the region becoming net importers of food. Livestock populations reached a ceiling in about 1987, by which time the number of humans surpassed the number of livestock units. Meat and milk production per animal and per person for the region is about 1/25th of the production levels in Europe (Cumming 1999b). Given these alarming trends and comparisons, the need to produce greater wealth from marginal lands through alternative enterprises such as high valued wildlife-based tourism is clear. Furthermore such service-orientated generation of wealth, which is also partly decoupled from primary production and the vagaries of drought, is likely to generate greater employment opportunities in marginal lands. However, because the tourism sector is also subject to the vagaries of world markets the need to maintain a diversity of production systems (i.e. irrigated agriculture, wildlife and livestock) in arid lands is likely to remain paramount.”

The central importance of conserving biodiversity as the cornerstone to sustaining ecosystem goods and services, animal health, and ultimately human health and livelihoods in marginal lands such as the GLTFCA is clear. Without this, no future is possible without high, external subsidies.

In the context of the AHEAD-GLTFCA programme a single central question, nested under the overall question of system sustainability, is “How does system health impact on the GLTFCA social-ecological system, and vice versa?”

However, rather than aim to develop a single conceptual model or framework, better progress may be made by looking at a range of linked conceptual models within a common vision, such as long term sustainability and resilience. The following section reconsiders each of the main research and development themes, namely, Theme #2 – “Animal health and disease,” Theme #3 – “Landuse, ecosystem goods and services and animal health,” and Theme #4 – “Human livelihoods, ecosystem goods and services and animal health” in terms of key questions within each theme.

¹ As per Osofsky, in "Minutes for the Sixth Meeting of the AHEAD-GLTFCA Working Group – March 9–10, 2006, Pestana Kruger Lodge, Mpumalanga, South Africa," pp. 2-3. http://www.wcs-ahead.org/workinggrps_limpopo.html

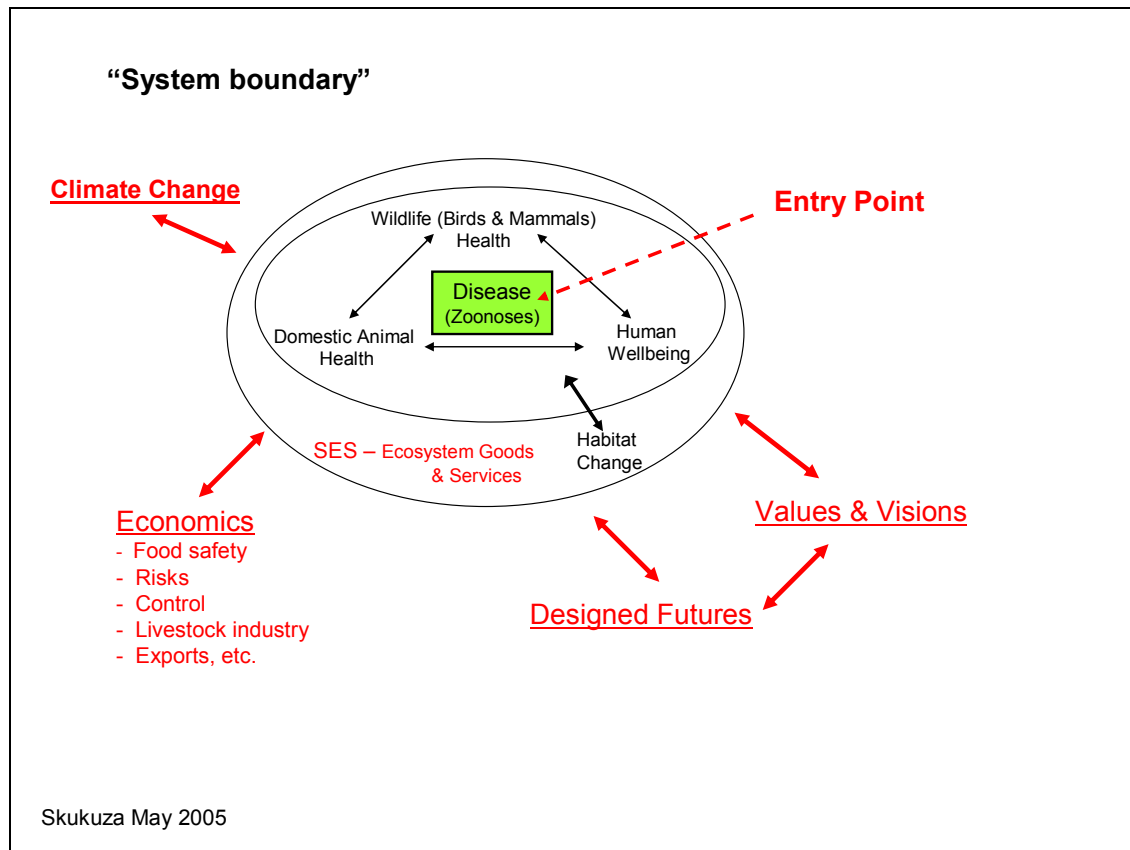


Figure 1. An outline of the system boundary for the AHEAD-GLTFCA programme developed at the May 2005 Skukuza meeting. The central circle focusing on disease is seen as being embedded within a larger, more encompassing linked social-ecological system (SES) which behaves as a complex adaptive system. External influences and potential drivers of change in the GLTFCA-SES are factors such as climate change, national and global economics and the values and visions of a wider society.

3. Key thematic questions

Of the six programme themes listed in the first paragraph of the introduction, three form the core research themes. These are Theme #2 on disease, Theme #3 on linking animal health to ecosystem health, and Theme #4 linking animal and ecosystem health to human wellbeing. Theme #1, on the conceptual framework, is the subject of this paper while Theme #5, on policy, provides the link between research and development. Theme #6, on communications and capacity building, provides the essential and necessary “glue” to link the wide range of stakeholders in the programme. Here we deal specifically with themes 2, 3, and 4 – the core research themes. The linkages between research, resource management, policy and development are indicated below in Figures 2 and 3.

3.1 Theme #2 Animal health and disease

This theme has three modules: epidemiology, alternative management strategies and theoretical studies. It forms a collection of projects and concepts, centered on currently important diseases, with a bias towards standard veterinary science approaches to the various problems, i.e. apart from the concepts so far advanced under the theoretical module. A key issue in this module is that very basic information on the incidence and spatial and temporal patterns of diseases in wildlife, domestic animals and humans is not known – apart perhaps from one or two diseases and then for only parts of the GLTFCA. So, the most basic questions that need to be answered are:

1. *What are the levels (incidence) and spatial and temporal patterns of diseases in wildlife, livestock and humans in the GLTFCA?*
2. *How are these patterns related to landuse or land tenure, or both – and to human livelihoods?"*

Answering these questions is not a trivial undertaking in itself, but the answers are a necessary first step to developing a coherent set of more cogent questions and a research programme with predictive models on the role of disease and animal and human health in the development and sustainability of the TFCA. Up to now we have assumed that the disease issue is of central importance but we need to challenge that assumption with sound data, by carrying out the necessary baseline surveys, analyses and modelling. We will then be better placed to develop a central conceptual and theoretical focus for this module that is firmly embedded within the wider social-ecological system.

Theme #3 – Landuse, ecosystem goods and services, and animal health

Ideally the modules and projects so far considered under this theme would require detailed information on the spatial and temporal distribution of diseases and ecosystem goods and services in the GLTFCA. The underlying disease dynamics would need to be well known in order to explore many of the issues that fall under this theme. But that information is not in place. Neither is there detailed information on the distribution and status of ecosystem goods and services, and particularly those associated with rivers, within the GLTFCA.

Are there alternative, readily measurable, proxies that can be used for examining questions about the links between landuse, ecosystem goods and services, and animal and human health? The normalized deviation vegetation index (NDVI) may serve as an initial proxy for primary production and the status of ecosystem goods and services, and provide the basis for two primary questions that could be answered more readily, namely,

1. *What is the distribution of primary production, as reflected by NDVI (a proxy for ecosystem goods and services), in the GLTFCA?*
2. *How does NDVI vary seasonally and annually in relation to soils, topography, landuse and land tenure?*

Once patterns of primary production in relation to landuse and tenure have been explored using remote sensing, the next step would be to conduct rapid stratified (and preferably participatory) ground surveys, and ground truthing, to determine livestock numbers, condition and disease status. These preliminary

assessments would provide the basis for developing an initial set of models to inform current development and policy initiatives as well as provide a sounder basis on which to explore more specific questions about the links between landuse, ecosystem goods and services, and wildlife and domestic animal health.

Theme #4 – Human livelihoods, animal health and ecosystem health

The modules under this theme deal with scenario planning, trade-offs between alternative landuses, implications of alternative policies and institutions, and baseline indicators. While funding for initial phases of scenario planning has been obtained, further thought needs to be given to the potential for synergistic linkages between major landuse options and how they may contribute to sustainability and resilience. An evaluation of trade-offs between alternative land uses will need to examine economic, social and environmental costs and benefits. The broad question linking the modules under this theme and providing a link to the two previous questions can be framed as

1. *What are the plausible alternative livelihoods (futures/scenarios) for the GLTFCA and the various components within it?*
2. *What are the associated social, economic, and environmental costs and benefits of current and alternative futures?*

This problem will need to be tackled in a fully participatory manner using at least three scales, namely, local or farm community/village level, the sub-regional level (i.e. within each country), and at the regional, i.e. entire GLTFCA, level.

4. A conceptual framework and key questions

Answers to the main questions posed above would provide the basis for exploring the linkages between animal, human and ecosystem health and feed directly into the important issues of social and cultural values and resource management choices (i.e. policy) and thus into a modified Theme #5 of the initial March 2004 concept document. Social and cultural choices then lead to management and feedbacks to the continuing exploration of questions about ecosystem productivity and sustainability, costs and benefits to all stakeholders (including the environment and biodiversity) and issues of animal and human health and well being. Further consideration of these issues leads to five important supplementary questions that link the GLTFCA to the wider context of national and international linkages that need to be explored. These ideas are summarized diagrammatically in **Figures 2 and 3** below.

A key feature of this framework is that it focuses on questions that have to be tackled before the programme can move into more advanced and specific research areas, i.e. an initial characterisation of the system is required as the basis for developing more advanced research questions. This is not to say that exploring advanced questions, developing models, or informing policy with the best available current information, will have to await the completion of baseline surveys. As indicated in Figs. 2 and 3 there are cross linkages and feedback loops between the research questions, policy and resource management (development) and, if appropriately used, these can provide the basis for ongoing cycles of advancement that serve to link, and overlap, shorter- and longer-term goals.

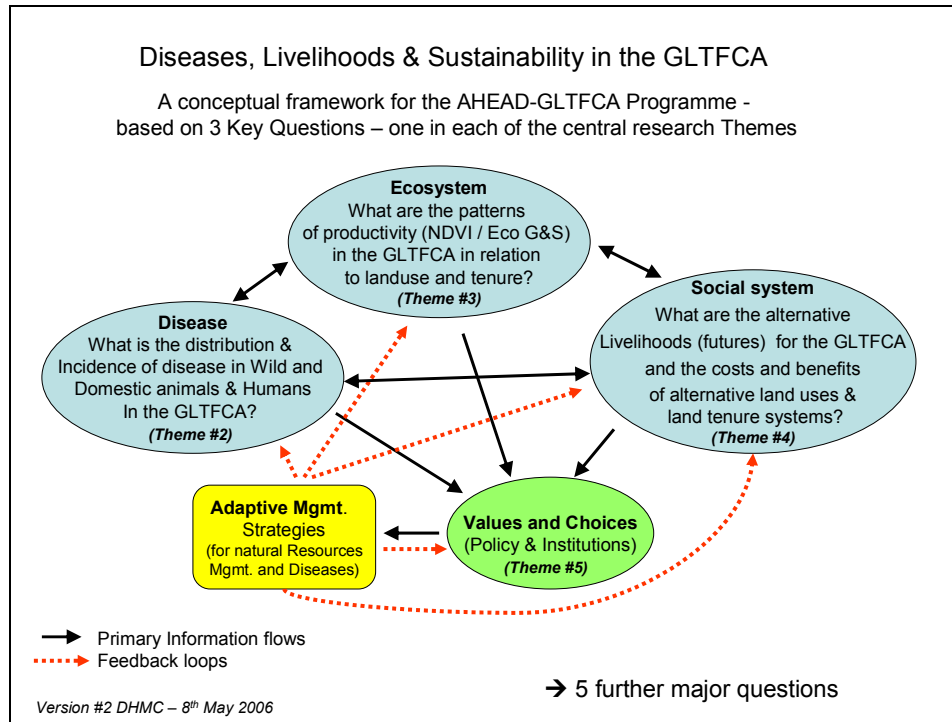


Figure 2. A revised conceptual outline for the AHEAD-GLTFCA program, based on three initial key questions that link to policy and adaptive management strategies, which provides a basis for feedback to ongoing research, learning and development.

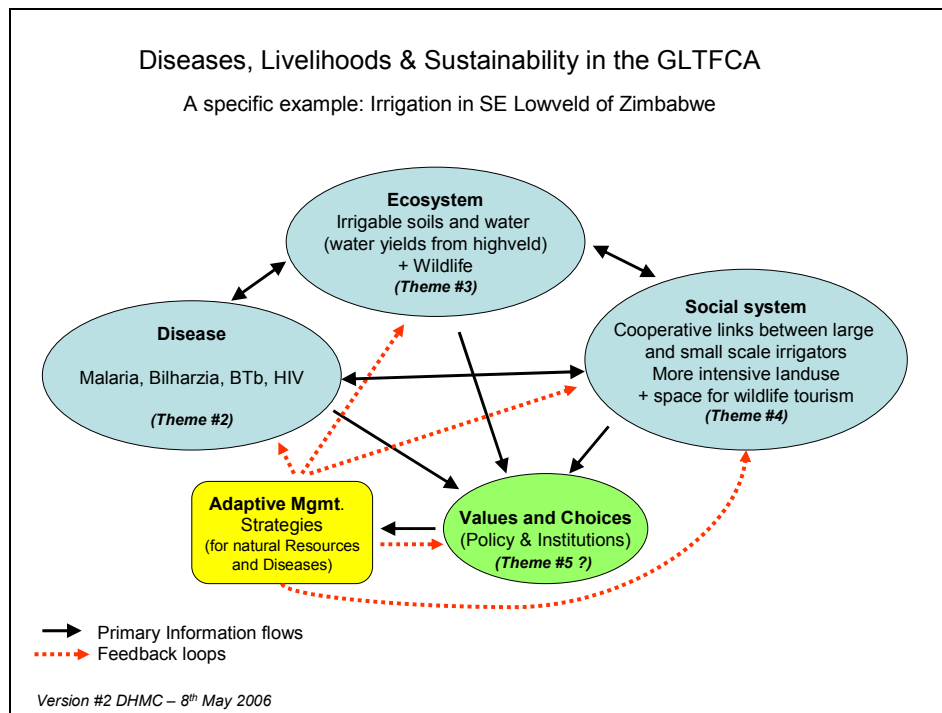


Figure 3. A specific example of the application of the broader questions to a particular sector or component within the GLTFCA

The key ecological question concerning productivity, ecosystem goods and services, and land tenure can be tackled rapidly and at relatively low cost. It will also serve to more firmly establish the links between research and development.

Information and analyses resulting from answers to the key questions posed above, and summarized in **Figures 2 and 3**, lead on to questions about sustainability and resilience of the social-ecological system that might be encompassed by the GLTFCA. If the longer term objective is to develop a sustainable, healthy, and **resilient social-ecological system**, then we might add to, or reframe, some of the key questions along the following lines:

1. What types and pattern of land tenure will enhance system health¹, productivity and resilience (sustainability) of the social-ecological system (SES) of the GLTFCA?
2. What is the state and trend of the five capitals (natural, human, social, financial, and physical) in each landuse/land tenure component of the GLTFCA and how might these change and influence system health under differing scenarios?
3. How will the biodiversity, environmental, social and economic trade-offs/opportunity costs of alternative patterns of land use influence adaptability and resilience of the SES?
4. What cross-subsidies exist within the system and how vulnerable are they to disturbance or shocks?
5. What is the level of external subsidy to the GLTFCA system and how dependent is the system on, or vulnerable to, external subsidies? (How do external subsidies support or hinder the development of adaptability, transformability and resilience of the SES?)

These are important questions and even partial answers to them would further strengthen the links between research, policy and development, and contribute to sustainable development of the GLTFCA social–ecological system.

Also important to a systemic study of the GLTFCA are its ecological and human history and assessing the impacts of major shocks and drivers of change that influenced the past development of the region. A preliminary listing of major shocks to, and drivers of change in, the GLTFCA region was drawn up at the “framework meeting” held in Skukuza in May 2005 and referred to earlier (See Appendix 1). Following on from this exercise a preliminary, but nevertheless comprehensive, systems model of a communal land agro-pastoral system was developed (**Fig. 4**). This model formed the basis of several conceptual diagrams that depicted linkages within and between the main themes of the programme. A simplification of Fig. 4 that focuses on the zoonotic pool and disease control strategies is shown in **Fig. 5** and serves to emphasize the important ramifications of disease control strategies and the need for a holistic approach to the development of the TFCA.

¹ In this context ‘health’ refers to animal, human and ecosystem health – the ‘One Health’ concept.

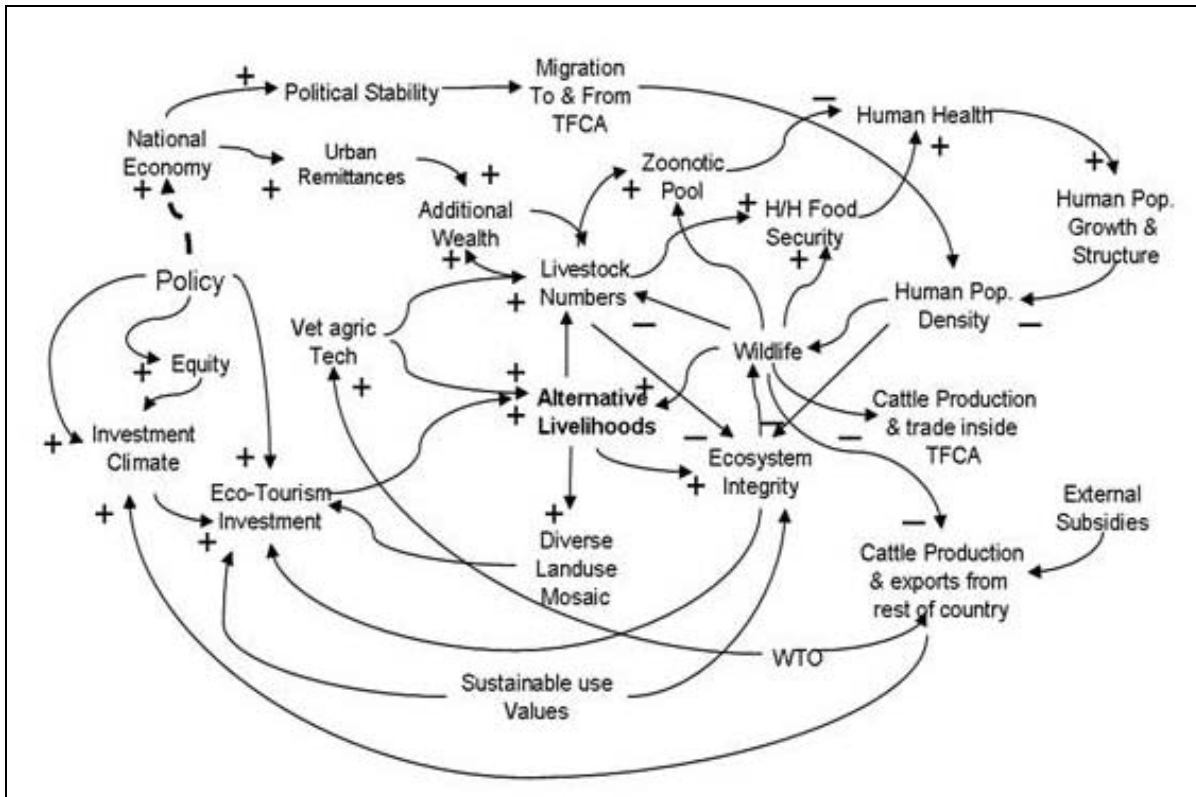


Figure 4. Systems diagram of major influences affecting alternative livelihoods in a communal agro-pastoral system in the GLTFCA (Mozambique and Zimbabwe)

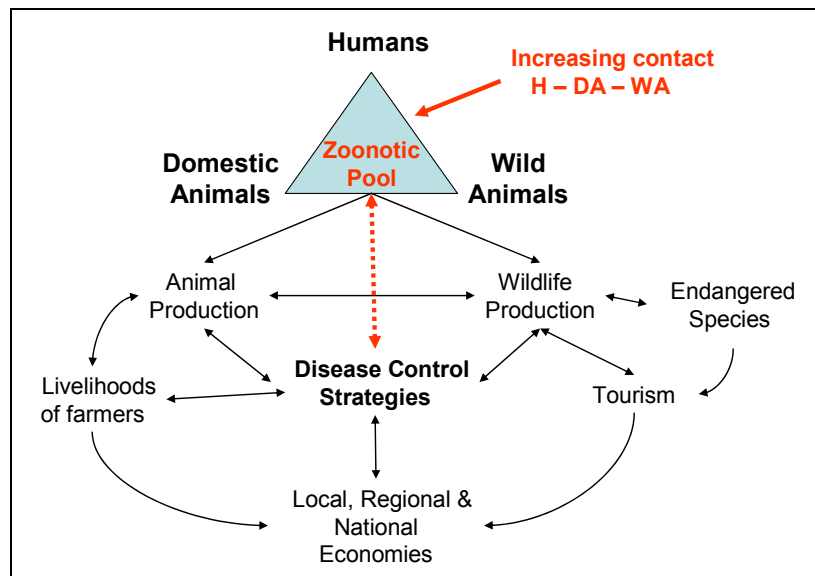


Figure. 5 Conceptual diagram of the linkages between wildlife, livestock and human diseases and the potential implications of disease control strategies for livelihoods and conservation.

5. Concluding comment

The current draft conceptual framework, which places greater emphasis on the sustainable development of the GLTFCA social-ecological system, is now framed in the form of key overarching questions linking disease, ecosystem goods and service and socio-economic systems into an interdisciplinary “One Health” paradigm. The framework and key questions posed here now provide a workable interdisciplinary framework for the AHEAD-GLTFCA programme. The research questions provide a clear basis on which to initiate an interdisciplinary programme clearly linked to exploring issues affecting long term sustainability of the GLTFCA system and the role of diseases in system dynamics.

Appendix 1. Historical time lines and drivers of change

Past shocks to the GLTFCA region provide valuable background information on the drivers that have shaped the history and development of the social-ecological system of the region. These varied from large scale changes that occurred across southern Africa, to changes at national levels, to those that may have been localized within all or part of the GLTFCA. A larger number and range of these changes, influences and shocks were captured during an examination of time lines at the Skukuza workshop in May 2005 (see Appendix 1).

The first major change occurred about 2000 years ago with the Bantu migration into southern Africa, which was soon followed by the introduction of domestic livestock. Archaeological research indicates that livestock had become an important component of human economies in the GLTFCA region by about 700AD and they have continued to be so since then. The period 1500 to 1800 was characterized by the climatic impacts of the mini-ice age, serious droughts, devastating wars and the collapse of dynasties such as that of Great Zimbabwe. This period also saw the start of European colonization along the coast and associated trade particularly in gold and ivory and the introduction of some alien diseases. The following century, 1800 – 1900 witnessed an acceleration of colonial influence, but little if any settlement, within the GLTFCA area. Nevertheless this was a period during which serious alien human and livestock diseases (e.g. measles, East Coast Fever and rinderpest) were introduced to the region. Elephant populations were all but eliminated from the region by 1870 and wildlife and livestock populations were decimated during the 1890s by rinderpest.

With accelerating development under colonial governments the period 1900 to 1945 was dominated by land tenure and land apportionment policies that entrenched the dual agricultural systems of small scale communal tenure and largely subsistence agriculture on the one hand and large scale commercial agriculture on the other hand. Associated with land apportionment policies was the setting aside of large game reserves from which people were relocated in South Africa and Zimbabwe but not in Mozambique. These areas later became established National Parks (KNP in 1902, Gonarezhou NP in 1938, and Limpopo National Park in 2001: note that the initial areas and boundaries of both KNP and GNP were extended in later years). The introduction of new technologies in human and animal health care resulted in rapid growth of both human and livestock populations. The introduction of market economies, which overwhelmed local barter economies, effectively forced rural people into the formal labour market to

meet taxes and other necessities. Human and animal diseases [e.g. malaria, anthrax, trypanosomiasis, theileriasis, foot and mouth disease (FMD)] continued to have a significant impact on local economies in the GLTFCA region.

The end of the Second World War in 1945 was followed by a second wave of colonization, further relocation of local people and the development of large scale commercial agriculture and irrigation in the region. The devolution of custodianship of wildlife to owners or occupiers of commercial farm land resulted in a rapid increase in wildlife ranching, followed by the development of lucrative wildlife-based tourism enterprises on large commercial ranches and conservancies. Rural human and livestock populations continued to increase. Civil and liberation wars in Mozambique and Zimbabwe impacted the region during the 1970s and 1980s. Changing global markets and prices of oil and increasing constraints on marketing of livestock from the region impacted local economies. The growing green movement and animal rights movements have more recently started to have major influences on wildlife management policies and sustainable use options relating to wildlife and particularly for the management of elephant populations.

As in previous periods, major droughts and floods, and human and animal diseases continued to play a significant role in the development of the region. By the 1960s tsetse flies, and trypanosomiasis, had advanced well south and west of the Save River and joint international control operations during the late 1960s and early 1970s were required to halt their advance and drive the fly back to the area north of the Save River in Mozambique. FMD continued to impact the livestock industry, with control measures having major secondary impacts on the wildlife industry in south eastern Zimbabwe and more recently in north eastern South Africa adjacent to KNP. The advent of HIV-AIDS and the spread of bovine tuberculosis pose more recent threats to human wellbeing, and development of the region. The increasing human / wildlife / domestic animal contact increase the risks of the emergence / resurgence of diseases, including zoonoses, and the possibility of the development of drug resistant organisms further compounds the problem.

In summary the major shocks and drivers of change within the GLTFCA region have been as follows:

- a) Wars and dislocation of people, including colonial occupation
- b) Periodic severe droughts and floods
- c) Introduced diseases and zoonoses arising from increasing contact at the interface between wildlife, livestock and humans
- d) Population growth of humans and livestock
- e) Central government policies and legislation, particularly in relation to land apportionment and tenure, and in relation to the devolution of custodianship of wildlife.
- f) The introduction of market economies in about 1900
- g) Global economic drivers such as pricing of fuel and other commodities
- h) The green and animal welfare movements

Table 1. Historical time lines and drivers in the GLTFCA system.

Time Period	South Africa	Regional and Mozambique	Zimbabwe	Key Drivers/Changes
Pre 1500		Livestock invasions		- New wildlife-livestock disease interactions and evolution Period of wealth accumulation
1500 to 1800	European settlement started in 1725 Mfecane Wars	← Mini Ice Age – Arid period? → - Establishment of Portuguese ports on the coast – Delagoa Bay ← Firearms and ivory trade →	Collapse of Great Zimbabwe	Turmoil and collapse of dynasties
1800 to 1900 (What did the landscape look like? Very open?)	1836 Cape Settlers move north Anglo-Boer War Sabi Game Reserve 1898 Gold rush – Barberton and Pilgrim’s Rest	← Introduction of alien diseases → after about 1830 (Bovine TB, Brucellosis and Human TB) ← 1884 Conference of Berlin → and partition of Africa ← Ivory trade collapsed 1890 → ← Rinderpest → collapse of livestock populations	1835 Measles and smallpox outbreaks 1893-96 Matebele wars	- Movements of people & War - Introduced human diseases and population declines - Colonisation - Collapse of Wildlife & Livestock populations - “Kings Game” legislation
1900 to 1945 Conservationist paradigm (Focus on erosion, grazing and livestock management)	1908 – OVRI 1912 ANC formed 1913 Native land Act European settlement in Lowveld from 1910 1936 Natives Trust Land Act (Acornhoek) 1940s irrigation and agricultural development	???? (major gap in info here for Mozambique) ← Shangaans to the Mines → ← Rapid Demographic changes → (linked to malaria control) ← 1st World War 1914-1918 → ← Anthrax panzootic 1923 → ← 1929 – 30 Great Depression → ← Asian Flu (c. 1920?) →	Pole tax and labour laws 1911 Land apportionment 1915 European settlement 1923 Self governing colony 1928 Gonarezhou GR 1929? Tsetse expansion into SEL and start of control hunting 1931 FMD in Zim	- Start of vet research, dips, vaccines and wildlife control to control livestock diseases - Rapid human pop. Growth - Land resettlement and displacements - Expansion of livestock pop. - Artificial water supplies for wildlife - Bush encroachment + Trees - Game reserves and recovery of wildlife from hunting and rinderpest - Fencing & Mechanisation - Anthrax Panzootic in lowveld

Appendix (Continued) Historical time lines and drivers in the GLTFCA system.

Time Period	South Africa	Regional and Mozambique	Zimbabwe	Key Drivers/Changes
<p>1945 – 2005</p> <ul style="list-style-type: none"> • Changing paradigms from “Game Reserves” in early days to “Ecosystem Stability” and pragmatic intervention to maintain stability, to “Biodiversity / Heterogeneity” • 1960s Wildlife vets with capture & translocation • Thresholds in control and outbreaks of animal diseases (?) • CITES and green activist movement • Environmental Justice 	<ul style="list-style-type: none"> • 1959 Bantu Self Govt. Act • Expansion of irrigation • Shift to wildlife landuse from 1952 but mainly since 1970s with rapid development since 1975 - rise in land prices • Extension of Kruger NP in 1960s • Culling of elephant 1967 and buffalo and hippos • Progressive decline of livestock (FMD & marketing) • 1980s Crisis in Agric. With reduced subsidies and further shift to wildlife in lowveld • Anthrax epizootics in 1990, 91, 93, 99. • EMC in elephants in 1993 • Bovine TB in wildlife 1960s but only diagnosed in 1990 • Elephant culling moratorium 1995 • Democratisation in SA followed by new Biodiversity, water and land legislation with cooperative governance of natural resources • Land claims • Increasing tourism since 1994 • Translocations and fences dropped → 	<p style="text-align: center;">← Atlantic Charter Decolonisation →</p> <p style="text-align: center;">← Eradication of Tsetse → (East Coast fever, BCPP, Glanders)</p> <p style="text-align: center;">← Trade driven disease control → (1970s with fences to control wildlife, mainly buffalo, & people?)</p> <ul style="list-style-type: none"> • 1972 Bahnine and Zinave gazetted • Fall of Salazaar Govt. and decolonization • Civil War and collapse of wildlife management <p style="text-align: center;">← GATT/WTO/OIE impacts → (since 1980)</p> <p style="text-align: center;">← Major drought 1991/92 →</p> <p style="text-align: center;">← Major Floods 2001/02 →</p> <p style="text-align: center;">← TFCAs 2002 →</p> <p style="text-align: center;">← Emerging infections →</p> <p style="text-align: center;">← Water catchment Mgmt. →</p> <p style="text-align: center;">← Regional Climate Change →</p>	<ul style="list-style-type: none"> • Second wave of European immigration 1945-55 • Contraction of area of Communal Lands in SEL • Major irrigation schemes developed 1950s & 1960s • 1960 Beginning of Game Ranching • Role of buffalo in FMD established • Eradication of buffalo in SE • Elephant culls 1970s and translocations 1990s • Liberation War 1975-80 • 1989 CITES ban on ivory trade and cessation of culling • Start of CAMPFIRE • Conservancies 1991/92 • Tourism declines 1997 • 2000 land reform and economic decline and crash in tourism 	<ul style="list-style-type: none"> • Human Population Growth • Land tenure and relocation of people • Wildlife legislation and ownership to farmers in 1960s and 1970s • Increase in knowledge of diseases with developments in molecular biology • Increased tourism (1950s) and increased water points, roads, etc. • Liberation wars/Civil wars • Droughts and impact of El Nino • Political instability triggering disease outbreaks • World Trade dynamics • Increasing contact between people and wildlife • Habitat changes • Translocation of animals • Diseases crossing species barriers (e.g. BTB) • Increased water demand with population growth and agro-industries • Changes in legislation • Politics of Patronage • Exchange rates and tourism growth • Fuel prices and airfares