“At the core of the global divide is the vast inequality in innovation and diffusion of technology”

“The spread of ideas and technical know-how lies at the heart of successful development”

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ILLUSTRATIONS

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**Mr Dave Elsworth, ILRI**
Volume I - III - Cover Photos
Volume I - III - Quote Page Photos
Volume III - Vaccine Development Insert Page
Volume I - acknowledged throughout Narrative

**Dr Sue Welburn, CTVM**
Volume III - Dissemination and Development Insert Page
Volume I - acknowledged throughout Narrative

**Dr Sarah Cleaveland, CTVM**
Volume III - Human Health Insert Page
Volume III - Diagnostics and Decision Insert Page
Volume I - acknowledged throughout Narrative

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Volume I - acknowledged throughout Narrative

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Volume I - acknowledged throughout Narrative

**Ms Lesley Sakyi, CTVM - R7363**
Volume I - acknowledged throughout Narrative
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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AHP</td>
<td>DFID/NRRD Animal Health Programme</td>
</tr>
<tr>
<td>AVHRR</td>
<td>Advanced Very High Resolution Radiometer</td>
</tr>
<tr>
<td>BALITVET</td>
<td>Research Institute for Veterinary Science (Bogor, Indonesia)</td>
</tr>
<tr>
<td>BBSRC</td>
<td>Biotechnology and Biological Science Research Council (see AFRC)</td>
</tr>
<tr>
<td>BCDIU</td>
<td>Bali Cattle Disease Investigation Unit</td>
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<tr>
<td>BHC</td>
<td>British High Commission</td>
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<tr>
<td>CAWS/CBAHW</td>
<td>Community Based Animal Health Workers</td>
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<td>CBPP</td>
<td>Contagious bovine pleuropneumonia</td>
</tr>
<tr>
<td>CCPP</td>
<td>Contagious caprine pleuropneumonia</td>
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<tr>
<td>CD</td>
<td>Compact disc</td>
</tr>
<tr>
<td>cDNA</td>
<td>Complementary deoxyribonucleic acid</td>
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<tr>
<td>cELISA</td>
<td>Competitive enzyme linked immunosorbent assay</td>
</tr>
<tr>
<td>CFB</td>
<td>Common Fly Belt</td>
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<tr>
<td>CG</td>
<td>Consultative Group (see CGIAR)</td>
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<tr>
<td>CGIAR</td>
<td>Consultative Group on International Agricultural Research</td>
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<tr>
<td>CIRAD-IEMVT</td>
<td>Centre de Coopération Internationale en Recherche Agronomique pour le Développement - Institut d’Elevage et de Médecine Vétérinaire des Pays Tropicaux</td>
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<tr>
<td>CNs</td>
<td>Concept Note(s)</td>
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<td>CoLRI</td>
<td>Collaborative Livestock Research Initiative (Indonesia)</td>
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<td>CPHP</td>
<td>Crop Post Harvest Programme</td>
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<td>CPP</td>
<td>Crop Protection Programme</td>
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<td>CSIRO</td>
<td>Commonwealth Scientific Industrial Research Organisation</td>
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<tr>
<td>CTVM</td>
<td>Centre for Tropical Veterinary Medicine (The University of Edinburgh)</td>
</tr>
<tr>
<td>CV</td>
<td>Curriculum vitae</td>
</tr>
<tr>
<td>DALY</td>
<td>Disability-adjusted Life Year</td>
</tr>
<tr>
<td>DANIDA</td>
<td>Danish Aid Agency</td>
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<tr>
<td>DAVID</td>
<td>Disease and Vector Related Database</td>
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<tr>
<td>DFID</td>
<td>Department for International Development</td>
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<tr>
<td>DG</td>
<td>Directorate General (of EC/EU)</td>
</tr>
<tr>
<td>DNA</td>
<td>Deoxyribonucleic acid</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
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<td>---------</td>
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</tr>
<tr>
<td>ECF</td>
<td>East Coast fever</td>
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<tr>
<td>ELISA</td>
<td>Enzyme-linked immunosorbent assay</td>
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<tr>
<td>EMPRES</td>
<td>Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases</td>
</tr>
<tr>
<td>ERGO</td>
<td>Environmental Research Group Oxford</td>
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<tr>
<td>ETA's</td>
<td>Edinburgh Technical Adviser's</td>
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<td>EU</td>
<td>European Union (= Community)</td>
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<td>FAI</td>
<td>Forest-Agriculture Interface</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organisation (UN)</td>
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<td>FAO/UNDP</td>
<td>Food and Agriculture Organisation/United Nations Development Programme</td>
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<td>FITCA</td>
<td>Farming in Tsetse Controlled Areas</td>
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<td>Foot-and-mouth disease</td>
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<td>FFS</td>
<td>Farmer Field Schools</td>
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<td>Forestry Research Programme</td>
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<td>Fellow of the Royal Society of Edinburgh</td>
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<td>FTR</td>
<td>Final Technical Report</td>
</tr>
<tr>
<td>FY</td>
<td>Financial Year</td>
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<td>GIS</td>
<td>Geographical Information Systems</td>
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<td>GREP</td>
<td>Global Rinderpest Eradication Programme</td>
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<tr>
<td>GTZ</td>
<td>German Agency for Technical Co-operation</td>
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<td>HP</td>
<td>High Potential (System)</td>
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<td>HP/PUI</td>
<td>High Potential / Peri-Urban Interface (System)</td>
</tr>
<tr>
<td>HRPT</td>
<td>High Resolution Picture Transfer</td>
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<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
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<td>IAH</td>
<td>Institute for Animal Health (Compton/Pirbright)</td>
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<tr>
<td>IAPGR</td>
<td>Institute of Animal Physiology and Genetics Research (now Roslin Institute)</td>
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<tr>
<td>IARC</td>
<td>International Agricultural Research Centre</td>
</tr>
<tr>
<td>ICAR</td>
<td>Indian Council of Agricultural Research</td>
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<tr>
<td>ICRISAT</td>
<td>International Crop Research Institute for the Semi-Arid Tropics</td>
</tr>
<tr>
<td>IERM</td>
<td>Institute of Ecology and Resources Management (University of Edinburgh)</td>
</tr>
<tr>
<td>IFNγ</td>
<td>Gamma interferon</td>
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<tr>
<td>IFPRI</td>
<td>International Food Policy Research Institute</td>
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<tr>
<td>IgA</td>
<td>Immunoglobulin A</td>
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<tr>
<td>IIITA</td>
<td>International Institute for Tropical Agriculture</td>
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<tr>
<td>ILRI</td>
<td>International Livestock Research Institute</td>
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</tbody>
</table>
INCO-DC = STD4 tranche of EU awards
INCO-DEV Confirming the International Role of Community Research: Research for Development (INCO-DEV)
INTERNET International Network
IPMI Insect Pest Management Initiative
ISCTRC International Scientific Council for Trypanosomosis Research and Control
ITC International Trypanotolerance Centre, The Gambia
ITTD Integrated Tsetse and Trypanosomosis Database
JDV Jembrana Disease Virus
KARI Kenya Agricultural Research Institute
KDa Kilodalton
KETRI Kenya Trypanosomiasis Research Institute
LARST Local Applications of Remote Sensing Techniques
LDCs Less developed countries
LIDIVET Research Institute for Veterinary Science (Bolivia)
LIRE Livestock Information and Research Exchange
LPAC Livestock Programmes’ Advisory Committee
LPP Livestock Production Programme
MAbs Monoclonal Antibody
MCF Malignant catarrhal fever
MHC Major histocompatibility complex
MPhil Master of Philosophy
MRC Medical Research Council
MRI Moredun Research Institute (Edinburgh)
MSc Master of Science
NARO National Agricultural Research Organisation
NARS National Agricultural Research System
NDDB National Dairy Development Board (India)
NDVI Normalised Difference Vegetation Index
NGOs Non-Governmental Organisation(s)
NOAA National Oceanographic and Aeronautical Administration
NRI Natural Resources Institute
NR International Natural Resources International
NRRD Natural Resources Research Department
NRSP Natural Resources Systems Programme
OCP Onchocercosis Control Programme
ODA Overseas Development Administration (DFID)
Livestock underpin or sustain the lives of two-thirds of the world’s rural poor – close to 700 million people. But chronic endemic diseases and zoonoses constrain livestock productivity and endanger human health thereby contributing to the perpetuation of poverty. Bringing together veterinary, medical and social scientists from the UK, Africa and South Asia, the Animal Health Programme (AHP) funds research that leads to better control of these diseases. Effective dissemination and uptake of AHP research findings contributes to enhanced livelihoods and improved health of poor livestock keepers.

The AHP vision is for

Better Lives for the Poor from Healthier Livestock
The pace of investment in technological change is greater than ever before in that small part of the world that is equipped to invest in technological innovation. However little investment is going into researching the problems of tropical societies, which include poor public health and low agricultural productivity. As the Government’s White Paper on globalisation and poverty states, “research that benefits the poor is an example of a global public good which is under-funded”. The Animal Health Programme seeks to address this widening technology gap by identifying and promoting research that will benefit poor livestock keepers.

Last year the portfolio of AHP projects was streamlined, and limited to four key areas:

- Human Health Impacts of Animal Diseases
- Diagnostics and Decision Support Tools
- Dissemination and Delivery of Animal Health Knowledge
- Vaccine Development

This thematic focus clearly embraces the needs of both poor livestock keepers, and those affected by zoonotic diseases, whose isolation or poverty mean that their conditions are either not diagnosed or inadequately treated.

The task is now to ensure that the work in those key areas is correctly targeted and reaches the critical mass necessary to achieve impact. In the area of strategic research it is difficult for potential clients to envisage what the possible research products might be. Two initiatives have been set in place to try to ensure that AHP research remains demand led. At the strategic level, DFID, through the AHP, has commissioned ILRI to identify priority areas for disease control research. This consultancy will cover Africa and Asia, and examine the importance of different diseases to poor livestock keepers and their researchability. At the adaptive level, the feasibility of setting up a Livestock Information and Research Exchange (LIRE) is being investigated which would bring together demand and supply for research.

During the course of this year, the AHP has further streamlined its project portfolio, by taking on new projects in two themes - zoonotic diseases and dissemination/delivery of animal health knowledge. The Zoonotic Disease project now identified for brucellosis will use the same methodology as the ongoing research work on bovine tuberculosis and will link up with work on mastitis and tick-borne disease in smallholder dairy cattle, thus creating a cluster of projects dealing with the human and animal health problems associated with milk production. Work on Diagnostics and Decision Support Tools has continued during the year under report through seven projects, five of which will continue next year. Two projects will strengthen the Delivery and Dissemination theme. One will investigate a new approach to disseminating knowledge relating to livestock and animal health, the farmer field school. The other project will work on a blue-print for the dissemination of past research results to target groups, using the example of tsetse control to NGOs. Research on Vaccine Development will now proceed primarily through the tick-borne disease vaccine development thrust for which ILRI will be the lead institute. By concentrating its strategic research thrust on the development of a vaccine for a single disease, the AHP hopes to bring together the funding to ‘crack’ one disease constraint of importance to poor livestock keepers.
1. Introduction and General Overview

Globalisation’s Challenge to Poverty Focussed Research

Access to technology is the key to combating poverty. As globalisation has brought the world closer together, it has also sharpened differences, and this growing divergence is most noticeable in the area of technology and technical innovation. Jeffrey Sachs\(^1\), sees today’s world as divided by technology, not ideology. Nearly all of the world’s technical innovations come from a small part of the globe, comprising about 15% of the world’s population, a further half of the world’s population makes use of these technologies, and the remaining third are “technically disconnected, neither innovating at home, nor adopting foreign technologies”. These are the tropical countries caught in the poverty trap (see Map: Extent and Severity of Poverty in Africa). This analysis identifies some of their greatest problems as:

- poor public health;
- low agricultural productivity; and
- environmental degradation.

Whilst elsewhere the pace and level of investment in technological change is greater than ever before, “almost nothing is going into the problems that are strictly the problems of tropical societies” says Sachs. Nowhere is this low level of investment in developing technology so apparent as in the field of human health. For example, annual investment by the World Bank in tropical health research totals about $10 million, and its investment in all tropical agricultural research $50 million, as against Merck’s 1999 R&D budget of $2.1 billion. As the Government’s White Paper on globalisation and poverty\(^2\) states, “research that benefits the poor is an example of a global public good which is under-funded”. The public good aspect is a key factor in understanding why this kind of research is not undertaken on a significant scale. Another factor is that, even where a research product such as a drug can be sold, the buying power of those who need it is woefully small.

In this context, animal health straddles the agricultural and health sectors, sharing the problems faced by both. The financial incentive to develop drugs and vaccines for tropical diseases of livestock is very small, and within the under-funded agricultural sector, livestock is often the poor cousin.

Accordingly, this analysis of the links between technical exclusion and poverty in a globalised economy has profound implications for the priorities and focus that the AHP should adopt as it contributes to the International Development Target of halving the proportion of people living in extreme poverty by the year 2015.

Firstly, it is clear that sufficient funds for new diagnostics, drugs and vaccines targeting livestock diseases which affect the poor in tropical countries are not likely to come from the private sector in the near future. For this reason the AHP’s medium term strategy is:

- to identify diseases which affects the livelihoods of a significant proportion of the poor livestock keepers who represent AHP’s target constituency;
- then to proceed to commission research, in collaboration with the private sector, on a scale such that the development of the necessary technology can take place.

\(^1\) Jeffrey Sachs is director for the Centre for International Development and professor of international trade at Harvard University, and has advised the governments of many developing and East European countries. The quotations used come from an article summarising his analysis of the global situation, published in The Economist of 22 June, 2000, and entitled ‘A new map of the world’.

INTRODUCTION and GENERAL OVERVIEW

Extent and Severity of Poverty in Africa

Secondly, in the same way as technological innovations by-pass whole regions – those countries caught in the poverty trap - on a micro-scale this process is replicated within communities in poor countries, where inputs and information by-pass the poor in those communities. So the AHP is looking to address the ways in which animal health technologies and information that are already available can be made more accessible to poor livestock keepers and those affected by zoonotic diseases, disproportionately the poor, in its target areas by:

- studying the mechanisms by which animal health knowledge and inputs reach poor livestock keepers, and conversely, often fail to be accessible to them;
- investigating zoonotic diseases, especially identifying risk factors for both animals and humans and using this knowledge to develop cost-effective control strategies; and
- adapting existing knowledge of how disease complexes can be controlled so that they apply to poor livestock keepers in specific production systems.

*The index mapped above attempts to capture both the extent and severity of poverty. It is given by: \( I = \ln (P \times \text{number of poor}) \). Full details of these measures can be found in Thornton and others. Assessment of priorities to 2010 for the poor and the environment, ILRI Impact Series Number 6, International Livestock Research Institute, Nairobi, Kenya, 2000.
1.1 Overall Vision and Strategy

Last year the portfolio of research projects was streamlined, and new applications were sought from four key areas, as shown in the diagram below. The task is now to ensure that the work in those key areas is correctly targeted and reaches the critical mass necessary to achieve impact.

Accordingly the existing projects and new applications have been grouped within these areas, although there are significant cross-cutting components. These four main areas will be retained, but the balance of emphasis has now shifted to incorporate the clearer mandate for the programme that has developed out of the debate about globalisation and technology, as discussed above.

Re-focussing the AHP: Poverty, Technology and Globalisation
The four themes have now been grouped. Three, which can be broadly classified as adaptive, address the issue of how technology by-passes poor countries and also by-passes the poor within those countries. The aim of the fourth theme, vaccine development, is to identify an area where a significant investment by DFID could lead to a research break-through. This is seen as the wedge with which to crack a disease constraint of importance to the poor. More detail on these four themes can be found in Section 2.1

**Dialogue with the Poor**
As the AHP moves forward into a more clearly poverty-focussed research programme, a major task has been to ensure that projects are adequately and appropriately demand-led. Often this is much easier to achieve for adaptive projects, which work closely with client communities, and can test and adjust innovations and disease control strategies together with the poor livestock keepers for whom they are destined. In the area of strategic research it is difficult for potential clients to envisage what the possible research products might be, so that the demand for them is, of necessity, indirectly articulated, in terms of identifying problem areas within livestock production systems.

**Identifying and Prioritising Areas for Poverty-focussed Research**

Two ongoing initiatives are trying to tackle these issues.

- **At the strategic level**, DFID, through the AHP, has commissioned ILRI to identify priority areas for disease control research. This consultancy will cover Africa and Asia, and examine the importance of different diseases to poor livestock keepers, ranking them primarily in terms of their impact on the productivity of livestock kept by the poor in production systems identified as being of importance to the poor. The direct impact on human health for zoonotic diseases - those transmissible between humans and animals - will also be considered. The consultancy will then go on to examine the researchability of the diseases which score highly, looking in particular for opportunities to build on existing work in order to produce a product for rapid delivery to the poor.

- **At the adaptive level**, the AHP commends the capacity of its researchers, field workers and countless livestock farmers, to identify areas for research and guide the work into channels which are fruitful and reflect the needs of poor livestock keepers. However, there is a need to ensure that the dialogue with poor livestock keepers is extended to cover a wider area, to focus more clearly on the poor and to report back on a more regular basis on the problems and preoccupations they face with their livestock. From this, it is essential to progress to a situation where demand from poor livestock keepers drives adaptive research, and directs strategic research. To this end, the feasibility of setting up a Livestock Information and Research Exchange (LIRE) is being investigated. It would operate initially in Eastern Africa, and aim to set up a series of ‘processes and institutions that would bring together demand and supply’ for research.
1.2 Programme Activity

The programme activities proceeded broadly as planned. Both the research and the management budgets were fully committed and spent their budgetary allocations. The Programme Manager has continued to work towards improving the refocusing of AHP funded activities to address a well-defined set of targets.

The Programme was represented at an Inter-Agency Meeting on Livestock Research, held in December 2000 and involving both the private and public-sectors. The objective was to explore opportunities for establishing a collaborative international livestock research effort. At this meeting it emerged that like DFID, other donors have recently adopted a strong poverty focus to their investments in livestock research. In the light of this change there was a need to re-evaluate research investments in regard to potential impact on poverty. As a first step towards creating a multilateral initiative on livestock research it was agreed that a study should be conducted to identify priorities for international action on livestock research for poor people. The AHP took the responsibility for managing this study on behalf of DFID (see below).

As a follow-up to the Inter-Agency Meeting on Livestock Research (see above) AHP, on behalf of DFID, commissioned ILRI to carry out a study to identify priority areas for international action for the development of livestock technologies. The study began in January 2000 and the findings will be presented at a second Inter-Agencies meeting to be held in June 2001. The study will firstly assess the major health constraints to those livestock species that most benefit the poor in sub-Saharan Africa and South and South-East Asia. This will include both comprehensive literature reviews and consultations, the latter involving both experts in the epidemiology and impact of the diseases and those working at farm level in the target areas. It will then assess the research opportunities to alleviate the constraints. Opportunities will include new technologies, whether vaccines, therapeutic agents or diagnostic tests, modified technologies to enhance impact on the poor and new approaches to the delivery and adoption of technologies. For each disease, an evaluation will be done of research opportunities, probability of success, time frame, resource requirements, potential for delivery and adoption, and possible environmental impact. Finally, a methodology will be developed to allow prioritisation of animal health constraints of the poor and for prioritisation of potential research options.

As a first step towards improving the dissemination and promotion of AHP research outputs a workshop was held in Nairobi, Kenya in October 2000 for invited project leaders, collaborators and representatives from other livestock related research and development institutions in east Africa. The objective of the workshop was to encourage researchers to devote more effort to considering how the outputs of their research would be disseminated to ensure impact on poor livestock keepers. One outcome of the workshop was the identification of the need to hold a further workshop to which representatives of both private and public sector animal health organisations would be invited. The objective of this second workshop would be to identify opportunities for collaboration between the two sectors and to learn form the experience of others working in the animal health field. The private/public sector dissemination and promotion workshop is scheduled for 2001.

Programme Activity Summary

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>ADVISOR/PARTICIPANTS</th>
</tr>
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<tbody>
<tr>
<td><strong>April</strong></td>
<td></td>
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<tr>
<td>Commission Review of Epidemiology and Economics of Tick-borne diseases</td>
<td>Dr Bruno Minjauw</td>
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<tr>
<td></td>
<td>Dr Anni MicLeod</td>
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<tr>
<td><strong>May</strong></td>
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<tr>
<td>Review of DFID Projects involving GMO’s (Meeting at NR International)</td>
<td>Sir John Berringer</td>
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<td></td>
<td>Dr Barbara Handley</td>
</tr>
<tr>
<td>Meeting with Joint Project Leader</td>
<td>R7271 - Dr Nick Ogden</td>
</tr>
</tbody>
</table>
## INTRODUCTION and GENERAL OVERVIEW

### June
- **LPAC Meeting, Dept of Agriculture, University of Reading**
  - Meeting Project Leaders
  - LPAC Members
  - R7196 - Dr John March
  - R7363 - Dr Lesley Sakyi

### July
- **NR Advisers Conference, Sparsholt**
  - Call for CONCEPT NOTES
  - DFID Lead Advisers / Programme Managers
- **Meeting Project Leaders**
- **Meeting SATV Dissemination Video Discussion**
  - R7595 - Ms Marina Martin
  - Mrs Jenny Sharp / Mr Barry Allsopp

### August
- **Meeting Project Leader**
- **Meeting SATV Dissemination Video Discussion**
  - R7595 - Ms Marina Martin
  - Mrs Jenny Sharp / Mr Barry Allsopp
- **Meeting with Project Leaders - University of Reading**
- **WHO Meeting - Trypanosomiasis Policy**
- **PAAT Meeting**
- **ICPTV Meeting**
- **Concept Note DEADLINE**
  - Geneva
  - Ethiopia (Dr Mark Eisler)

### September
- **Meeting with Project Leaders - University of Reading**
- **WHO Meeting - Trypanosomiasis Policy**
- **PAAT Meeting**
- **ICPTV Meeting**
- **Concept Note DEADLINE**
  - R7359 - Dr Claire Heffernan
  - R7271 - Dr Mike Bryant

### October
- **1st International Course on African Trypanosomes**
- **Meeting LIDIVET Bolivia staff**
- **South African Workshop Meeting Discussion**
- **Stakeholders Meeting, Mombasa, Kenya**
- **Marseille, France**
- **Dr Jonathan Rushton**
- **Dr Anne Pearson**
- **Dr Paul Coleman**
- **Dr Mark Eisler**
- **Dr Noreen Machila**

### November
- **LPAC Meeting, SAC, Auchencruive, Ayr**
- **AHP/LPP Team - Exchange of Information**
  - Geneva
  - Ethiopia (Dr Mark Eisler)
- **DFID Meeting**
- **CABI Meeting, Animal Health & Production Compendium**
- **ILRI, Kenya - Epidemiology and Economics of Tick-borne Diseases Review**
  - Ms Susanna Thorp / Mr Dylan Winder and Project Leaders

### December
- **Meeting Wrenmedia & DFID Interviews - East African Projects (R7196/R7360/R7596/R7595)**
- **DFID Inter-Agency Meeting on Livestock and Animal Health GMO Policy - DFID**
- **Ms Susanna Thorp / Mr Dylan Winder and Project Leaders**

### January
- **Meeting Project Leader**
- **Meeting ILRI**
- **Stakeholder's Workshop - South Africa**
- **Meeting DFID HQ London**
- **Economic Analyses of Health Interventions Meeting**
- **Project Memoranda DEADLINE**
  - R7598 - Dr Keith Sumption
  - Dr Keith Sones / Dr Tony Luckins / Dr Anne Pearson
  - Mr Mike Wilson
  - Dr Alex Shaw

### February
- **Visit to ILRI, Kenya**
- **Visit by LPAC Member**
- **Review of Project Memoranda**
- **SATV - Dissemination Video Discussion**
- **LPAC Meeting, DFID HQ London**
  - Professor David Taylor
  - Professor Cled Thomas
  - Ms Susanna Thorp / Mr Dylan Winder and Project Leaders

### March
- **Meeting with Project Leader**
- **Meet with Project Collaborators**
- **Meet with Development Editor Books & Reference Works**
- **Proposal discussion**
- **Prepare Annual Report - DRAFT Narrative**
  - R7363 - Ms Lesley Sakyi
  - Professor Rudovic Kazwala (R7229, R7357)
  - Dr Rebecca Stubbs, CABI
  - Dutch visitor Dr Frans Jongejan / R7357 - Dr Sarah Cleaveland
  - Dr Keith Sones
1.3 Research Impact

The impacts of currently-funded AHP research work are highlighted in the project inventory (Section 4.3) and described in more detail in the individual project summaries (Part II). This year three areas where the impact has been of particular interest emerged:

- influencing policy and public opinion with respect to the control of zoonotic diseases;
- developing and testing approaches for disseminating animal health messages based on research results obtained from the programme; and
- understanding the importance of livestock to, and the livestock management strategies used by, poor livestock keepers.

Current Research Impacts

**Influencing Policy and Public Opinion: Tuberculosis and Sleeping sickness in Tanzania and Uganda**

Current research projects studying bovine tuberculosis (TB) in Tanzania and sleeping sickness in Uganda have followed on from previous AHP-funded work in these countries. Both have had a significant impact on the way these diseases are now regarded and controlled.

**Tuberculosis** has reached epidemic proportions world-wide. It is now estimated that a third of all humans are infected at some time in their lives, although only a proportion will develop the disease. Some TB patients suffer from the bovine form of the disease, which can be transmitted between cattle and humans, and which also causes production losses in cattle. But before the AHP projects studying bovine tuberculosis, the existence of this form of the disease was not recognised in Tanzania. Now awareness has been created among both health professionals and the general public: The manual distributed to health workers in this field has been altered accordingly and many people now realise that drinking raw milk – which can be contaminated with *M.bovis*, the human-infective organism responsible for the bovine form of the disease - is risky.

The AHP funded projects have also played another important role in Tanzania. By bringing together the medical and veterinary establishments, for the first time joint ventures to research and develop strategies for the control of diseases which affect both people and animals have been possible. The signing of a Memorandum of Understanding between two research bodies (Sokoine University of Agriculture and the National Institute for Medical Research) has provided a model for future medical-veterinary cooperation that will facilitate work on other zoonotic diseases in Tanzania.

Work on rhodesiense sleeping sickness in Uganda has been ongoing for more than a decade funded by a consortium of donors: DFID/AHP, MRC and The Wellcome Trust. Research results had previously shown that cattle are the main reservoir of human sleeping sickness in south-eastern Uganda. These results have been sadly, but dramatically, vindicated with the appearance of an outbreak of sleeping sickness in Soroti District, an area where this disease had never previously existed. Sleeping sickness almost always occurs in discrete foci. New AHP funded research has shown that the emergence of this new focus of the disease is due to the importation into the district of cattle, infected with human infective *T.b.rhodesiense* parasites, from areas where human sleeping sickness is endemic. As a result of these findings, veterinary and health authorities in Uganda began treating cattle around outbreaks of rhodesiense sleeping sickness in the early 1990s and this approach has now become official policy.

(R7229, R7357, R7596)
Developing and Testing Ways of Disseminating Animal Health Knowledge

This project has looked at the incidence and impact of tick-borne diseases and mastitis in the small-holder dairying sector in Tanzania. As was reported in last year’s annual report, the initial work on mastitis demonstrated a high incidence of the disease, with 24% of farmers reporting clinical cases of the disease, and 80% of cows testing positive, pointing to the existence of a significant problem with subclinical disease. The project has used a series of techniques to disseminate its findings. A mastitis awareness campaign was introduced; a ‘mastitis roadshow’ had a video screening which brought about a social occasion. 1000 copies of a cartoon poster were distributed extensively to create overall awareness (see below) and a course was held aimed at livestock keepers, extension workers, community animal health workers and ‘cow boys’ to train and educate on the importance of mastitis.

Evaluation of the impact of these dissemination activities has been very encouraging: Prior to the campaign around a third of farmers checked their cattle for mastitis prior to milking. Sixteen weeks after the campaign three quarters did so. Similarly, awareness of the risks associated with drinking raw milk improved as a result of the campaign. This combination of approaches provides a model that could provide useful pointers for the effective dissemination of results of similar adaptive research.

Empowerment through Training

‘Cow boys’ are often either poor relatives or unskilled youths employed at low wages to look after the cows, milk them, cut grass for them to eat, etc. Some cattle keepers were reluctant to have the cow boys they employed attend the course, for fear that having received some training they would demand better wages - strong testimony to the effectiveness of the course and its perceived ability to empower.
INTRODUCTION and GENERAL OVERVIEW

Impact Evaluation of a Selection of Past Research Projects

The impact of a selected subset of previously funded AHP projects was evaluated as part of the DFID-commissioned review of its livestock research projects, undertaken by Landell Mills consultants - 'Impact on Sustainable Livelihoods of Selected Livestock Research Themes'.

The review was completed in July 2000. Its remit was to look through the 220 projects undertaken by the LPP and the AHP over the past decade and identify key themes or a subset of projects which had produced measurable impact. The review team looked in detail at fifteen projects spread over three selected themes:

- draught power (LPP projects);
- smallholder dairying (both LPP/AHP projects); and
- zoonotic diseases (AHP projects).

The review also analysed the economic impact of two subjects of AHP research – discovery and proof that cattle are the main reservoir of rhodesiense sleeping sickness in Uganda and work on rabies control in Tanzania. In both cases, control of the disease in humans was effected by controlling the disease in the animal reservoir, cattle in the case of sleeping sickness and dogs in the case of rabies.

Understanding the Importance of Livestock and the Livestock Management Strategies used by Poor Livestock Keepers

Working in Kenya and Sudan, these projects have analysed the ways in which poor livestock keepers perceive livestock disease, how they diagnose it and what strategies they use for dealing with it. Most of these projects are ongoing, but preliminary results have already helped to clarify a number of issues:

- livestock are proportionally more important to the livelihood security of the poor than the better off (R7359);
- access rather than affordability is the primary constraint on expenditure on drugs amongst all income groups (R7359);
- farmers have imperfect knowledge about disease and its causes, nevertheless they often resort to treating their own cattle, and obtain information on treatment from unqualified sources (R7360);
- participatory methodologies can be used to understand the perceptions of poor livestock keepers, and to involve them in planning and problem solving where other traditional approaches exclude them (R7164).

As these projects come to an end, together they will have produced a set of methods and insights which will illuminate the situation facing poor livestock keepers, and guide research in the other thematic areas.

(R7359, R7360, R7164)
Economic Evaluation of the Control of Sleeping Sickness in Uganda

DFID Livestock Research Review

The review analysed the likely benefits from measures to control sleeping sickness in South-East Uganda. DFID-funded research has proven that cattle are the main reservoir of the disease in this area. As well as the treatment of cattle, the measures taken since 1987 had included some tsetse control using traps as well as disease surveillance in humans. The main innovation was the systematic control of the disease in cattle. The epidemiology of this is being further analysed by project R7596. The benefits of the work done were estimated by comparing the observed reduction in the recorded incidence of the disease to three alternative scenarios for disease incidence in the absence of effective control measures. This is illustrated in the graph below.

Based on historic data, the most likely scenario, 3, was that an epidemic was avoided. For sleeping sickness, as with other zoonotic diseases, the cases diagnosed only represent a fraction of total incidence, so that the true importance of the disease is usually much greater than official statistics imply. Also (see R7596) the number of disability-adjusted life years (DALYs) lost per case of sleeping sickness is high, since the disease is rapidly fatal in about 3% of individuals who are treated, and in all untreated individuals. Since the disease tends to strike the economically active members of the population, the impact on affected household livelihoods is devastating. Taking these facts into consideration, the review estimated that the reduction in the incidence of the disease led to financial benefits due to savings in the costs of treating patients and improved livestock productivity in treated cattle, to be set against the costs of research, intermittent tsetse control, disease surveillance and cattle treatment. The excess of benefits over costs was estimated at a net present value of £3 million. To this must be added the human lives saved, estimated at about half a million DALYs in total over the past ten years. These cannot be valued in financial terms, although an estimate of the loss to the rural economy that they represent can be made, taking into account that the incidence of the disease is highest in the active adult population. This could amount to just over £30 million.
1.4 New Knowledge and Innovations

The following are some examples of new knowledge and innovations that emerged from the programme this year:

- **A novel marker for T.b.rhodesiense parasites** - the presence in T.b.rhodesiense parasites or absence in T.b.brucel of a gene which confers human serum resistance – shows considerable promise as a method to identify livestock that are carrying the human infective parasite that causes rhodesiense sleeping sickness in man. In the past it was difficult to distinguish between the human infective rhodesiense parasite and the closely related T.b.brucel, which only infects livestock. This approach is more sensitive and specific, faster and cheaper than previously used methods, which required the use of laboratory mice and took several weeks to obtain a result. The new method paves the way for the development of a simple, rapid, field test for the identification of rhodesiense parasites in livestock. Application of the above tool will allow the construction of a risk map for human and animal trypanosomiasis in south-east Uganda. The map will be used as the basis for determining cost-effective control and policy options for both the human and animal diseases.

- A number of innovations have emerged from a project working towards more effective vaccines and diagnostic reagents for the disease contagious bovine pleuropneumonia (CBPP) – a disease that causes losses estimated in the region of US$2 billion per year. These include development of a new vaccine that has shown considerable promise in preliminary tests in mice, identification of a better medium to produce CBPP vaccines that significantly extends the useful life of the resultant vaccines and development of a rapid pen-side latex agglutination diagnostic test.

- A DNA finger-printing technique was used to determine feeding preferences of tsetse flies in Zimbabwe. The technique allowed over 90% of bloodmeals to be traced to individual cattle. This revealed that most blood meals were taken from the largest animals within a herd and very few came from calves. This finding has important practical implications in relation to trypanosomiasis control by the application of insecticide to cattle. Firstly, it provides evidence that the practice of not treating young animals, which allows the development of natural resistance to tick-borne diseases, does not compromise the efficacy of using insecticide treated cattle to control tsetse. Secondly, by using insecticide selectively on the larger adult cattle major cost savings can be achieved without any significant reduction in efficacy: Treating half the herd would reduce efficacy by just 5%. Currently cost is a major barrier to the more widespread use of these insecticidal products. The scope for cost savings indicated by this project will make their use more accessible to poor livestock keepers.

- Polymerase chain reaction (PCR) tests were used to identify biting flies infected with trypanosomes in Bolivia. Seven species of fly were shown to have trypanosomes in their bloodmeals, with Tabanus occidentalis being the most numerous. The use of this technique has resulted in a significant advance in knowledge of the fly species incriminated in transmission of trypanosomiasis in Bolivia.

- A new pen-side diagnostic test that can differentiate between peste des petits ruminants (PPR) and rinderpest infected and vaccinated animals has been developed. The ability to differentiate - for the first time - between infected and vaccinated animals will improve the efficiency of diagnosis, assist in delineating rinderpest outbreaks and facilitate ring vaccination. The device can be used by personnel in the field who have relatively little training, such as community-based animal health workers.
The incidence in humans of zoonotic diseases - those transmissible between humans and animals - is relatively small when compared to the major plagues which currently menace the world’s poor. However, the incidence of these diseases is often very localised and confined to communities living in close contact with their livestock - mostly the poor. This, together with the fact that dealing with the disease in animals brings benefits in terms of improved livestock productivity while reducing the risk to humans, provides the basis for affordable control of this group of diseases. By studying the risk factors for humans, such as occupation, diet and links with livestock, it is possible to determine what groups of individuals are likely to catch the disease. Mapping the disease in livestock, to see where the infected livestock populations are found, defines its geographic focus. Control strategies can then target those groups at risk in a very cost-effective way. The zoonotic diseases for which the AHP is currently implementing this approach are sleeping sickness and bovine tuberculosis, both of which are almost invariably fatal if untreated. A new project is about to begin that will focus on brucellosis, a debilitating and usually undiagnosed illness.
Programme Innovations

Dissemination

Commissioned Review Environmental change and the autonomous control of tsetse and trypanosomiasis in sub-saharan Africa" by David Bourn, Robin Reid, David Rogers, Bill Snow and William Wint.

This review examines the historical record of agricultural expansion and environmental change over the past fifty years and assesses their impact on trypanosomiasis in five countries across Africa: Ethiopia, The Gambia, Kenya, Nigeria and Zimbabwe.
1 Opinion of researchers and field workers to identify primary constraints to effective cultural/eradication of rinderpest
2 How existing technology may be improved by research
3 New technologies that would be desirable in terms of durability and sustainability that could be developed through research
4 What economic/socio-economic impact assessment team been made especially relating to impact on the poor
Livestock Health...And Why It Matters

**Livestock Benefits**
- Food transport fuel & different of cultural roles
- Mainstay of important source of household food security for the poor
- Vital to farming systems of the poor
- Providing drought water, manure
- Acts as buffer to crop yields in drought-prone environments
- Particularly important for women for whom they are the most easily held asset

**Human Health Impacts of Livestock**
- Disease-resistance to animals increases significantly; there is awareness of the possible diseases to the community if human health is adversely affected
- These diseases are particularly important to those living in communities with a high incidence of poverty, the elderly, children, and women
- Disease reduces the productivity of farmers and the educational achievement of children residing in a poor return on donor investment

**Zoonoses**
- Livestock can transmit a number of diseases which severely affect the health of livestock keepers and their families

**DFID Funded Research Provides the Tools**

**Controlling the Vector**
- Flies and tsetse flies, developed by DFID research, enable farmers to control tsetse populations themselves

**Controlling the Reservoir of Disease**
- Molecular research has shown the main reservoir of infection of sleeping sickness in Uganda is domestic livestock
- Participatory research methods are helping to develop messages to improve their role by farmers
- Combination of irradiated tsetse can reduce the risk of disease transmission from cattle to human

**Sleeping Sickness Resurgence in Africa: A Cause for Concern**
- The disease caused by tsetse is transmitted by the vector fly, with African Africa, in a reservoir
- There are 40 million people at risk of contracting sleeping sickness, with only 40% of these people being under surveillance. An estimated 300,000 are infected
- Resurgence is now happening in central Africa, resulting in great epidemics comparable to those of the last century where millions of rural people died

Healthy Cows Mean Healthy People
Livestock raisers and healers everywhere have traditional ways of classifying, diagnosing, preventing, and treating common animal diseases. Many of their 'ethnoveterinary' practices offer viable alternatives or complements to conventional, Western-style veterinary medicine — especially where the latter is unavailable, unaffordable, unreliable, or inappropriate.

This volume contains some 700 abstracts from around the world relating to people's animal healthcare, otherwise known as ethnoveterinary medicine. Each abstract, many of them substantial, contains, where possible, details of the livestock disease, the name of the treatment, its method of preparation and administration. The abstracts cover the treatment of animals in 118 countries of Europe, Africa, The Americas, Asia and the Pacific.

Examples of ordinary people’s diverse knowledge, skills, beliefs, and both empirical and medico-religious practices are recorded for some 200 health problems of 25 livestock species kept by more than 160 named ethnicities in these nations.

The species discussed range from 'exotics' like reindeer, camels, elephant, and yak, through more familiar farm animals as well as pet animals, to micro-livestock like fish and bees. Reference is made to 765 plant species or genera, some 45 inorganic items or compounds, and innumerable foodstuffs and household items employed as materia medica in treatments that run the gamut of medicinal, surgical, physical/mechanical, and supernatural. Also noted are well over 100 types of local healthcare specialists. In addition, stockraisers' many astute and often environmentally friendly health-related herding, housing, husbandry, and breeding practices are documented.

The bibliography is aimed at all involved or interested in ethnoveterinary medicine: botanists, animal production professionals, veterinarians, anthropologists, social scientists, rural development professionals and anyone interested in Indigenous Knowledge.
Commissioned Review of Epidemiology and Economics of Tick-borne diseases -
Their Effects on the Livelihoods of the Poor in East and Southern Africa, and in
India - Dr B Minjauw / Dr A McLeod

- An outline of the socio-economic constraints which tick-borne diseases present to
  poor rural and peri urban livestock keepers in eastern and southern Africa and India.
- A review of available control methods for tick borne diseases of livestock in the same
  geographical area, identifying constraints to their use by poor livestock keepers

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**Epidemiology and Economics of Tick-borne Diseases**

Their Effects on the Livelihoods of the Poor
in East and Southern Africa, and in India
Commissioned Didactic Posters on the Epidemiology of Tick-borne Diseases in Sub-Saharan Africa - Dr B. Minjauw (Tick-borne diseases Epidemiologist)

Ticks and tickborne diseases (TBD) are a major cause of animal losses in Sub-Saharan Africa. Of these, diseases transmitted by Boophilus spp. (Anaplasmosis and Babesiosis), Amblyomma spp. (Cowdriosis) and Rhipicephalus spp. (Theileriosis) are the most important.

In order to ascertain the impact of these diseases, the distribution of the vectors, agents and hosts need to be studied and mapped. The availability of actual and potential distribution of ticks and TBD in Sub-Saharan Africa is essential for the recognition of disease outbreaks and the correct diagnosis of animal diseases. Although there is knowledge of vector and disease distribution, most of it needs up-dating. In addition, new analysis and mapping techniques as well as improved models are now available to enable us to get a better picture of the situation.

A series of posters illustrating the distribution of major disease vectors are being produced in collaboration between the UK’s Department for International Development (DFID) and FAO. The first one covered Tsetse in Sub-Saharan Africa. The present Agreement covers the production of two of the 3 posters to be produced to illustrate tick and TBD distribution. The production of the remaining poster in the series will be funded by FAO. The posters will be distributed together with the Newsletter of the International Consortium of Ticks and Tickborne Diseases that has a worldwide reach.
Anaplasmosis and Babesiosis in Sub-Saharan Africa

Anaplasmosis is a "flagellate" that causes non-contagious, acute diseases in domestic and wild animals. The causative agent is the genus Anaplasma, usually transmitted by ticks, but which may also be transmitted mechanically by biting flies and some veterinary observations have also implicated the dog (Canis familiaris). The species is differentiated into two main groups: Anaplasma marginale and Anaplasma platys. Anaplasma marginale is the major cause of anaplasmosis in cattle and is the predominant species in the Americas, while A. platys is more common in Africa.

Demonstration of the organism in a Giemsa-stained blood smear in an animal with anaplasmosis confirms the diagnosis. Two Anaplasma spp. infect cattle: A. marginale and A. platys. At this time, there is no specific treatment for them. However, antibiotics such as tetracycline, erythromycin, or doxycycline can be effective in controlling the disease.

Babesiosis, also known as "redwater," is a parasitic disease of domestic and wild animals caused by the protozoan parasite Babesia. Babesiosis is transmitted by ticks in the same family, the Ixodidae. Babesia species include B. bovis, B. bigemina, B. divergens, and B. musculi. Babesiasis is a serious and often fatal disease in domestic and wild animals.

The life cycle of most Babesia species is typically a 3-host cycle. This cycle is completed on the bovine hosts where red blood cells are normally infected. Some species, however, have a 2-host cycle. Following larval feeding, there are two further life stages: a nymph and a tick. The nymph feeds on the white-tailed deer, while the tick feeds on other mammals.

Anaplasmosis and Babesiosis are both transmitted by ticks. The major African tick species that transmit these diseases are Boophilus decoloratus, B. microplus, and Rhipicephalus sanguineus. These ticks are found in various parts of Africa, and their vectors are responsible for the transmission of these diseases.

The life cycle of most Babesia species is typically a 3-host cycle, meaning that the tick drops off the host between three times in its life cycle. Some species, however, have a 2-host cycle. Following larval feeding, there are two further stages: a nymph and a tick. Babesiosis is a serious and often fatal disease in domestic and wild animals.

The most widely available and effective drug for the treatment of bovine babesiosis is diminazine aceturate (Berenil®) and imidocarb (Imizol®). These drugs are effective in treating both B. bovis and B. bigemina. It is important to note that the prevalence of babesiosis is affected by various tick species and environments.

Anaplasmosis can cause severe anemia and death in cattle, especially in young animals. Babesiosis can cause fever, anemia, and death in domestic and wild animals. The two diseases can be difficult to distinguish, and prompt diagnosis and treatment are crucial to prevent outbreaks.

Anaplasmosis and Babesiosis are both transmitted by ticks. The major African tick species that transmit these diseases are Boophilus decoloratus, B. microplus, and Rhipicephalus sanguineus. These ticks are found in various parts of Africa, and their vectors are responsible for the transmission of these diseases.
Heartwater in Sub-Saharan Africa

Heartwater is a disease caused by the bacteria *B. bovis* and *B. bigemina*, which are transmitted to animals by ticks of the genus Amblyomma. It is prevalent in much of Africa and parts of the Caribbean. The disease is difficult to diagnose and only occurs in animals that have been bitten by infected ticks. Heartwater is generally fatal and can affect animals of all ages. Post-mortem examination is therefore performed to confirm the diagnosis.

Amblyomma species

- **Amblyomma variegatum**: This species is prevalent in much of Africa and is responsible for the transmission of heartwater. It is also responsible for the transmission of other diseases such as tick-borne encephalitis and babesiosis.
- **Amblyomma hebraeum**: This species is prevalent in parts of Africa and is responsible for the transmission of heartwater.
- **Amblyomma cohaerens**: This species is prevalent in parts of Africa and is responsible for the transmission of heartwater.
- **Amblyomma hebraeum**: This species is prevalent in parts of Africa and is responsible for the transmission of heartwater.

Potential distribution of Cowdria ruminantium

Potential distribution of Amblyomma variegatum

Potential distribution of Amblyomma hebraeum

Potential distribution of Amblyomma cohaerens

Potential distribution of Amblyomma hebraeum

Potential distribution of Amblyomma variegatum

Potential distribution of Amblyomma hebraeum

Heartwater or conditions affect cattle, sheep, and goats and some wild ruminants. It is prevalent in much of Africa and parts of the Caribbean. It is caused by the bacteria *B. bovis* and *B. bigemina*. The disease is transmitted to animals by ticks of the genus *Amblyomma*. Heartwater is most severe in small ruminants and less severe in cattle. In small ruminants, heartwater is also known as benign theileriosis.

Heartwater is a significant economic problem in many countries, particularly among small-scale farmers. The disease affects animals of all ages, and the mortality rate can be as high as 100%. Post-mortem examination is therefore performed to confirm the diagnosis.

Amblyomma species

- **Amblyomma variegatum**: This species is prevalent in much of Africa and is responsible for the transmission of heartwater. It is also responsible for the transmission of other diseases such as tick-borne encephalitis and babesiosis.
- **Amblyomma hebraeum**: This species is prevalent in parts of Africa and is responsible for the transmission of heartwater.
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- **Amblyomma hebraeum**: This species is prevalent in parts of Africa and is responsible for the transmission of heartwater.

Potential distribution of Cowdria ruminantium

Potential distribution of Amblyomma variegatum

Potential distribution of Amblyomma hebraeum

Potential distribution of Amblyomma cohaerens

Potential distribution of Amblyomma hebraeum

Potential distribution of Amblyomma variegatum

Potential distribution of Amblyomma hebraeum

References and further reading:


FAO Sub Regional Office, Po Box 3730, Harare, Zimbabwe. Tel: 263 4 253693, Fax: 263-4-703497.

Acknowledgements: We would like to thank the different department of ILRI: Graphics & tick pictures (D. Elsworth), microscopy (C. Wells) and...
Theileriosis is caused by protozoan parasites transmitted by ticks of the genus *Rhipicephalus*, *Haemaphysalis*, or *Aponosoma*. The genus *Theileria* is responsible for the most pathogenic tick-borne disease in cattle. The *Theileria parva* complex transmitted mainly by *Aponosoma appendiculatum* (the Brown Ear Tick) and *A. zambeziensis*, causing East Coast Fever (ECF), affects millions of cattle in eastern and southern Africa, while *T. annulata* transmitted by *Haemaphysalis spp.* and causing Tropical Theileriosis is widespread throughout the Mediterranean basin, the Middle East and Asia. The other species of theeleraeae is responsible for the disease in India. Although indigenous cattle are recognized to be less susceptible than imported exotic breeds, heavy losses are reported in some regions because of endemic instability. The latter is generally caused by insufficient tick control or the seasonal pattern of the tick vector.

Blood or lymph node biopsy (Giemsa stained smears) reveal the presence of organisms or schizonts respectively. The disease is characterized by pyrexia, generalized lymphadenopathy and heparthropathy. Susceptible bovine species usually die within three to four weeks of infection. In the first stage, enlarged lymph nodes, gross hepatomegaly and splenomegaly, are observed. Lymphadenopathy, fever, anemia, and depression are usually observed on the second or third day of clinical symptoms. The condition resembles a septicemia, but with a chronic, relapsing course marked by repeated episodes of clinical disease followed by apparent remission. In treated cases, the disease may appear acute but persist for years as intermittent fevers.

To overcome this, and to provide estimates of the geographical distribution of risk from tickborne disease, the predicted values of habitat suitability for the major African tick species were based on logistic regression models of reported presence and absence of tick species against 49 remotely sensed and interpolated environmental variables. Species range estimates at 0.25 x 0.25-degree resolution were produced using logistic regressions based on climatic factors and in some cases normalized difference vegetation index (NDVI). Since different numbers of variables were used to derive the p-values for each species, and since the number of observations differed, the p-values are not comparable between species, so it would not be appropriate to choose a single cut-off value above which a p-value indicated presence of the species, and below, absence. To overcome this, and to provide estimates of habitat suitability for each tick species for which the risk was highest in each cell. This makes the assumption that all ticks are equal in terms of their contribution to disease risk. The estimated number of animals under tickborne disease risk is only an estimation of the extent of disease without predicting the economic impact of a particular disease.

The long-term effects of tickborne disease on animal production in Africa are likely to be profound. For example, in Kenya, the disease has been shown to reduce milk production by 30% and meat production by 40% in infected animals. The disease also has a significant impact on the productivity of livestock and is a major constraint to the development of the livestock sector in Africa.

Further information can be obtained from:

- Animal Health Programme, Centre for Tropical Veterinary Medicine, The University of Edinburgh, Easter Bush Veterinary Centre, Roslin, Midlothian, EH25 9RG, Scotland, UK; Tel/Fax: (44) (0)131-650-7348; ahp@vet.ed.ac.uk.
- FAO Sub Regional Office, P.O. Box 3730, Harare, Zimbabwe. Tel: 263 4 253693, Fax: 263-4-703497.

Acknowledgements: We would like to thank the different department of ILRI: Graphics & tick pictures (D. Elsworth), microscopy (C. Wells) and the GIS Department.
In 1999 DFID introduced an award scheme for those who manage DFID's programmes of natural resources research. It was designed to acknowledge their role in engaging the UK science community's expertise in tropical science and development and their contribution in commissioning and applying research relevant to the needs of poor people. This booklet presents the entries for the year 2000 award.

Our research in natural resources aims to address the needs of the many millions of people worldwide who do not have enough food or access to other commodities to meet their basic needs. Poor people can improve their livelihoods through better natural resource management. The examples in this booklet illustrate the variety of work which is going on and how collaborative research and effective promotion can make a real contribution to eliminating poverty.

**NATURAL RESOURCES RESEARCH**

**AWARD SCHEME**

**2000/2001**

**IMPROVING POOR PEOPLE'S LIVELIHOODS**
Commissioned Didactic Posters on the Epidemiology of Tick-borne Diseases in Sub-Saharan Africa - Dr B. Minjauw (Tick-borne diseases Epidemiologist)

'Linkages, Livestock, and Livelihoods' is a summary and synthesis of a meeting held at Imperial College at Wye in December 2000. The meeting, organised by NRIL and sponsored by DFID, was the first interagency meeting designed to promote coordination in livestock research for poor people. It brought together research managers from donor and implementing agencies to identify the research priorities, activities, and resources of the participants; areas of common interest; and mechanisms for coordinating future investments in research via a plan of action through which they can commit to working together.

This publication is an output from the DFID Livestock Production and Animal Health Programmes, for the benefit of developing countries, but the views expressed are not necessarily those of DFID.
Trypanosomosis, Tsetse and Africa: The Year 2001 Report has been written for the non-specialist reader and as a complement to the DFID-Funded Tsetse and Trypanosome Research and Development since 1980. This publication is in three volumes and provides a comprehensive review of the subject:

Volume I Scientific Review
Volume 2 Economic Analysis
Volume 3 Summary of Projects
2. Programme Management Strategy

2.1 Management Structure

The AHP is in a state of transition. Over the last eighteen months the programme has become increasingly focused geographically, demographically and with regard to classes of livestock and types of disease. This process is continuing today. The AHP now primarily targets:

- East and Southern Africa, although South Asia may also be included in the future
- Moderately poor people owning/managing small numbers of livestock – for example smallholder dairy farmers
- Marginalized people for whom livestock are an important component of livelihood – this includes pastoralists
- Large stock (cattle, camels, equines) where they underpin livelihoods of poorer people
- Small stock (sheep and goats) as part of a network of income generating activities
- Chronic endemic diseases – such as helminth infections
- Zoonoses (diseases that are transmissible between humans and animals) – such as some forms of tuberculosis and sleeping sickness

Better targeting of AHP funded research will enable the Programme to contribute more effectively to the UK Government’s commitment to work with the world’s governments to halve extreme poverty by 2015.

Four inter-related thematic areas of research address animal health problems related to these targets. Three of these are broadly adaptive:

- **Human Health Impacts of Animal Diseases**
- **Diagnostics and Decision Support Tools**
- **Dissemination and Delivery of Animal Health Knowledge**

whilst a fourth is strategic:

- **Vaccine Development**

In the year 2000/2001, the AHP directed approximately three-quarters of its funding to adaptive research and one quarter to strategic research, the latter being development of improved vaccines for tick-borne and viral diseases.
Currently the portfolio of projects supported by the AHP is heavily biased towards cattle and, for historical reasons, includes some projects that do not address the targets listed above. The balance of the Programme will be gradually improved as these on-going projects are completed and new projects are selected that are more appropriate to these targets. This will be achieved by wider dissemination of the AHP’s revised focus to veterinary, medical and social scientists in the UK, Africa and South Asia and a more pro-active approach to ensure that concept notes address the AHP’s targets.

The thematic grouping of projects has formed an effective structure for the work undertaken this year. The figure below shows how the balance between the themes worked out financially. Twenty-two projects were being undertaken throughout all or part of the financial year 2000/01, of which three were jointly funded with the LPP. Those dealing with human health impacts of animal diseases accounted for about 10% of total funding allocated to the 22 projects, diagnostic support and decision support tools for 35%, dissemination and delivery of animal health knowledge for 31% and vaccine development for 24%. The total funding allocated to the 22 projects was £4.1 million, of which £1.5 million was disbursed by the AHP during 2000/01. The total funding allocated by the AHP to the three joint projects with LPP is £338,000, of which just over £105,000 was disbursed in 2000/01. The chart below shows funding for the lifetime of the 22 on-going projects by theme.

Current AHP Funding by Theme

<table>
<thead>
<tr>
<th>Theme</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Human Health Impacts of Animal Diseases</td>
<td>10%</td>
</tr>
<tr>
<td>Diagnostic and Decision-Support Tools</td>
<td>35%</td>
</tr>
<tr>
<td>Dissemination of Animal Health Knowledge</td>
<td>31%</td>
</tr>
<tr>
<td>Vaccine Development</td>
<td>24%</td>
</tr>
</tbody>
</table>

Total Allocation to Current Projects: £4.1 million

Human Health Impacts of Animal Diseases

The emphasis on research into zoonotic diseases continues reinforced by the positive results from this theme which were obtained by the DFID-commissioned review of livestock research 'Impact on Sustainable Livelihoods of Selected Livestock Research Themes' (Section 1.3).

“Zoonotic diseases are characterised by the fact that their incidence is often very localised, their symptoms are not widely recognised, and many patients spend a lot of time and money obtaining a diagnosis or on the wrong treatment, and all too frequently die in the interim. Responsibility for their control tends to get passed back and forth between the over-stretched medical and veterinary services. The human victims of zoonotic diseases are almost always the isolated rural poor.”

Photo: Sue Welburn
A newly commissioned project has added brucellosis to the cluster of diseases which have been or are being studied: tuberculosis, sleeping sickness, rabies and pork and beef tapeworms. Of the AHP themes, this one perhaps has the clearest poverty focus. As stated in the review:

Although the incidence of some zoonotic diseases is low when compared to the major scourges like AIDS, malaria, and human tuberculosis, they are important for two reasons:

- these diseases are almost always under-diagnosed, so that their real incidence is greater than statistics suggest;
- they tend to occur in clusters that can be identified if the risk factors, which predispose individuals to contract the diseases, are known.

For this reason the existing projects, and the newly commissioned project on brucellosis, emphasize the study of risk factors. A knowledge of risk factors makes it possible to target areas where the disease may be present, testing for the disease and creating public awareness. This makes controlling these diseases far more cost-effective, as does the fact that controlling them in a livestock reservoir almost always yields benefits to livestock production which are sufficient to cover control costs.

There are currently two projects being funded under this theme, to which just over £400,000 has been allocated, of which almost £140,000 was disbursed in 2000/01. Another project is also examining sleeping sickness as well as animal trypanosomiasis, and the newly commissioned project on brucellosis will fall into this cluster.

**Diagnostics and Decision support Tools**

Poor livestock keepers rarely have access to qualified veterinarians. Instead they depend on lower cadres of animal health workers, such as community based animal health workers, or simply have to be self-reliant diagnosing and treating their own animals. Diagnostic laboratories are generally lacking and diagnosis almost always has to be done from an assessment of clinical symptoms. It is likely that many cases are misdiagnosed and many animals treated with inappropriate drugs, leading to unnecessary mortality and morbidity, both contributing to reduced productivity of the livestock of the poor. Currently, there is therefore a pressing and largely unmet need for simple, inexpensive pen-side diagnostics and equally simple decision support systems. The AHP is addressing this need, especially in relation to trypanosomiasis and tick-borne diseases in east Africa.

In parallel with the point-of-care diagnosis of disease, and decision-making on treatment and control regimes, it has been decided to place greater emphasis on the socio-economic component of decision-making at the farmer’s level. Although the AHP has long emphasised the need to develop cost-effective control strategies, the work on this has tended to be more suitable for policy makers and has not really produced information set out in such a way as to facilitate decision-making by livestock keepers. In order to provide farmers and those advising them with the information necessary to choose options which are financially sound, the programme is working towards providing researchers on projects with clear guidelines as to what data needs to be collected, and how information needs to be presented, by adapting standard decision-making formats used in farm planning and management. Because these implicitly involve calculating the potential net benefits from adopting particular control strategies, they will also provide the basis for assessing the overall economic impact of the research work.

There are currently seven projects being funded under this theme, to which just over £1.4 million has been allocated, of which a little over £0.5 million was disbursed in 2000/01.
PROGRAMME MANAGEMENT STRATEGY

Dissemination and Delivery of Animal Health Knowledge

Dissemination and delivery projects were only introduced into the AHP's research portfolio for the first time in 1996. There are currently seven projects running under this theme, which is considered of particular importance in the light of the need to improve dissemination, uptake and delivery of animal health knowledge and products due to:

- the change in the nature of livestock services,
- the need to ensure that the AHP's work is successful in targeting the poor.

About £1.3 million has been allocated to the eight projects under this theme, of which about £435,000 was disbursed in 2000/01. Two of the new projects commissioned this year will add to this cluster. This new cluster has been one of the most dynamic in the AHP's research portfolio and has covered a wide range of activities which include: community animal health workers (CAHWs) and the impact of CAHW schemes, the development of a livestock poverty assessment methodology, the ability of communities to work together to control disease problems such as tsetse flies, the development of participatory rural appraisal (PRA) techniques suitable for work with poor livestock keepers, the role of dukas (shops) selling animal health products in delivery of products and information about disease control, and the development and testing of dissemination materials targeting poor livestock keepers.

This theme is the key to ensuring that the AHP maintains a clear poverty focus, since the projects under this theme profile poor livestock keepers and identify their needs, and develop the methodologies which projects under the other three themes will use to ensure that their projects successfully target and reach the poor and, above all, respond to their needs and requirements.

Vaccine Development

The programme has now broadened its thinking under this heading, to incorporate the insights and direction which have come out of the White Paper on globalisation and the debate discussed at the beginning of this report (See 1.1). Given the low level of investment in tropical diseases and the extremely poor prospects for obtaining private funding, the AHP has commissioned ILRI to investigate what the priority disease control issues are for poor livestock keepers in Africa and Asia, and the likelihood that, with sufficient funding, particular research avenues will be successful providing the technology to make a significant impact on these diseases.

However, the key to the success of such a strategy is sufficient funding. As was discussed in Section 1, investments in combating human disease in the tropics have been akin to trying to crack a rock with a pin – and this is even more true of animal disease. While not necessarily expecting funds to provide the required sledgehammer, it would be desirable to be able to at least upgrade efforts to the log-splitting level. If the AHP it to achieve something significant in the field of strategic research to combat tropical livestock disease, it will need to be able to invest on a sufficient scale to command the human and material resources required.

There are currently 5 projects being funded under this theme, to which nearly £1 million has been allocated, of which almost £0.4 million was disbursed in 2000/01.

Tick-borne Disease Vaccine Thrust

A proposal is currently before DFID for a project to develop an improved vaccine to prevent losses that poor African farmers incur from East Coast fever (ECF), a fatal tick-transmitted disease of cattle in eastern, central and southern Africa. The lead institute will be ILRI, part of the CGIAR, which has
already developed a vaccine based on a parasite antigen that reduces the incidence of severe ECF by 50%. The proposed three year project will focus on identifying additional parasite antigens to enhance the level of protection. These antigens will lead to development of a multi-component subunit vaccine that will be highly efficacious, safe, affordable and easy to deliver to poor farmers. The project will exploit new opportunities in science, particularly the availability of the complete genome sequence of Theileria parva, the causative organism of ECF, and novel technologies for antigen identification and presentation. A consortium of multi-disciplinary teams from advanced research institutes in the UK, national agriculture systems from the target countries and ILRI, will contribute to the high chance of success of the project. An independent scientific panel will evaluate the project annually.

Ex-ante impact assessments in different production systems within the region have demonstrated significant economic benefits to smallholder farmers if they were to adopt vaccine-based control methods for ECF. The benefits will be in terms of reduced disease risk and reduced livestock mortality and morbidity for smallholder dairy, agro-pastoral and pastoral farmers.

Conservative ex-ante impact assessment of research on vaccine development for ECF indicates a benefit to cost ratio of 24 to 1. The new vaccine will have many advantages over the current live parasite vaccine. These will include the elimination of the low temperature cold chain requirement, reduced cost, easier distribution and application, and an absence of reactions following vaccination. An overall demand of 1.8 million doses annually has been predicted, with expected adoption rates ranging from up to 50% in smallholder systems to 5% in agro-pastoral and pastoral systems, the latter being a conservative estimate. Likely intensification of the agro-pastoral system and changes to pastoralist systems will increase both vaccine demand and its delivery over the next 20 years; poverty reduction impacts are likely to be greatest among the intensifying agro-pastoral and pastoral communities.

The recent progress in high throughput DNA sequencing technology has presented ILRI with a significant opportunity to rapidly sequence the entire genome of T. parva, a task that would have taken a lifetime to accomplish only a few years ago. This is currently underway and will be completed by mid 2001 at The Institute for Genomic Research (TIGR), a private non-profit institute in Maryland, USA. Bio-informatics technologies will enable screening of the entire genome sequence data for the identification of candidate vaccine antigens. The other new and important opportunity is the development of novel vaccination methods that elicit robust cell mediated immune responses. Researchers at the University of Oxford have successfully validated this method for malaria and tuberculosis in humans, and ILRI will be drawing on their experience to adapt the methodology for ECF research.
2.2 Programme Development

**Prioritisation of Livestock Diseases that Impact the Poor**
The AHP-managed, DFID-commissioned, study to identify priority areas for international action for the development of livestock technologies will provide a rational basis for the selection of future poverty-focussed AHP projects.

**AHP Workshop in South Africa**
A workshop organised by the AHP in South Africa introduced the programme to animal health scientists working in southern Africa. The outcome of the workshop was three concept notes, one of which has been selected by LPAC for development into a full project memorandum.

**Social Sciences**
A brief overview of the role of the social sciences in the AHP research portfolio was provided by Dr. Alex Shaw for discussion at the November LPAC meeting. This highlighted several aspects. There is a need to distinguish between projects where a social science is the core discipline - mainly those in the dissemination and delivery theme - and those where it is not. Under the dissemination and delivery theme, the AHP should aim to bring researchers together periodically, to manage its research portfolio so that projects complement each other and use a common methodology where appropriate. Where a social science is not the core discipline, there is a need to ensure that projects deliver in two key areas. The first is their diagnosis of the situation, so as to ensure that the poverty focus is present from the start and remains throughout the research work and delivery of outputs. The second is to undertake the economic and financial assessments of the cost-effectiveness of various control measures as initially proposed and in a form suitable for decision-making at the point-of-care/farmer level.

**LIRE**
The role of the Livestock Information and Research Exchange (LIRE) as part of the AHP’s thrust to promote a dialogue with poor livestock keepers, and complete the transition to demand-driven research was mentioned in Section 1.1. This initiative, undertaken jointly with the LPP, will aim to set up processes whereby poor livestock keepers’ (PLK) demand for research outputs is fed through to researchers, so that a ‘market’ for research develops, in which demand generates supply.
## Programme Development 2000-2001

### AHP ACTIVITIES

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<thead>
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<td>Epidemiology of TBD</td>
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<td>[Uganda]</td>
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<tr>
<td><strong>T O T A L</strong></td>
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</tr>
</tbody>
</table>

### Joint Funded

* LPP
** LPP/NRSP
*** Multi-programme
2.3 New Project Proposals

The last call, which went out in July 2000 explicitly stated:

- the categories of poor livestock keepers the AHP is focussing on,
- the new thematic grouping of projects,
- the programme’s geographic area of interest.

It was hoped that this would be successful in eliciting a response that corresponded to the AHP’s current targets (see box Details of last call).

The programme’s concern to ensure that projects maintain a clear poverty focus and deal with relevant cross-cutting issues has now been built into the application and selection process at every stage:

- the concept note includes a set of questions designed to act as a check-list for proposers. Those which specifically address poverty-focus and cross-cutting issues are included in the box;
- in the project memorandum a section deals exclusively with these issues, asking explicit questions designed to assess poverty focus, environmental impacts and impacts on different social groups and a further section tackles the issue of dissemination;
- and finally, this year the review forms for both concept notes and project memoranda were split into two – a scientific and a socio-economic assessment.

The scientific part is reviewed by specialists in the proposals’ core-discipline and the socio-economic part is sent for review to social scientists and covers poverty focus, dissemination and cross-cutting issues. This split was agreed at the June LPAC meeting, and has been effective in ensuring that reviewers feel they are asked questions within their area of expertise (in the past social scientist reviewers commented that they could not assess questions, about say, vaccine development technology, and those developing vaccines felt the same when asked to assess, say, dissemination issues). The split in the review forms has also made it easier to weight and assess the scores given by reviewers, and to ensure that adequate importance is given to the wider cross-cutting issues.
This year all concept notes were reviewed by a total of 68 reviewers, of whom 56 are broadly biological scientists and 12 social scientists. The problem of research proposals receiving widely differing scores from reviewers was less great than in previous years, perhaps reflecting the fact that reviewers were commenting on subjects only within their own area of expertise.

### Details of Last Call

**Focusing on people and their livestock**

AHP research must target appropriate groups of livestock keepers and livestock species for whom the Programme can have specific relevance.

Groups which are appropriate foci for AHP research:
- moderately poor people owning/managing small numbers of livestock,
- marginalised people, including pastoralists, for whom livestock are an important component of livelihood.

Appropriate livestock species for AHP research:
- large stock, cattle and camels where they underpin livelihoods of poorer people,
- small stock as part of a network of income generating activities.

Four inter-related thematic areas of research will address animal health problems of these target groups of poor livestock keepers:
- **point of care diagnostics and decision support systems** aimed particularly at the major endemic diseases of livestock (e.g. tick borne disease, helminth infections and trypanosomiasis),
- **human health impacts of livestock**: zoonoses (e.g. tuberculosis, sleeping sickness, and rabies),
- **dissemination and delivery of animal health knowledge**,
- **tick-borne disease vaccine thrust**.

In addition, under ‘Details for applicants’, it was specified that:
- preference will be given to proposals that are important to the livelihoods of poor people in countries in **Eastern** and **Southern Africa** or **South Asia**.

**Selection of cross-cutting questions from the Concept Note Checklist:**
- Will the technology/product be economically and socially acceptable to local people?
- Will the technology/product benefit poorer people?
- Will the technology/product benefit women?
- Will there be positive environmental benefits?
2.4 Concept Note Reviews (See Annex A)

In response to the call for concept notes of July 2000, a total of 48 concept notes were received and submitted for consideration by the November 2000 LPAC meeting, and a further 3 concept notes were submitted in time for consideration at the February 2001 LPAC meeting. The call was successful in eliciting a response that consisted of a relatively small number of focussed and high quality proposals. The majority of the concept notes clearly addressed one of the four themes, and all targeted either the groups of poor livestock keepers specified in the call, or the human health impacts of livestock disease. The graph below shows the breakdown by theme. A number of concept notes were cross-cutting: in particular 37% of those submitted contained elements of decision support as well as dissemination and delivery of animal health knowledge, and have hence been classified as ‘disease control strategies’. Of the disease clusters tick-borne disease was the largest, accounting for 22% of the 51 concept notes submitted.

The geographic spread was more skewed, with by far the majority (42%) of proposals targeting East Africa, and most of the research being planned for Kenya and Tanzania. Although the submissions do reflect current AHP priorities, the programme would like to see more concept notes from, and more work being done in, Asia, in particular the Indian subcontinent.

Of the concept notes reviewed, 15 were recommended for project memoranda. Thirteen project memoranda were submitted during the year under report.

The review process has been strengthened through the inclusion of a wider base of international reviewers drawn from a diverse range of institutions including WHO, FAO, EU, academia and international research institutes. Four to six experts review each concept note submitted thereby contributing towards a transparent selection process.
2.5 New Projects

Sufficient funds were available for three new AHP projects out of the thirteen full proposals submitted. Projects were selected for their contribution to the AHP portfolio in two key themes - Human Health Impacts of Animal Diseases and Dissemination of Animal Health Knowledge - and, of course, on the basis of the overall quality of the planned research work.

Within the zoonotic diseases theme, a project looking at the incidence, impact on human and animal health and risk factors for brucellosis, was added to the cluster of projects dealing with smallholder milk production in Tanzania. The AHP regards taking on this project as a good example of the type of work it is trying to promote, where several projects:

• target a similar group of producers, in this case smallholder dairy farmers;
• target the human health problems associated with a particular animal product, in this case milk, which is sometimes drunk untreated, so that brucellosis, tuberculosis and other bacteria can be transmitted, and which may also contain antibiotic residues associated with treatment for mastitis;
• use a uniform methodology, which here combines analysis of risk factors, calculation of the disease’s impact on livestock productivity, and dynamic dissemination techniques already developed in conjunction with the work on mastitis.
The second new project adds a new dimension to the dissemination and delivery of animal health theme. It aims to adapt the methodology for Farmer Field Schools (FFS), which was originally developed by FAO for integrated pest management for use by crop farmers in Asia, to cover animal health and livestock productivity issues. FFS have been extremely successful in Asia, and are now also found in large numbers in Africa and parts of South America. The proposed work will be undertaken in Kenya, where this approach has already been successfully used in poultry projects. This project has the potential to add an important new approach to the existing range of delivery methods (community animal health workers, shops which sell drugs for livestock) already included in the AHP research portfolio.

The third new project, 'Message in a bottle', aims to promote on-farm and community-level options for tsetse control which has been developed by DFID-funded research over the past two decades. It has chosen a clear target group, NGOs seeking to advise communities and farmers within those communities, and consequently will promote tsetse-control techniques appropriate to those groups (traps, targets and pour-ons). It may in time also advise on optimal drug regimes, thus taking up research results from the AHP.

The AHP has also taken on one joint project with the LPP. The Livestock Information and Research Exchange (LIRE) aims to set up a dialogue between poor livestock keepers and researchers, so that researchers become aware of the requirements of poor livestock keepers and design and target their research work accordingly. This has been described elsewhere.
2.6 Collaboration with Institutions

The programme works, or will work, in collaboration with a wide range of research institutes and target institutions. These include:

- UK institutes: IAH, NRI, Glasgow, Edinburgh and Liverpool Veterinary Schools, CTVM, Natural History Museum, Moredun Research Institute, VEERU, Oxford University
- The tick-borne disease vaccine development thrust will be implemented through ILRI, a member of the CGIAR.
- The Wellcome Trust is keen to collaborate with the AHP. The Trust’s investment in basic science and technology development will complement the Programme’s more adaptive bias and its excellent links to partners working in the field in the target countries, e.g. East Africa.
- The MRC works with the AHP on sleeping sickness.
- The AHP has been invited to contribute expertise to the WHO’s Scientific Working Group on African Trypanosomiasis – a response to the resurgence of sleeping sickness in Africa.
- The AHP supports livestock orientated NGOs such as VETAID and IIED.

Overall, 35% (£520,531) of the AHP budget for 2000/2001 was spent on collaborating institutions in developing countries.
3. Delivery of Outputs

3.1 Projects Completed 2000-2001

The following projects were completed during the year:

R7361: The development of simple detection assays for Jembrana Disease Virus
Two major outputs were listed in the project proposal: a viral detection system for Jembrana disease and the establishment of a continuous cell line that is permissive for JDV culture. Both specified outputs were achieved.

R7164: Indigenous knowledge, participatory appraisal and animal health information systems: Options for complementary methods in public and private veterinary services in Africa
Three major outputs were listed in the project proposal: improved understanding, attitudes and current use of PA/EVK systems in public and private veterinary services, wildlife services and research institutes in Africa; validated PA/EVK methodologies with associated statistical methods for use in veterinary epidemiology, needs assessment, planning and evaluation; and a participatory appraisal manual targeted at veterinary and wildlife professionals and covering applications of PA/EVK in public and private sector veterinary activities. The first output was fully achieved, the second partially achieved and the third output was not achieved. Key dissemination activities, including the manual, were included in a additional proposal for a one-year project extension that has not to date been funded.

R7595: Impact assessment of community animal health services – a literature review
The literature review has been completed as proposed.

R7356: Incrimination of vectors of Trypanosoma vivax in the new outbreak zone of Santa Cruz, Bolivia
The major output of this project was the ‘identification and incrimination of potential vectors of bovine trypanosomiasis, leading to improved information on the epidemiology of bovine trypanosomiasis in Bolivia’. Polymerase chain reaction tests were carried out on the bloodmeals of 582 flies captured at a farm in Guarayos Province.

Seven species of fly were found to have trypanosomes in their bloodmeals. The most numerous species captured for analysis and that which was positive in greatest numbers for trypanosomes was Tabanus occidentalis. The project therefore successfully achieved this output.

3.2 Unfruitful Activities

The AHP did not find it necessary to terminate any project or programme activity ahead of schedule in the year under report.
3.3 Programme Reporting

Reporting by the project leaders was generally adequate and timely. The Programme reported to DFID as required in terms of quarterly reports. A back-log of four FTRs remain but progress has been made on this aspect during the year.

Project Completion Summaries

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<thead>
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<th>Date Sent to DFID</th>
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<td>4097</td>
<td>Jackal ecology – rabies and wildlife</td>
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<td>30.11.94</td>
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<td>Identification of immuno-dominant antigens of Mycoplasma capricolum subsp capripneumoniae (Mcc), the causal agent of contagious caprine pleuropneumoniae, their expression in bacteria as recombinant proteins, for potential use in vaccines and serological assays</td>
<td>31.03.99</td>
<td>31.05.99</td>
<td>20.09.00</td>
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<td>6556</td>
<td>The development of a recombinant ELISA for Jembrana disease virus</td>
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<td>5937</td>
<td>Use of antibody-labelled colloidal dyes for rapid pen-side differential diagnosis of animal diseases</td>
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<td>6554</td>
<td>The epidemiology of lumpy skin disease in Southern Africa</td>
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<td>Improved diagnosis of Trypanosoma vivax infection in cattle in Bolivia</td>
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Final Technical Reports

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<td>6560</td>
<td>Development of sustainable control methods and diagnostic tools for Western Kenya where trypanosomiasis is a developmental constraint</td>
<td>31.03.99</td>
<td>31.05.99</td>
<td>26.07.00</td>
</tr>
<tr>
<td>5937</td>
<td>Use of antibody-labelled colloidal dyes for rapid pen-side differential diagnosis of animal diseases</td>
<td>31.03.00</td>
<td>31.05.00</td>
<td>20.09.00</td>
</tr>
<tr>
<td>6554</td>
<td>The epidemiology of lumpy skin disease in Southern Africa</td>
<td>30.09.00</td>
<td>30.11.00</td>
<td>26.09.00</td>
</tr>
<tr>
<td>7162</td>
<td>Improved diagnosis of Trypanosoma vivax infection in cattle in Bolivia</td>
<td>31.03.00</td>
<td>31.05.00</td>
<td>26.07.00</td>
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### DELIVERY of OUTPUTS

<table>
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<tr>
<th>Code</th>
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<th>31.03.99</th>
<th>31.05.99</th>
<th>26.07.00</th>
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<tbody>
<tr>
<td>7163</td>
<td>A laboratory animal model for screening of theilerial vaccine candidates</td>
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<tr>
<td>5527</td>
<td>The epidemiology, immunology and control of fasciolosis in dairy cattle in Cajamarca, Peru, an area of infection pressure - follow-up monitoring of R5527</td>
<td>31.03.00</td>
<td>31.05.00</td>
<td>26.07.00</td>
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<td>7173</td>
<td>Cattle management practices in tsetse-affected areas</td>
<td>31.03.00</td>
<td>31.05.00</td>
<td>26.07.00</td>
</tr>
</tbody>
</table>

**Four projects have overdue FTRs:**

- **R6557**: 'Contained trial of modified recombinant capripox-rinderpest vaccine (as produced by R4661) in Kenya' due 31.03.99
- **R7048**: 'Development of a genetically marked rinderpest vaccine' due 31.03.99
- **R7161**: 'Development of immunotherapeutic regimens for the control of amblyomma variegatum associated dermatophilosis based on Dermatophilus congolensis components in the presence of Th1 inducing immunomodulators' due 31.03.00
- **R7366**: 'Comparison of integrated animal health management and integrated pest management of crops in smallholder farming systems' due 31.03.00
### DELIVERY of OUTPUTS

#### 3.4 Publications / Dissemination Outputs (See Annex B)

**Peer-Reviewed Publications**

<table>
<thead>
<tr>
<th>R no.</th>
<th>Shortened Title</th>
<th>Type of Publication</th>
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<tbody>
<tr>
<td>7229</td>
<td>Mycobacterium bovis infection of cattle and man in Tanzania</td>
<td>A x 1</td>
</tr>
<tr>
<td>7357</td>
<td>Quantifying Costs and Risk Factors of Bovine Tuberculosis in Tanzania</td>
<td>None</td>
</tr>
<tr>
<td>7196</td>
<td>CBPP polysaccharide conjugate vaccine (Abbreviated)</td>
<td>A x 13</td>
</tr>
<tr>
<td>7356</td>
<td>Incrimination of Vectors of Trypanosoma vivax in the New Outbreak Focus of Santa Cruz, Bolivia</td>
<td>A x 1</td>
</tr>
<tr>
<td>7361</td>
<td>The Development of Simple Virus Detection Assays for Jembrana Disease Virus</td>
<td>A x 2</td>
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<tr>
<td>7362</td>
<td>Pen-side Diagnostics for the Detection of Antibodies Against a Marked Rinderpest Virus</td>
<td>None</td>
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<tr>
<td>7364</td>
<td>The Use of DNA Profiling to Establish the Feeding Responses of Tsetse to Cattle</td>
<td>A x 1</td>
</tr>
<tr>
<td>7596</td>
<td>Decision support for trypanosomiasis control</td>
<td>A x 7</td>
</tr>
<tr>
<td>7597</td>
<td>Haemoglobinometer</td>
<td>A x 3</td>
</tr>
<tr>
<td>7599</td>
<td>Alternative FMD and TBD Control Strategies for South Africa</td>
<td>None</td>
</tr>
<tr>
<td>7050</td>
<td>Sustainable use of wildland resources: Ecological, social and economic interactions</td>
<td>None</td>
</tr>
<tr>
<td>7164</td>
<td>Indigenous knowledge, participatory appraisal and animal health information systems</td>
<td>A x 2</td>
</tr>
<tr>
<td>7271</td>
<td>Optimising milk production in small holder dairy farms in Tanzania</td>
<td>None</td>
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<tr>
<td>7359</td>
<td>The Delivery of Animal Health Services to the Rural Poor: A Framework for Analysis</td>
<td>None</td>
</tr>
<tr>
<td>7360</td>
<td>Field Methods and Tools for Resource-poor Farmers and Extension Workers to Improve Use of Drugs for Control Trypanosomiasis</td>
<td>None</td>
</tr>
<tr>
<td>7595</td>
<td>Impact assessment of Community Animal Health Services – A review</td>
<td>A x 2</td>
</tr>
<tr>
<td>7598</td>
<td>Role of dukas in livestock information and health delivery</td>
<td>None</td>
</tr>
<tr>
<td>7358</td>
<td>Development of a Subunit Vaccine against ECF Using a Novel Prime-boost Immunisation Strategy</td>
<td>None</td>
</tr>
<tr>
<td>7363</td>
<td>Investigation of the Immunogenic Potential of Heartwater (Cowdria ruminantium) Grown in Tick Cell Lines</td>
<td>None</td>
</tr>
<tr>
<td>7365</td>
<td>Identification of Antigens of Theileria parva and Evaluation of their Vaccine Potential in Laboratory Trials</td>
<td>None</td>
</tr>
</tbody>
</table>

**Key to Scoring for Publication Categories:**

- **A** - Papers in refereed journals, book chapters, edited international conference proceedings or bulletins (published or accepted for publication)
- **B** - Scientific abstracts, oral presentations, posters, non-edited conference proceedings
- **C** - Internal Reports
- **D** - Newsletters, technical leaflets, lecture presentations, manuals, handbooks, etc.
- **E** - Ph.D. Theses
- **F** - M.Phil/M.Sc. theses
- **F*** - Undergraduate level theses
- **G** - Miscellaneous (e.g. radio/ TV programmes, video, oral presentations to non-scientific audiences)
- **H** - Computer software (including data-bases) and websites
### 3.5 Publications / Dissemination Outputs (Annex B)

#### Non Peer-Reviewed Publications

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Type of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>7229</td>
<td>Mycobacterium bovis infection of cattle and man in Tanzania</td>
<td>B x 4</td>
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<tr>
<td>7357</td>
<td>Quantifying Costs and Risk Factors of Bovine Tuberculosis in Tanzania</td>
<td>B x 2</td>
</tr>
<tr>
<td>7196</td>
<td>CBPP polysaccharide conjugate vaccine (Abbreviated)</td>
<td>B x 1</td>
</tr>
<tr>
<td>7356</td>
<td>Incrimination of Vectors of Trypanosoma vivax in the New Outbreak Focus of Santa Cruz, Bolivia</td>
<td>B x 3, D x 4, G x 1, H x 1</td>
</tr>
<tr>
<td>7361</td>
<td>The Development of Simple Virus Detection Assays for Jembrana Disease Virus</td>
<td>None</td>
</tr>
<tr>
<td>7362</td>
<td>Pen-side Diagnostics for the Detection of Antibodies Against a Marked Rinderpest Virus</td>
<td>None</td>
</tr>
<tr>
<td>7364</td>
<td>The Use of DNA Profiling to Establish the Feeding Responses of Tsetse to Cattle</td>
<td>B x 1, G x 1</td>
</tr>
<tr>
<td>7596</td>
<td>Decision support for trypanosomiasis control</td>
<td>C x 1, G x 1</td>
</tr>
<tr>
<td>7597</td>
<td>Haemoglobinometer</td>
<td>D x 1</td>
</tr>
<tr>
<td>7599</td>
<td>Alternative FMD and TBD Control Strategies for South Africa</td>
<td>None</td>
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<tr>
<td>7050</td>
<td>Sustainable use of wildland resources: Ecological, social and economic interactions</td>
<td>B x 1</td>
</tr>
<tr>
<td>7164</td>
<td>Indigenous knowledge, participatory appraisal and animal health information systems</td>
<td>B x 2</td>
</tr>
<tr>
<td>7271</td>
<td>Optimising milk production in small holder dairy farms in Tanzania</td>
<td>B x 10</td>
</tr>
<tr>
<td>7359</td>
<td>The Delivery of Animal Health Services to the Rural Poor: A Framework for Analysis</td>
<td>B x 4, H x 1</td>
</tr>
<tr>
<td>7360</td>
<td>Field Methods and Tools for Resource-poor Farmers and Extension Workers to Improve Use of Drugs for Control Trypanosomiasis</td>
<td>None</td>
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<tr>
<td>7595</td>
<td>Impact assessment of Community Animal Health Services - A review</td>
<td>B x 6, C x 1</td>
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<tr>
<td>7598</td>
<td>Role of dukas in livestock information and health delivery</td>
<td>B x 3, C x 1, F x 1</td>
</tr>
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<td>Identification of Antigens of Theileria parva and Evaluation of their Vaccine Potential in Laboratory Trials</td>
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</tr>
</tbody>
</table>
DELIVERY of OUTPUTS

3.6 List of Reports and Datasets

R7050


Database of household survey questionnaires in 24 villages adjacent to Serengeti National Park.

R7164


R7357

R7359
Report: The Delivery of Veterinary Services to the Poor: Preliminary findings from Kenya (88 pages).

Dataset: Livestock Poverty Assessment: Bolivia

Literature Review: Livestock Disease and Poverty Impacts (81 pages)

Literature Review: Bias in Participatory Methods (40 pages)

R7598
Database of agrovet stores in 4 districts of Kenya. MS Access database, KARI/CTVM.

R7599
Andrew Ainslie submitted a report entitled: Partial feasibility study of Project R7599.

Report on the Design of a Longitudinal Study "Spatial and Temporal Patterns of FMD Vaccination Coverage and Tickborne Disease Infection" by Professor Dirk Pfeiffer, Royal Veterinary College, University of London and Dr. Dan Haydon, Centre of Tropical Veterinary Medicine, University of Edinburgh.

Prof. Pfeiffer designed a questionnaire to be used when farmers participate in the study to determine whether their quality of life will be influenced by the project.
Peer and Non-peer Reviewed Publications

Human Health impacts of Animal Diseases

R7229 - Mycobacterium bovis infection of cattle and man in Tanzania


R7357 - Quantifying Costs and Risk Factors of Bovine Tuberculosis in Tanzania


Diagnostics and Decision Support Tools

R7196 - CBPP polysaccharide conjugate vaccine (Abbreviated)


R7196 - CBPP polysaccharide conjugate vaccine (Abbreviated) continued


R7356 - Incrimination of Vectors of Trypanosoma vivax in the New Outbreak Focus of Santa Cruz, Bolivia


JL Aramayo Bejarano, Hall, M. and J. Chainey participated in two seminars on bovine trypanosomiasis organised by UNIVEP, Fegaben and the Universidad Tecnica “Mariscal Jose Ballivan” in Trinidad, Bolivia, 21 and 22 March 2000 [D]

J.L. Aramayo Bejarano Oral presentation on work of the project at the IX Congreso Ibérico de Entomologia, held in Zaragoza, Spain (3-7 July 2000) [B]
R7356 - Incrimination of Vectors of Trypanosoma vivax in the New Outbreak Focus of Santa Cruz, Bolivia continued

J.L. Aramayo Bejarano Oral presentation on tabanids and trypanosomiasis to field veterinarians and livestock workers at three seminars convened by LIDIVET collaborators for livestock workers in San José de Chiquitos (14 October 2000), Puerto Suarez (2 December 2000) and Santa Cruz (14 December 2000) [D]

J.L. Aramayo Bejarano Poster presentation on tabanids and trypanosomiasis at Feria of Universidad Autonoma “Gabriel Rene Moreno”, Santa Cruz, November 2000. [B]

M. Hall, J.L. Aramayo Bejarano and T. Jones Oral presentations at Ciclo de Conferencia Internacional “Los Transmisores de la Tripanosomiasis Bovina” held on 14th March 2001 at LIDIVET, Bolivia, attended by 80 persons from the livestock industry. [D]

Production of Spanish Language leaflet on “La Tripanosomiasis Bovina (Trypanosoma vivax) with one further leaflet on tabanids and control to follow, March/April 2001. [D]

Production of a 15-minute documentary video on the project work by “CANAL 11” television company, Santa Cruz. [G]

Preparation of WWW site detailing results from the project, for publication in April/May 2001 (http://www.nhm.ac.uk/entomology/). [H]

R7364 - The Use of DNA Profiling to Establish the Feeding Responses of Tsetse to Cattle


Dr Torr presented results to livestock specialists and/or owners at workshops in Zimbabwe (April 2000; October 2000) and Ethiopia (July 2000) [G]

R7596 - Decision support for trypanosomiasis control


Waking up to reality? New Agriculturalist on-line 3/6/01 [G]

Dissemination and Delivery of Animal Health Knowledge

R7050 - Sustainable use of wildland resources: Ecological, social and economic interactions

R7164 - Indigenous knowledge, participatory appraisal and animal health information systems

R7271 - Optimising milk production in small holder dairy farms in Tanzania
R7271 - Optimising milk production in small holder dairy farms in Tanzania continued


R7359 - The Delivery of Animal Health Services to the Rural Poor: A Framework for Analysis


R7595 - Impact assessment of Community Animal Health Services – A review


Oral presentation of Cochrane methods to veterinary clinicians, Royal “Dick” School of Veterinary Studies, University of Edinburgh [B]

Oral presentation of results to graduate students, Centre for Tropical Veterinary Medicine, University of Edinburgh [B]
ANNEX A

R7595 - Impact assessment of Community Animal Health Services – A review continued
Oral presentation of results to graduate students, Moredun Research Institute, Midlothian, Scotland [B]
Oral presentation of results to undergraduate students, faculty, VSF Europa representatives and members of
DIO (VSF Netherlands), Veterinary Faculty, Utrecht, the Netherlands [B]
Oral presentation of results to members of civil society at the Farm Africa offices, London. Present included
representatives from the Brooke Hospital for Animals, Acord, VEERU, DFID Livestock Production
Programme, and Farm Africa [B]
Poster presentation, Cochrane Colloquium, Cape Town [B]
Martin, M. (2001). The Impact of Community Animal Health Services on Farmers in Low-Income Countries: A
Literature Review. VETAID. (ISBN number pending) [A]

R7598 - Role of dukas in livestock information and health delivery
Emongor, R., Okuthe, O.S., Wamwayi, H.M., Ngotho, R.N., Wanyangu, S.W., Sumption, K., Wanjala, K. and
[B]
delivery presented at a DFID AHP stakeholders workshop, October 23rd, 2000, Nairobi. [B]
Wamwayi, H.M., Okuthe, O.S., Ngotho, R.N., Sumption, K.J., Emongor, R.A., Wanyangu, S.W. and Fielding, D.
report submitted to senior KARI management (February, 2001) [B]
Lewis, S. The role of the agro-vet shop in animal health information delivery in Kenya. MSc dissertation,
University of Edinburgh. [F]
Review of the legislation regarding Animal health Services in Kenya. KARI internal document [C]

Vaccine Development

R7361 - The Development of Simple Virus Detection Assays for Jembrana Disease Virus
of two bovine lentiviruses in the cattle population of Bali. Veterinary Microbiology (In press) [A]
against Jembrana disease virus in Bali cattle sera using a recombinant ELISA. Journal of Clinical Virology,
18:67 (Eurovirology 2000, Glasgow). [A]
4 Uptake Promotion

4.1 Promotion of Project Outputs

Two strategies for promoting projects’ outputs are being implemented:

Looking at past work in the field of strategic research, published results are taken up as appropriate and built upon by other researchers. However, during the coming year the AHP intends to review projects completed during the last five years, to see whether there is any potential for further promotion or development of their outputs.

With respect to current work, the AHP would, firstly, like to state how successful researchers have been in identifying appropriate target groups, involving stakeholders and disseminating their own outputs at many levels. This successful shift in outlook towards paying greater attention to delivery has gone hand in hand with the increased poverty-focus which is now evident in all projects. Among the adaptive projects, a particularly successful formula has been working together with communities in such a way that research results are obtained within the community, and almost immediately taken up by that community – as has been the case with messages about greater milking hygiene to lower the incidence of mastitis, or information about avoiding risks of contracting bovine tuberculosis, such as drinking raw milk. The AHP will continue to foster this type of approach, which will be underpinned by the results of the two initiatives designed to help AHP research target the requirements of poor livestock keepers more closely: the DFID commissioned study to identify and prioritise livestock disease research opportunities and the establishment of the Livestock Information Research Exchange. Matching demand and supply in this way will ensure that research results are needed and therefore taken up.
4.2 Uptake Promotion

For the further promotion of uptake of its outputs, the AHP main thrust during the coming year will be geared towards:

- consolidating its research into delivery and dissemination, by reviewing past and present work on this theme and identifying gaps;
- identifying a more diverse range of media and formats for disseminating AHP research outputs both to end users and the wider public.
4.3 Programme Outputs

Human Health Impacts of Livestock: Zoonoses

**R7229: Mycobacterium bovis  Infection of Cattle and Man in Tanzania**

A principal output of the initial phase of the project has been improved collaboration between medical, veterinary and wildlife sectors and enhanced awareness of the zoonotic risks of bovine tuberculosis. The integration of personnel at the workshop and during field studies has had an impact at the level of Directors as well as at the District and village level. During the course of tuberculin-testing and questionnaire surveys, public health information on tuberculosis and other zoonoses (e.g. brucellosis, rabies) has been disseminated informally to community leaders and householders.

**R7357: Quantifying Costs and Risk Factors of Bovine Tuberculosis in Tanzania**

- The institutional impact of the project continues to be important, with increasing collaboration between veterinary, medical and wildlife sectors and growing awareness among Directors and Ministers of the importance of integration between different Ministries.
- For both the human and cattle case-control study, outputs will be in the form of odds ratios, quantifying the relative importance of different risk factors. This will identify key areas for development of control strategies, in both cattle and people, that can be targeted directly to farmers, consumers of animal products, community-based animal/human health workers, local government, and policy makers within the relevant Ministries.

Calculation of a DALY score for zoonotic tuberculosis will provide policy makers with information on the public health significance of the disease, which can be compared with other zoonoses in Tanzania to evaluate public health priorities.
Latex agglutination test results after five minutes on glass slides

Current diagnosis of contagious bovine pleuropneumonia depends upon laboratory-based tests such as ELISA or complement fixation. A rapid latex agglutination test has been developed as part of DFID R7196 which is based upon detection of capsular polysaccharide antigen in the serum of infected animals. The test is particularly suitable for diagnosis of acutephase animals, or animals at the onset of infection before a serological response is present.

R7196: CBPP Polysaccharide Conjugate Vaccine

Restriction enzyme findings (last year) will have significant economic and scientific/health impacts in research and diagnostic institutes throughout the Third World. These findings will be of only to CBPP research but most generally should positively affect the health of both animals, and more importantly, humans. Vaccines and diagnostic reagents, if they prove to be successful in the field (as well as the laboratory), should have significant impact at the level of the individual farmer, but only if properly developed and implemented- this is likely to require further funding. Our stabilised vaccine formulation should have positive impact at the level of individual farmers, but again, only if publicised and implemented.

R7356: Incrimination of Vectors of Trypanosoma vivax in the New Outbreak Zone of Santa Cruz, Bolivia

In the study of trypanosomes in vectors, 1164 polymerase chain reaction tests (PCR’s) were carried out on the bloodmeals of 582 flies captured on cattle at Chocolatal. Seven species of fly were found to have trypanosomes in their bloodmeals: one species was positive only for Trypanosoma vivax, one species only for T. evansi and five species positive for both. The most numerous species captured for analysis and that which was positive in greatest numbers for trypanosomes was Tabanus occidentalis. Trypanosomes were found in approximately 7% of completed bloodmeals.

R7361 - The Development of Simple Virus Detection Assays for Jembrana Disease Virus

During the period of research the virus antigen detection ELISA has been developed using new reagents created as a direct result of the funding. The development of a culture system for JDV was initiated as detailed.

R7362: Pen-side Diagnostics for the Detection of Antibodies against a Marked Rinderpest Virus (RPV) Vaccine to allow Differentiation of Vaccinated from Infected Animals

A new pen-side diagnostic test to differentiate between PPR and rinderpest infected and vaccinated animals. The ability to differentiate between infected and vaccinated animals will improve the efficiency of diagnosis, assist in delineating rinderpest outbreaks and facilitate ring vaccination. This should reduce livestock losses and increase the livelihood and food supply of local farmers. Because of the nature of the devices, they can be used by personnel in the field who have had relatively little training and are ideally suited to the Community-based Animal Health Workers (CAWS).
R7364: The Use of DNA Profiling to Establish the Feeding Responses of Tsetse to Cattle

The outputs will contribute towards developing a sustainable, environmentally beneficial and cost-effective strategy for controlling trypanosomiasis using insecticide-treated cattle. The work indicates that a selective dipping strategy, based on the treatment of the larger animals within a herd can achieve more cost-effective control. Such a strategy will be particularly cost-effective for poorer livestock-keepers in Zimbabwe, Tanzania and Ethiopia who typically have small heterogeneous herds of cattle. The findings are being used in the design of community-based tsetse control operations being conducted in Ethiopia and Tanzania and government-funded operations in Zimbabwe.

R7596: Decision Support System for the Control of Trypanosomiasis in South-East Uganda: Improving Public Health and Livestock Productivity Through Cost-effective Control of Trypanosomiasis in Livestock

The case controlled study on the origins of the new sleeping sickness outbreak to be published in The Lancet will be of direct relevance to policy makers concerned with the control of trypanosomiasis in both the medical and agricultural sectors of east Africa and international agencies (such as WHO). The construction of a risk map for human and animal trypanosomiasis in SE Uganda on which to base and cost control and policy options for both animal and human disease.

R7597: A Low-cost Haemoglobinometer as a Decision-support Tool for Bovine Disease Diagnosis in Sub-Saharan Africa

The information on clinical signs and haemoglobin levels obtained will be disseminated in a scientific publication and also extension material to be specifically distributed directly to animal health workers in East Africa in a range of institutes from ILRI, Ministry of Agriculture District Veterinary Offices and NGOs working in the target production systems. Modalities for the wider distribution of the haemoglobinometer and associated decision support system to animal health workers in the field will be investigated in order to achieve the greatest possible impact on animal health.

R7599: Development of Alternative Foot and Mouth and Tick-borne Disease Strategies to Benefit Resource Poor Farmers in South Africa

The market feasibility study will enable us to contact various stakeholders for possible funding should we see that feedlots and abattoirs will assist the people currently affected by the FMD control policies in marketing their livestock. Such possibilities need to be discussed with the Directorates of Veterinary Services as they are responsible for movement policies out of the control zones. The small-scale farmers will receive information packages on several very relevant topics and training on animal improvement and marketing. The FMD information packages will be distributed outside the FMD control areas to sensitise more farmers about the importance of the disease.

The serological data will be used in mathematical modelling and risk analysis. This data is very important to the Directorate of Veterinary Services to investigate the efficacy of their current disease control strategies and to propose changes so that a repeat of the FMD outbreaks does not occur.
R7050: Sustainable Use of Wildland Resources: Ecological, Social and Economic Interactions

Methods were developed for collection of information from arrests by ranger patrols and were adopted by Tanzania National Parks for wider use in all parks - by the end of the project providing valued management-related information with potential for influencing policy-level decisions. Participatory techniques and household questionnaires, with training in their use, were employed in villages adjacent to the park. Together these data enabled an analysis of key linkages between rural livelihoods and poaching. The training provided will enable similar work to be carried out in other areas by Park’s Community Conservation Service staff.

R7271: Optimising Milk Production in Smallholder Dairy Farms in Tanzania: Studies of the Epidemiology and Socio-economics of Animal Disease and the Quality and Safety of Milk

1. Estimates of the frequency of mortality and morbidity in dairy cattle, particularly tick-borne disease and mastitis. 2. Estimates of the contribution of independent variables to the risk of disease and to productivity. 3. Effective dissemination methods of mastitis knowledge. Impact: Veterinary Departments, NGOs (dairy development programmes), smallholder farmers.


Improved understanding, attitudes and current use of PA/EVK systems in public and private veterinary services, wildlife services and research institutes in Africa. This output was fully achieved, primarily by a questionnaire survey of veterinarians working in Africa. Validated PA/EVK methodologies with associated statistical methods for use in veterinary epidemiology, needs assessments, planning and evaluation. This output was partly achieved with 6 PA methods validated and 7 statistical methods applied to data derived from PA. Field research was conducted in 2 countries. A participatory appraisal manual targeted at veterinary and wildlife professionals and covering applications of PA/EVK in public and private sector veterinary activities. This output was not achieved. Key dissemination activities, including manual production, were included in a proposed project extension that has not yet been approved for funding.
R7359: The Delivery of Animal Health Services to the Rural Poor: A Framework for Analysis

1. Livestock Poverty Assessment: A methodology to identify poor livestock keeping households based upon a simplified SL framework and Participatory Poverty Assessments. Clients of the LPA include CGIAR centres, research institutes, governments, donors, NGOs and indeed farmers and pastoralists themselves who will benefit from better targeted more appropriate animal healthcare projects.

2. An Assessment of Livestock in the Livelihoods of the Poor: By illuminating the role of livestock in the livelihoods of the poor, NGOs, donors and research institutes may evaluate the relevance of their activities to poverty alleviation strategies. Further, Understanding livestock as a means of both acquiring and maintaining social capital is fundamental to improving the impact and uptake of animal healthcare projects specifically and livestock development projects more generally. The findings will be useful for a large variety of stakeholders: research centres, donors, governments, NGOs, CBOs and ROs at both the policy and implementation levels.

3. Key parameter assessment: A methodology to identify key parameters important for the uptake of animal healthcare programmes has been developed. By creating a system that evaluates needs prior to project implementation and determines poverty impact after start up, donors, NGOs and governments will gain from the improved cost-effectiveness and sustainability of programmes. Herders and farmers will also benefit from projects that are directly responsive to their needs.

4. Policy Recommendations: Finally, by establishing mechanisms to enhance the collaborative links both with and between donors and NGOs, the results of the research will support the development of pro-poor livestock development policy at a global level. All of the above named stakeholders will benefit from the collaborative linkages.
**R7360: Field Methods and Tools for Resource-Poor Farmers and Extension Workers to Improve Targeting and Appropriate Use of Drugs Used for Control of African Bovine Trypanosomiasis**

The project will contribute directly to the Livestock Production and Animal Health Programme – Peri-urban Intensive Purpose: ‘Improvement in the performance of livestock through the control of disease’, Output 4 ‘To evaluate smallholders’ perceptions of trypanosomiasis’ and Output 5 ‘To develop animal health messages for knowledge transfer to smallholder farmers’. Ultimate beneficiaries will be resource poor households dependent upon livestock for maintenance of livelihoods, smallholder farmers, particularly women who play a key role in livestock management in Africa. Intermediate beneficiaries from community education material will be schools, Women’s Groups, community based organisations and NGOs. Target Institutions are Kenya Agricultural Research Institute (KARI), Kenya Trypanosomiasis Research Institute (KETRI) and other NARS; EU Regional Projects: Farming in Tsetse Controlled Areas (FITCA) - East Africa; Regional Tsetse and Trypanosomosis Control Programme (RTTCP) - Southern Africa, FAO/IAEA, Programme Against African Trypanosomiasis (PAAT), DFID-NRRD.

**R7595: Impact Assessment of Community Animal Health Services – A Literature Review**

Project completed and literature review produced.

**R7598: Identification of the Role of Dukas in Animal Health Information and Service Delivery**

Reports will be written on the distribution and characteristics of agro-vet dukas in different livestock production zones of Kenya; Report on the effectiveness of rural dukas in the delivery of drugs and information on animal health in the target communities, and possible strategies for improvement; Report on the impact of simple information and training in selected animal health topics upon quality of services and information delivered by the dukas. The results (also from 1 and 2) will be presented, discussed, reviewed and documented at a stakeholder's workshop held towards the end of the project. Recommendations for dissemination of animal health information through dukas; guidelines for animal health information dissemination, research and extension workers; will be made available to stakeholders in East Africa, (Vet Dept, KARI, at OAU/IBAR, donors (DFID/AHP) and will include non-governmental organisations active in the field.
**R7358: Development of a Subunit Vaccine Against East Coast Fever in Cattle Using a Novel Prime-boost Immunisation Strategy**

The project outputs will be progress towards an experimental sub-unit vaccine against East Coast Fever, through development of a generic technology for induction of antigen-specific, class I MHC restricted T cells in ruminants. If successful such a subunit vaccine will ultimately lead to reduced use of toxic acaricides and increased productivity for small scale farmers in Kenya and other Southern and Eastern African countries where ECF is endemic. A recent analysis of market potential for East Coast fever vaccine sales by system in the year 2025 revealed that 42% of the predicted market would be in the small scale dairy sector and 25% in Agro pastoral systems.

![Photo: Lesley Sakyi](image.jpg)


Cowdria grown in tick cells has induced a protective immune response in sheep against experimental challenge with both homologous and cross-protective heterologous isolates, confirming its immunogenicity and potential for contributing to improved heartwater vaccines. As part of the EU INCO-DEV project “Integrated diagnostic and recombinant vaccine development for cowdriosis and anaplasmosis” the Cowdria/tick cell culture system is contributing to investigation of differential stage-specific gene transcription. Tick cell lines supplied by the project to medical, veterinary and biological research laboratories in UK and Europe for viral, rickettsial and tick genome studies are raising the profile of DFID-funded tick cell culture work.
4.4 Progress Towards Achievement of Outputs

The AHP log frame has two outputs:

1. Cost-effective and appropriate strategies developed to sustainably control diseases of livestock that affect the livelihood of the poor.

2. Promotion of proven strategies to control diseases of livestock that affect the livelihoods of the poor.

During the year under report, thirteen projects have contributed to Output 1 and seven projects to Output 2. Three new projects will be added to the AHP portfolio for 2001/2002; 2 will contribute to Output 1 and one to Output 2.
### 4.5 Progress towards Impact

#### Progress:  
- **R No.**  
- **Shortened Title**  
- **Progress:**  
  - Uptake Pathway  
  - Target Groups  

<table>
<thead>
<tr>
<th>R No.</th>
<th>Shortened Title</th>
<th>Progress</th>
<th>Target Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>7229</td>
<td>Mycobacterium bovis infection of cattle and man in Tanzania</td>
<td>A, B, D</td>
<td>E, G, H</td>
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<td>7357</td>
<td>Quantifying Costs and Risk Factors of Bovine Tuberculosis in Tanzania</td>
<td>A, B, C</td>
<td>G, H, I</td>
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<td>7196</td>
<td>CBPP polysaccharide conjugate vaccine (Abbreviated)</td>
<td>B</td>
<td>A, B, C</td>
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<tr>
<td>7361</td>
<td>The Development of Simple Virus Detection Assays for Jembrana Disease Virus</td>
<td>B/C</td>
<td>E, H, K</td>
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<tr>
<td>7362</td>
<td>Pen-side Diagnostics for the Detection of Antibodies Against a Marked Rinderpest Virus</td>
<td>C</td>
<td>G, H, J</td>
</tr>
<tr>
<td>7364</td>
<td>The Use of DNA Profiling to Establish the Feeding Responses of Tsetse to Cattle</td>
<td>D</td>
<td>H, I, J, K</td>
</tr>
<tr>
<td>7596</td>
<td>Decision-support for trypanosomiasis control</td>
<td>B</td>
<td>G, H, I, K</td>
</tr>
<tr>
<td>7597</td>
<td>Haemoglobinimeter</td>
<td>B</td>
<td>D, E, I</td>
</tr>
<tr>
<td>7599</td>
<td>Alternative FMD and TBD strategies in South Africa</td>
<td>B</td>
<td>E, G, H</td>
</tr>
<tr>
<td>7050</td>
<td>Sustainable use of wildland resources: Ecological, social and economic interactions</td>
<td>E</td>
<td>H</td>
</tr>
<tr>
<td>7164</td>
<td>Indigenous knowledge, participatory appraisal and animal health information systems</td>
<td>B</td>
<td>A, D, E F, H</td>
</tr>
<tr>
<td>7271</td>
<td>Optimising milk production in small holder dairy farms in Tanzania</td>
<td>G</td>
<td>H, K</td>
</tr>
<tr>
<td>7359</td>
<td>The Delivery of Animal Health Services to the Rural Poor: A Framework for Analysis</td>
<td>A, B, C, D</td>
<td>A, D, E, G</td>
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<tr>
<td>7360</td>
<td>Field Methods and Tools for Resource-poor Farmers and Extension Workers to Improve Use of Drugs for Control Trypanosomiasis</td>
<td>D</td>
<td>D, E, F, H, I, K</td>
</tr>
<tr>
<td>7595</td>
<td>Impact assessment of Community Animal Health Services – A review</td>
<td>D</td>
<td>A, I</td>
</tr>
<tr>
<td>7598</td>
<td>Role of dukas in livestock information and health delivery</td>
<td>A, B</td>
<td>A, E, H, I</td>
</tr>
<tr>
<td>7358</td>
<td>Development of a Subunit Vaccine against ECF Using a Novel Prime-boost Immunisation Strategy</td>
<td>B</td>
<td>B, C, J, K</td>
</tr>
<tr>
<td>7363</td>
<td>Investigation of the Immunogenic Potential of Heartwater (Cowdria ruminantium) Grown in Tick Cell Lines</td>
<td>F</td>
<td>D, E</td>
</tr>
<tr>
<td>7365</td>
<td>Identification of Antigens of Theileria parva and Evaluation of their Vaccine Potential in Laboratory Trials</td>
<td>B</td>
<td>D, E</td>
</tr>
</tbody>
</table>

#### (a) Key to Scoring for Uptake Pathway:  
- **A** - Generation of relevant research results  
- **B** - Formal/informal agreement with target institutions  
- **C** - Development of appropriate research-based products through adaption/packaging  
- **D** - Promotion of products into target institutions  
- **E** - Adoption of products by target institutions  
- **F** - Application and replication of results in target institution programmes  
- **G** - Promotion of technology or behavioural change among end-users by target institutions  
- **H** - Adoption of technology by end-users and generation of economic benefits i.e. developmental impact

#### (b) Key to categories of Likely, Direct Beneficiaries:  
- **A** - Donors  
- **B** - Strategic researchers in developed countries  
- **C** - Strategic researchers in IARC’s (includes national institutions working overseas)  
- **D** - Applied researchers in IARC’s (includes national institutions working overseas)  
- **E** - Applied researchers in NARS  
- **F** - Training (institutions and individuals)  
- **G** - Planners at national/regional levels  
- **H** - National extension and other technical support services  
- **I** - NGO’s  
- **J** - Pastoralists  
- **K** - Smallholders (largely subsistence based)  
- **L** - Landless or land poor
4.6 Programme Achievements Reported in the Media

**BBC Radio 4, Today Programme**, 29th March, 2001: Interview with Dr Alex Donaldson (IAH) in which Pen-side RP test, developed under AHP, referred to during discussion about the problem of rapidly diagnosing FMD.

**New Agriculturist On-line** January issue - Four AHP Projects featured
- **Pave-ing the Way Forward** - R7164
- **Waking up to Reality** - R7596
- **A Handheld Solution to a Hidden Problem** - R7597
- **No Vet in Sight** - R7598

**WRENMedia Interviews Recorded at CTVM on 4th December 2000 with:**
- Dr Mark Eisler (Haemoglobinometer; R7597)
- Dr John March (CBPP vaccine; R7229)
- Dr Keith Sumption (Dukas: R7598)
- Mr Eric Fèvre (Sleeping sickness; R7596)

for distribution and broadcast as appropriate to leading radio stations in anglophone Africa, Asia and Europe.
Earth Report for BBC World (R7271) Film on Mastitis research in Iringa as a result of research from this project. Transmitted nine times weekly throughout May 2000.


Mural Displayed at Arusha Market, Tanzania. (R7271) Illustrating nutritional benefits of milk consumption and the importance of boiling milk to avoid zoonotic diseases.

Canal 11 Television Company, Santa Cruz, Bolivia. (R7356) 15 minute documentary featuring work of Dr Martin Hall—Incrimination of vectors of T. vivax in the new outbreak of Santa Cruz, Bolivia. Spanish language leaflet produced on 'La Trypanosomiasis Bovina (Trypanosoma vivax)'.

Radio Interview with Professor Julie Fitzpatrick (R7271) Optimising milk production on smallholder dairy farms in Tanzania, broadcast in Tanzania, Kenya, Nigeria, Rwanda, Burundi, Congo and Somalia. The interview was translated into 28 local languages including Swahili and Hausa.
5. Progress Review

5.1 Progress Against Milestones for the Year Under Report

2000/1

Consensus Conference and Economic Appraisal of Theileriosis Research

**Activity:** A workshop was held at ILRI in January 2001 attended by eight international experts, the Programme Manager and six ILRI staff members, acting as an initial forum for consultation on how to identify and score priorities for the development of livestock technologies, which would have the greatest impact on the livelihoods of poor people.

**Outcome and Impact:** ILRI has been commissioned to undertake a study to identify priority areas for international action for the development of livestock technologies. The study began in January 2001 and the findings will be presented in June 2001. The January workshop was the first main activity under this study, which will assess and prioritise the major health constraints to those livestock species that most benefit the poor in sub-Saharan Africa and South and South-East Asia, assess the research opportunities.

2000/2

Stakeholder Meeting – Uganda

**Activity:** A stakeholder meeting was held in May in ILRI, Uganda, to bring together Project Leaders and other stakeholders involved in projects on-going in Uganda (R7596/R7597).

**Outcome and Impact:** Increased cohesiveness of AHP projects in Uganda.

2000/3

Stakeholder Meeting – Kenya

**Activity:** A stakeholder meeting was held in Nairobi in October bringing together Project Leaders and other stakeholders involved in projects (R7360/R7596/R7597/R7598/R7271/R7357) on-going in Kenya/Uganda/Tanzania to discuss the sustainable dissemination of research outputs in the region.

**Outcome and Impact:** The workshop served to reinforce the cohesiveness of the East African research hub and drew participant’s attention to the complexity and importance of dissemination of research findings. Amongst the outcomes of the workshop was the identification of the need to hold a further workshop involving participants drawn from the private and public sectors, including AHP project leaders and collaborators, to seek opportunities for greater collaboration, e.g. between AHP projects and veterinary pharmaceutical companies.

2000/4

Stakeholder Meeting – South Africa

**Activity:** A stakeholder meeting was held at the Onderstepoort Veterinary Institute, South Africa organised by Dr Anne Pearson to promote research especially on helminths in the region.

**Outcome and Impact:** Increased awareness in southern Africa of aims and objectives of AHP. The meeting proved very successful, three concept notes were produced during the meeting dealing with ethnoveterinary knowledge, helminths in donkeys and helminths in goats, respectively. The latter was selected at the February 2001 LPAC meeting and OVI have been invited to submit project memorandum for further consideration.

2000/5

Meeting with Lead Advisers/Programme Managers

**Activity:** AHP Programme Manager attended DFID meeting in May 2000.

**Outcome and Impact:** Better understanding of DFID’s requirements in relation to Programme development and management.
2000/6
Themes: Identify Key Players to add to the thematic basis of the programme who can fit in with our foci of interest in South Africa and India prior to call for Concept Notes
Activity: Onderstepoort Veterinary Institute (OVI) identified as entry point for AHP in southern Africa. Workshop held in January 2001 at OVI to introduce AHP and facilitate preparation of concept notes.
Outcome and Impact: Contact established with key animal health scientists at OVI and three concept notes written and submitted to AHP.

2000/7
Call for Proposals
Activity: AHP Call for Proposals issued July 2000.
Outcome and Impact: Fifty-one concept notes received during year under report.

2000/8
NR Advisers’ Conference
Activity: Programme manager attended conference and gave presentation on the AHP strategy.
Outcome and Impact: Improved links between research programmes and bilateral programmes and improved communication with bilateral programmes.

2000/9
Project Abstracts
Activity: Two page abstracts written for all AHP funded projects completed during the last ten years. These are currently being edited after which they will be made available through the AHP website.
Outcome and Impact: Project abstracts completed and currently being edited in preparation for final layout and production. Improved accessibility of information about AHP projects which will facilitate dissemination and uptake.

2000/10
RNRRS Award 2000/01
Activity: Animal Health Programme invitation to submit Project entry which best illustrates contribution to DFID's research objectives.
Outcome and Impact: AHP Entry submitted - R7164 - Dr Andy Catley [PAVE Project] - 'Herders' Hidden Knowledge: Learning with Livestock Keepers in the Horn of Africa'. AHP were delighted to be shortlisted to the last six entries and awarded 'highly commended' when the results came out. Impact is at various levels. At field level it helps existing programmes improve animal health services by combining local and modern knowledge. Links with African veterinary schools ensure that lessons learned in PAVE are incorporated in veterinary courses, and new vets are equipped to develop effective community-based programmes. Via a partnership with the Organisation for African Unity/Inter-Africa Bureau for Animal Resources, the project also distributes experiences to senior policy makers in livestock services in Africa.

2000/11
Rinderpest Review
Activity: AHP commissioned review of DFID-funded research aimed specifically at the production of rinderpest vaccines.
Outcome and Impact: Review completed. Established the role DFID (through AHP) might play in co-ordinating research in this field.
2000/12
CBPP Review
Activity: Commissioned review of CBPP research to inform, and identify AHP of future activities in respect of CBPP research and promotion of outputs and strategies.
Outcome and Impact: Review commissioned and undertaken, submission deadline imminent.

2000/13
East Africa Regional Co-ordinator
Activity: Regional Co-ordinator (RC) for Natural Resources Research and Development was appointed for East Africa (Kenya, Uganda and Tanzania).
Outcome and Impact: Dr Dan Kisauzi took up the appointment in September 2000 and manages the offices in Kampala and is jointly supported by the three DFIDEA bilateral programmes and six research programmes (AHP, CPHP, CPP, LPP, NRSP and PHFP). With over 40 RNRSS projects operating in the region, and growing bilateral programmes, the priority of the office is coordination, comprising dissemination of programme information and outputs and development of research initiatives.

2000/14
Exchange Visit LPP Management Team
Activity: AHP/LPP Management Team visit took place in November.
Outcome and Impact: The Update meeting was very beneficial to both programmes with effective exchange of information and ideas.

2000/15
Promotion of Proven Strategies to Control Diseases of Livestock that Affect the Livelihoods of the Poor
Activity: Visit on-going Projects. Review/Summarise past and present activities aimed at disseminating research findings from AHP funded research to target beneficiaries. Identify more effective and innovative approaches to dissemination/promotion.
Outcome and Impact: To promote effective dissemination of AHP funded research findings to poor and small-scale farmers and to a wider global audience.

2000/16
Theileriosis in India
Activity: Commissioned visit to ground-truth present situation of Theileria annulata in India
Outcome and Impact: Visit undertaken September 2000.

2000/17
First Inter-Agency Meeting on Livestock Production and Animal Health
Activity: First Inter-agency Meeting on Livestock Production and Animal Health held in December.
Outcome and Impact: Designed to promote co-ordination in livestock research for poor people this meeting was very successful. It brought together research managers from donor and implementing agencies to identify research priorities, areas of common interest; and mechanisms for co-ordinating future investments in research via a plan of action through which they can commit to working together.

2000/18
Assess the Impact of Malignant Catarrhal Fever in Tanzania
Activity: AHP commissioned assessment to evaluate economic, social and conservation impacts of MCF in Tanzania and identify future activities with respect to research strategies for the control and/or prevention of the disease.
PROGRESS REVIEW

5.2 Programme Management Response to Recommendations made by 1999/2000 Assessment Panel

The inter-disciplinary panel which reviewed the 1999-2000 AHP annual report made **nine specific recommendations** for action by the programme manager. These are listed below with a commentary on the programme manager’s response:

1. **The strategy is a considerable improvement on earlier Programme strategies. That said, the strategy does need to be based on a more solid analysis of user needs. We recommend that the PM conduct a more formal assessment of user needs, and revise the strategy in the light of the findings arising from this assessment. The logical framework should also be revised following an assessment of user needs. The revised logical framework should underpin the Programme strategy.**

   **Response:** The study being carried out by ILRI to identify priority areas for development of livestock technologies that will impact on the poor addresses this requirement. When the findings become available, in June 2001, the log-frame will be amended accordingly.

2. **The Programme Strategy should outline how complementarity will be built both within the programme, with other DFID research programmes, and with other donor livestock research initiatives.**

   **Response:** The fostering of research hubs within the AHP, for example the East African hub, and the clustering of projects around a common target, such as those concerned with smallholder dairy farmers, help to ensure complementarity within the programme. The close working relationship between AHP and LPP ensures complementarity between the two DFID livestock programmes. Complementarity with other donors is effected through participation in the inter-agency meetings on livestock research and direct interaction with organisations such as FAO, WHO, EU and The Wellcome Trust.

3. **The PM should develop a dissemination strategy, and dedicate resources to its implementation, to ensure greater promotion and uptake for the research findings. This should include (a) a more formal strategy for outlining proposals for promoting uptake to specified organisations and (b) exploring the use of a wider range of publication outlets to ensure that research results are presented to a wider audience.**

   **Response:** A consultant with experience of both the public and private sectors has been identified to develop the dissemination strategy together with the PM and to promote the use of a broader range of formats and media to achieve wider dissemination of research results.

4. **We suggest that in the light of the revisions required to the strategy, and the need to invest further in promotion and uptake activities, the proportion of budget allocated to these activities be increased.**

   **Response:** The budget allocated to promotion and dissemination has been increased from less than 5% in 1999/2000 to more than 11% in 2000/2001.

5. **As with the Livestock Production Programme (with whom the AHP shares a PAC), we recommend that the PAC be used to provide strategic advice to the PM and ensure a transparent review process is in place.**

   **Response:** The concept note review process has been improved through the use of a wider base of international reviewers and by increasing the number of reviewers per concept note from two to at least four. In addition two separate concept note review forms are now used, one for scientific reviewers and one covering the social science aspects. By ensuring that comments are made by reviewers within their own area of expertise, this has made the reviews received easier to evaluate and more transparent.
6. We recommend that in future guidelines for submission of proposals provide details of the criteria which will be used when scoring the concept notes.

Response: This will be implemented at the next call for concept notes. More guidance is already being provided in the call for concept notes to help ensure that concept notes address the Programmes’ goals. In general the AHP is moving from supply-led research, which used to dominate the Programme, to a more demand-led approach.

7. The PM should produce an analysis of the environmental implications of the research strategy (once it has been refined in the light of user needs) so as to avoid directing support to research themes that might incur substantial negative environmental impacts. We also recommend that the PM develop environmental and animal welfare check lists to be used to screen all approved concept notes before they are developed into project memoranda. These should be based on the standard guidance to PMs issued by Rural Livelihoods Department and should be developed in discussion with Rural Livelihoods and Environment Division.

Response: The AHP has adopted an animal welfare checklist and this aspect is explicitly covered in the project memoranda. The Programme’s approach to environment implications of projects is being addressed by commissioned research by Prof Ian Grant. The review commissioned by the AHP – Environmental Change and the Autonomous Control of Tsetse and Trypanosomiasis in Sub-Saharan Africa (Edited by David Bourn, 2001) - also provides useful pointers in this area. The AHP is therefore working towards the development of an environmental check-list that can be used to screen proposals at the concept note stage.

8. We recommend the following changes to the format of next year’s annual report:
   (i) The table on project completion documents in the annual report should include the dates when reports should have been delivered to DFID, and dates when they actually were.
   (ii) More detail should be provided for the outcome – and impact – of achieving each milestone.
   (iii) More tangible indicators of quality of outputs, and uptake (such as number of farmers using a given technology, or number of publications) should be collected and presented in the report.
   (iv) Information on uptake should be presented along the lines of Table 3.4 in the LPP annual report.

Response: The recommendations have been noted and appropriate changes incorporated into the current annual report.

9. We recommend that the PM should continue his effort to reduce the number of outstanding project completion documents.

Response: The PM is continuing to tackle this problem.
5.3 Proposed Milestones for 2000/2001

2001/1
All Themes
Continue to streamline work on these themes, by taking on new projects that complement or build on existing work so as to build up critical mass and by promoting linkages and uniformity of approach between themes.

2001/2
All Themes
Continue to improve poverty-focus, both within projects and in the selection of existing projects, especially through the results of the ILRI consultancy on research priorities and by financing the LIRE initiative.

2001/3
All Themes
Ensure that research results and publicity materials are linked through the AHP web-site whenever appropriate.

2001/4
All Themes
Implement initiatives to ensure that the AHP’s outputs reach a wider global audience.

2001/5
Strategic Theme
Tick-borne disease vaccine development thrust. Use AHP funds to leverage additional funding from other donors to ensure adequate resources are available to permit vaccine development thrust to have impact.

2001/6
Adaptive Themes
Formulate draft guidelines for project leaders on presentation and collection of financial data to assist farm-level decision-making with respect to the animal health control measures being researched.

2001/7
Adaptive Themes
Develop a standard format for the production of written reports, handbooks and other dissemination materials which will ‘badge’ these as AHP-funded outputs.

2001/8
Adaptive Themes
The reporting system for projects will be reviewed, in particular with a view to asking researchers to provide more quantitative indicators of progress.

2001/9
Dissemination and Delivery Theme
Take stock of work done so far, consolidate on delivery and uptake of results and identify gaps in knowledge, with a view to commissioning future research on selected subjects within this field.

2001/10
Past Research Projects
Investigate a selection of these projects to see if more work on uptake and delivery is justified or required.
2001/11
Meeting with Lead Advisers/Programme Managers
DFID Meeting to be held 14/15 June 2001 - AHP Discussion Theme - 'Globalisation and the Technology Gap'

2001/12
NR Advisers' Conference

2001/13
Inter-agency Meeting on Livestock Health and Production Research
Second Inter-agency Meeting to be held in Copenhagen - 15 - 17 August 2001.

2001/14
Private/Public Sector Dissemination and Promotion Workshop - Kenya
Second workshop will be held to identify opportunities for collaboration between the two sectors and to learn from the experience of others working in the animal health field. Scheduled for Summer/Autumn 2001.
6. Conclusion

Achieving Critical Mass and Impact

During the course of this year, the AHP has been successful in further streamlining its project portfolio, by taking on projects that fit in with and complement work being done in two of its selected themes – zoonotic diseases and dissemination/delivery of animal health knowledge.

The zoonotic disease project now identified for brucellosis will be using the same methodology as the ongoing research work on bovine tuberculosis in people and animals. It will also link up with work on mastitis and tick-borne disease in smallholder dairy cattle, thus creating a cluster of projects dealing with the human and animal health problems associated with milk production.

Two projects will strengthen the delivery and dissemination theme. One will investigate a new approach to disseminating livestock and animal health knowledge, the farmer field school. This approach has been used successfully in three continents to help farmers acquire knowledge on integrated pest management and other aspects of crop production. The other project will work on a blueprint for the dissemination of past research results to target groups working with poor livestock keepers, using the example of tsetse control to NGOs.

Work on the diagnostics and decision-making tools has continued during the year under report through eight projects, four of which will continue next year.

Finally, subject to funding, work on vaccine development will proceed primarily through the tick-borne disease vaccine development thrust for which ILRI will be the lead institute.

6.1 Key Points for the Year Ahead

While the more strategic research fits into an ongoing continuum, with products of work being published and then built on by other researchers in the field, the adaptive work needs more active promotion in order to ensure optimal uptake. The programme is aiming to work towards this by developing further guidelines for researchers, with the aim of:

- ensuring that projects within the same theme are aware of and build on work being done by other AHP-funded projects through the development of research hubs and clusters of projects;
- integrating the cross-disciplinary elements into projects more effectively, in particular in the field of the social sciences;
- disseminating the work of the AHP more widely, and
- ‘badging’ the products of AHP-funded research, by creating a more uniform look to the materials produced and making greater use of web-site links.

The imbalance between the care taken at the start of projects (through the selection and screening process) and at the end, will be gradually corrected. More management effort will be directed towards ensuring that the end of the research process is fruitful, setting up mechanisms and dialogue with researchers and among researchers so that outputs are successfully delivered and disseminated.

As was discussed in the introduction to this report, within the global economy the lack of funding for technology development, particularly in the area of tropical disease, has been identified as a major reason why some countries are technically excluded and their inhabitants poor. By concentrating its strategic research thrust on the development of a vaccine for a single disease, the AHP hopes to bring together the funding to ‘crack’ one disease constraint of importance to poor livestock keepers.
CONCLUSION

Finally, the AHP’s current thematic focus clearly embraces the needs of both poor livestock keepers, and those individuals affected by zoonotic diseases, whose isolation or poverty mean that their conditions are either not diagnosed or inadequately treated. During the next year, the programme hopes to further sharpen its focus on the poor, as it benefits from the results of the two initiatives undertaken to improve the match between research efforts and the needs of poor livestock keepers: studying and ranking disease constraints and their researchability world wide and initiating an ongoing dialogue with poor livestock keepers.

Professor Ian Maudlin
April 2001
# DFID Renewable Natural Resources Research Strategy

## Logical Framework - Animal Health Programme 2000

### Semi-Arid / High Potential / Peri-Urban Production Systems

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<tr>
<th>SUPERGOAL</th>
<th>OBJECTIVE VERIFIABLE INDICATORS</th>
<th>MEANS OF VERIFICATION</th>
<th>ASSUMPTIONS</th>
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### Narrative Summary

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<tr>
<th>Goal</th>
<th>Indicators of Achievement</th>
<th>Means of Verification</th>
<th>Assumptions</th>
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<tbody>
<tr>
<td>1. Livelihoods of poor people improved through sustainably enhanced production and productivity of RNR systems.</td>
<td>1.1 Measures of change in capabilities, assets and activities.</td>
<td>DFID commissioned external reviews of DFID impact. FAO and other agency datasets.</td>
<td>Livelihoods of the poor are not disrupted by political upheaval, economic turmoil, civil unrest or unusual climatic conditions.</td>
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### Purpose

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<tr>
<td>1.1 Increased sustainable production of livestock by the resource poor;</td>
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<td>1.2 Decreased production costs for resource poor livestock keepers;</td>
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<tr>
<td>1.3 More reliable supply of safe livestock products to the poor.</td>
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</table>

### Outputs

| 1. Cost-effective and appropriate strategies developed to sustainably control diseases of livestock in semi-arid, high potential and peri-urban production systems that affect the livelihoods of the poor. | 1.1 3 new, validated and acceptable methods for the control of tick-borne diseases, trypanosomiasis, helminthiasis and other diseases, particularly zoonoses that are important to poor livestock keepers by 2003. | Animal Health Programme reports. External referee reports. Final technical reports of projects. Annual reports of delivery systems. Systematic evidence-based reviews. | Intermediary organisations able and willing to produce and deliver new technologies to poor livestock keepers. |
| 2. Promotion of proven strategies in semi-arid, high potential and peri-urban production systems to control diseases of livestock that affect the livelihoods of the poor. | 2.1 Disease management strategies, acceptable for use by the poor, adopted and promoted by appropriate delivery systems to end-users by 2004. | | |
### ANNEX B

<table>
<thead>
<tr>
<th>Activities</th>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
</table>
| **1.1 Current projects brought to contracted completion.** | 24 projects completed by end March 2003 including: 
- **Diagnostics** (R6554, R7196, R7364, R7599, R7361, R7362, R7536, R7597) 
- **Dissemination/Delivery** (R7538, R7596, R7596, R7164, R7271, R7359, R7360) 
- **Human Zoonoses** (R7596, R7229, R7357) 
- **Tick-borne Disease Vaccines** (R7358, R7363, R7365) 
- **Wildlife Interface** (R7050, R6625) 
- **Environmental Risk** (R7539) | AHP and projects’ research reports. | Scientists able and willing to undertake research that addresses, and is assessed in terms of, Programme objectives. 
NARs and other in-country partners able and willing to effectively collaborate. 
Researchers able to conduct activities in target countries. |
| **1.2 New projects and activities commissioned to achieve Output 1.** | 3 new projects in Kenya, Uganda, Tanzania, South Africa, Bangladesh or India that identify and quantify the economic cost of animal disease constraints that are important to the poor by 2005. 
3 new projects in Kenya, Uganda, Tanzania, South Africa, Bangladesh or India to develop rapid, reliable and cheap field diagnostic tests for tick-borne diseases, trypanosomiasis or helminthiasis and other diseases, particularly zoonoses by 2005. 
3 new projects in Kenya, Uganda, Tanzania, South Africa, Bangladesh or India on user-acceptable field-level decision support tools for control of tick-borne diseases, trypanosomiasis or helminthiasis and other diseases, particularly zoonoses by 2005. 
2 new projects in Kenya, Uganda, Tanzania, south Africa, Bangladesh or India on novel vaccines for effective control of tick-borne diseases and other diseases, particularly zoonoses by 2005. 
4 new projects that identify appropriate methods and use acceptable promotional pathways for increasing the impact of animal health knowledge dissemination on the livelihoods of the poor by 2005. | |
| **2.1 New and existing knowledge effectively disseminated.** | | |

AHP and projects' research reports.
“Many of the technologically-excluded regions, especially in the tropics are caught in a poverty trap. Among their greatest problems are tropical infectious disease, low agricultural productivity and environmental degradation – all requiring technical solutions beyond their means”
<table>
<thead>
<tr>
<th>DFID No</th>
<th>Project Title</th>
<th>Project Leader</th>
<th>Institution</th>
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<tr>
<td>R7229</td>
<td>Mycobacterium bovis infection of cattle and man in Tanzania</td>
<td>Sharp M</td>
<td>MRI</td>
</tr>
<tr>
<td>R7357</td>
<td>Quantifying costs and risk factors of bovine tuberculosis in Tanzania</td>
<td>Cleaveland S</td>
<td>CTVM SUA, Tanzania</td>
</tr>
<tr>
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<td>March J</td>
<td>MRI</td>
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<td>Incrimination of vectors of Trypanosoma vivax in the new outbreak focus of Santa Cruz, Bolivia</td>
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<td>RVC</td>
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<td>Anderson J</td>
<td>IAH Pirbright</td>
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<td>R7364</td>
<td>Improving the control of tsetse: The use of DNA profiling to establish the feeding responses of tsetse to cattle</td>
<td>Torr S</td>
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<td>R7596</td>
<td>Decision support system for the control of trypanosomiasis in South-East Uganda: improving public health and livestock productivity through the cost-effective control of trypanosomiasis in livestock</td>
<td>Coleman P</td>
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<td>A low-cost haemoglobinometer as a decision support tool for bovine disease diagnosis in sub-Saharan Africa</td>
<td>Eisler M</td>
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<td>R7599</td>
<td>Development of alternative foot and mouth and tick-borne disease control strategies to benefit resource poor farmers in southern Africa</td>
<td>Vosloo W</td>
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<td>R7050</td>
<td>Sustainable use of wildland resources: Ecological, social and economic interactions</td>
<td>Campbell K</td>
<td>NRI</td>
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<td>R7164</td>
<td>Indigenous knowledge, participatory appraisal and animal health information systems: Options for complementary methods in public and private veterinary services in Africa</td>
<td>Catley A</td>
<td>IIED</td>
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<td>R7271</td>
<td>Optimising milk production in small holder dairy farms in Tanzania: Studies of the epidemiology and socio-economics of animal disease and the quality and safety of milk</td>
<td>Bryant M et al</td>
<td>Reading/ Glasgow/ Liverpool</td>
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<td>R7359</td>
<td>The delivery of animal health services to the rural poor: A framework for analysis</td>
<td>Heffeman C James A</td>
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<td>R7360</td>
<td>Field methods and tools for resource-poor farmers and extension workers to improve targeting and appropriate use of drugs used for control of African bovine trypanosomiasis</td>
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<td>R7595</td>
<td>Impact assessment of community animal health services - a literature review</td>
<td>Martin M</td>
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<td>R7598</td>
<td>Identification of the role of “Dukas” in animal health information and service delivery</td>
<td>Sumption K</td>
<td>CTVM</td>
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<td>R7358</td>
<td>Development of a subunit vaccine against East Coast fever in cattle using a novel prime-boost immunisation strategy</td>
<td>Gilbert S Hill A</td>
<td>Univ of Oxford</td>
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<td>R7363</td>
<td>Investigation of the immunogenic potential of heartwater (Cowdria ruminantium) grown in tick cell lines</td>
<td>Sakyl L</td>
<td>CTVM</td>
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<tr>
<td>R7365</td>
<td>Identification of antigens of Theileria parva that are recognised by bovine parasite specific cytotoxic T lymphocytes and evaluation of their vaccine potential in laboratory trials</td>
<td>Ellis S A Morrison I</td>
<td>IAH Compton</td>
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Human Health Impacts of Animal Diseases
## HUMAN HEALTH IMPACTS of ANIMAL DISEASES

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<td>Mycobacterium bovis infection of cattle and man in Tanzania</td>
<td>SHARP M</td>
<td>01/07/98</td>
<td>30/06/01</td>
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<tr>
<td>R7357</td>
<td>Quantifying costs and risk factors of bovine tuberculosis in Tanzania</td>
<td>CLEAVELAND S KAZWALA R</td>
<td>01/10/99</td>
<td>30/09/01</td>
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</table>
HUMAN HEALTH IMPACTS of ANIMAL DISEASES

Project Number: R7229  
Project Title: Mycobacterium bovis Infection of Cattle and Man in Tanzania  
Project Leader: Mike SHARP  
Institution: Moredun Research Institute, Edinburgh  

Project Background
Bovine tuberculosis contributes to rural poverty and welfare by means of production losses and its zoonotic transmission. During the past 10 years, a dramatic increase in the prevalence of human tuberculosis has been reported by WHO. In developing countries, where HIV/AIDS has exacerbated events, the contribution of bovine tuberculosis to this upsurge of tuberculosis is unknown. A recent study in Tanzania, conducted by an interactive veterinary-medical collaboration, indicated that bovine tuberculosis is endemic in indigenous cattle in some areas and was being transmitted to man. These preliminary findings indicated that bovine tuberculosis imposes economic burdens on the rural community, as well as posing a threat to human health.

Development and Scientific Objectives
The project aims to develop in-country skills, infrastructure and knowledge to increase awareness of bovine tuberculosis in cattle, wildlife and man. It will achieve these overall aims by :-  
• Determining the presence of Mycobacterium bovis in cattle by traditional and molecular techniques,  
• Identifying wildlife hosts of M.bovis,  
• Studying the contribution of M.bovis to human tuberculosis and its zoonotic importance by genotyping isolates from man, wildlife and cattle,  
• Establishing modes of transmission of M.bovis from cattle to man and vice versa.

Progress against Log-frame Indicators
One major achievement has been the demonstration that early activities of the project to develop in-country skills, infrastructure and knowledge have born fruit. This has been amply demonstrated by the collection of samples and their delivery to the two laboratories through the cold chain that has led to successful culture of mycobacteria.

The veterinary-medical collaboration continues to strengthen and provides a model that can be extended to improve the surveillance and control of other diseases affecting humans and animals.

Achievements in Current Year
Milestone 13: The collection of samples from animals and from human patients (tasks 2a-2c) has been completed, apart from samples originating from wildlife.

Milestone 14: 7589 cattle were inspected at the slaughter slabs in the survey area and tuberculous lesions identified in 1485 (20%). Results of the tuberculin reactivity of over 10,000 cattle in the study area identified 94 individual reactors (0.9%) in 78/631 herds (12%).

Milestone 15: Laboratory analysis of these samples is at an advanced stage. At SUA, 1501 (96%) samples have been processed and positive cultures obtained from 236 (16%). Many environmental mycobacteria have been identified and, notably, 18 of 165 (11%) examined to date have been identified as M.bovis by biochemical tests.

At Muhimbili, 368 (96%) samples have been processed and positive cultures obtained from 54 (15%). Again, many environmental mycobacteria have been identified, although M.tuberculosis was identified in 10/42 (24%) samples examined and M.bovis in 5/42 (12%).

Some of the samples have been examined directly by a duplex PCR that detects, and often discriminates, M.tuberculosis and M.bovis (Sinclair, Challans, Kazwala, Hewinson and Sharp (1995). A multiplex polymerase chain reaction for distinguishing Mycobacterium tuberculosis from Mycobacterium tuberculosis complex. Molecular and Cellular Probes, 9, 291-295). This assay has detected M.bovis in 22/107 animal
samples and 2/144 human samples; in addition, the assay detected M. tuberculosis in 13/144 human samples.

Milestone 17: Analysis of data to establish the epidemiology of bovine tuberculosis in the study area is in progress. Preliminary analysis has pointed to herd size as an important risk factor.

Milestone 18: Results have been communicated to all participants in the project and extended to include representatives from the Tanzanian Ministries of Health and Water and Livestock Development, TAWIRI and TANAPA. Some aspects of the project were presented as oral papers at the Annual Scientific Conference of the Tanzanian Veterinary Association.

**Planned Activities for Next Year**

The project will end 30th June 2001 and planned activities are directed at completing the outstanding analyses and preparing these for publication and the final report for DFID.

**Output / Impact**

A principal output of the initial phase of the project has been improved collaboration between medical, veterinary and wildlife sectors and enhanced awareness of the zoonotic risks of bovine tuberculosis. The integration of personnel at the workshop and during field studies has had an impact at the level of Directors as well as at the District and village level. During the course of tuberculin-testing and questionnaire surveys, public health information on tuberculosis and other zoonoses (e.g. brucellosis, rabies) has been disseminated informally to community leaders and householders.

**Targets for the following year**

Not applicable.

**Dissemination**

The project leaders from SUA and Muhimbili took part in a local TV programme to broadcast the role of the project its implications of its findings for public health.

Two videos are in preparation to assist with training of i) laboratory personnel who handle category 3 pathogens and ii) veterinarians and field workers who will be involved with tuberculin testing and meat inspection.

Professor Kazwala attended the DFID meeting on dissemination of research findings in Nairobi, Kenya, Sept 2000 as well as the Keystone Symposium on Molecular and Cellular aspects of Tuberculosis Research in Post Genome Era, held in Taos, New Mexico, US Jan 25 – 30 2001

**Publications**

See Volume I - Annex B
Project Number  R7357
Project Title  Quantifying the Costs and Risk Factors for Bovine Tuberculosis in Tanzania
Project Leader  Sarah CLEAVELAND
Rudovick KAZWALA
Institution  1. Centre for Tropical Veterinary Medicine, The University of Edinburgh
2. Dept. of Veterinary Medicine and Public Health, Sokoine University of Agriculture
Project Dates  Start – October 1999      End – September 2001

Project Background
Bovine tuberculosis, caused by the bacterium Mycobacterium bovis, contributes to rural poverty both as a cause of production losses in livestock and as a cause of zoonotic disease in people that have contact with infected animals or consume animal products. In people, bovine tuberculosis is usually associated with the extrapulmonary form of tuberculosis, which has increased substantially in Tanzania over the past decade. The incidence of extrapulmonary tuberculosis is particularly high in the Arusha Region of Tanzania, which also has the largest per capita population of cattle. However, little is still known about the extent to which M. bovis contributes to the human epidemic or the specific risk factors associated with M. bovis infection in people.

Development and Scientific Objectives
The developmental aims of the project are:
• to improve human health and welfare by minimising the public health burden of bovine tuberculosis.
• to improve livestock productivity in rural Tanzania through the control of bovine tuberculosis.
• to provide environmental benefits by minimising the risk of disease transmission to key wildlife populations in northern Tanzania.

Control of tuberculosis in cattle has the potential to improve livestock productivity and public health, particularly among people in contact with cattle. However, quantitative data are needed on the relative importance of different risk factors and the mechanisms by which infection is transmitted between populations. The scientific objectives of the project are thus:
• to determine the economic impact and public health burden of bovine tuberculosis in Tanzania.
• to identify and quantify specific risk factors for infection in cattle and human populations through case-control studies.
• to incorporate the findings into sustainable, environmentally-sound and cost-effective strategies for the control of bovine tuberculosis in cattle and human populations.

Progress against Log-frame Indicators
• Field data collection for the case-control study of bovine tuberculosis infection in cattle has been completed, with data analysis underway to identify and quantify risk factors of infection.
• Trace-back of human M. bovis cases and controls has been implemented, with questionnaire surveys and tuberculin-testing of cattle completed for approximately 30% households. A parallel case-control study has also been initiated to investigate risk factors for human extrapulmonary tuberculosis (EPTB) caused by atypical Mycobacteria spp.
• Longitudinal studies have been initiated in both Arusha Region and Mwanza Region to investigate impacts of M. bovis infection on morbidity and mortality in cattle.
• Clinical data have been collected from human cases of EPTB to investigate the severity of disease caused by Mycobacteria species and to allow calculation of the public health burden of zoonotic tuberculosis.
Achievements in Current Year

M. bovis Infection in Cattle
The project has completed collection of data on (i) the prevalence of M. bovis infection in cattle determined through tuberculin-testing, (ii) demographic characteristics of cattle herds and (iii) cattle management practices in four Rift Valley Districts in Tanzania. Results of single comparative intradermal skin testing in 10,542 cattle from 631 randomly-selected herds demonstrated an overall prevalence of 0.9% cattle and 12.4% herds infected with M. bovis. There was a significant increase in the prevalence of infection with age, but no significant differences in prevalence between male and female cattle. Although large herds were more likely to be infected, there was no significant increase in prevalence with herd size. Data analysis is currently underway to investigation associations between infection and possible risk factors, such as housing, confinement and movement of cattle, contact with other domestic and wildlife species, introduction of new animals and environmental factors, such as land-use and flooding.

M. bovis Infection in People
For the human case-control study, field-testing of questionnaires has been completed and age- and sex-matched controls have been selected at random from the population for trace-back studies. Questionnaire data, tuberculin-testing and blood sampling have been carried out on 30 control patients in Babati and Hanang Districts. HIV serological analysis is currently being carried out at Muhimbili Research Centre. To date, only four human cases of M. bovis extrapulmonary tuberculosis (EPTB) have been confirmed by culture, which has limited the trace-back of cases.

An important recent finding has been the isolation of atypical Mycobacteria species from an unexpectedly large proportion (67.8%) of culture-positive human EPTB cases, as well as from cattle with tuberculous lesions (R7229). This has stimulated the implementation of a new parallel case-control study to identify risk factors and investigate the zoonotic significance of atypical Mycobacteria infection in humans. Trace-back studies and blood sampling have now been completed for 12 human cases of of EPTB caused by atypical Mycobacteria.

Longitudinal Studies
Longitudinal studies have been initiated in infected herds within Arusha and Mwanza Region, in collaboration with the DFID Animal Health Services Project. Within infected herds, monthly demographic and clinical data have been collected for both reactor-positive and reactor-negative individuals to assess the impact of infection on morbidity, mortality and reproduction. Data collection will be continued until mid 2001 before analysis of results.

Estimating the Public Health Burden of Zoonotic Tuberculosis
Over the past year, data on clinical signs, response to treatment and mortality have been collected from human cases of EPTB caused by M. bovis, M. tuberculosis and atypical Mycobacteria. These data will be used to calculate the disability-adjusted life years (DALYs) lost to different forms of EPTB and will provide an estimate of the public health burden of zoonotic tuberculosis.

Smallholder Dairy Cattle
In collaboration with the smallholder dairy project (R7271), tuberculin-testing has been carried out on 362 cattle in 87 herds involved in the tick-borne disease study in Tanga Region. None of the cattle tested were positive.

Tuberculosis in Wildlife
In collaboration with Tanzania National Parks and the Serengeti Regional Conservation Programme, samples have been collected from a range of wildlife species for culture and serological analyses. To date, wildlife tuberculosis has been confirmed through opportunistic sample collection in buffalo, wildebeest, eland and giraffe in the Serengeti National Park, and from 1/20 (5%) wildebeest and 0/11 topi sampled systematically during a meat-cropping programme adjacent to the park. Mycobacterium avium has been detected as the cause of severe pathology in one wildebeest, with culture and molecular analysis of other samples in progress at the Sokoine University of Agriculture. Serological analysis, carried out using the mpb70 ELISA at the Onderstepoort Veterinary Institute, has demonstrated TB seropositivity in 4/46 lions (8.7%) sampled between 1996 and 2000 and in 4/138 (2.9%) lions sampled from 1985 to 1995. Seroprevalence in wild ungulates was lower, with seropositives detected in only 2/270 (0.7%) animals sampled from 1998-2000. The positives comprised one buffalo and one eland.
HUMAN HEALTH IMPACTS of ANIMAL DISEASES

Planned Activities for Next Year

- Completion of the cattle case-control analysis will result in identification of risk factors for bovine tuberculosis, which will allow disease control programmes to be targeted to practices that pose particularly high risks. Analysis of skin-test data will also be carried out to investigate non-specific reactivity in cattle, which may result from atypical Mycobacteria infection and may have implications for both human health and cattle production.

- For the human case-control studies, trace-back and HIV testing will be completed for all controls and all culture-positive cases of human EPTB. Data collected during follow-up will not only allow identification of risk factors for infection of M. bovis and atypical Mycobacteria (including potential zoonotic transmission), but also provide valuable data on the severity of disease and treatment outcomes. This is of particular interest with respect to M. bovis, which is naturally resistant to pyrazinamide, one of the components of current TB therapies.

- The public health burden of zoonotic tuberculosis will be estimated by calculation of DALYs lost to disease.

- Longitudinal morbidity and mortality data will be analysed to investigate production impacts of M. bovis infection in cattle.

Output / Impact

- The institutional impact of the project continues to be important, with increasing collaboration between veterinary, medical and wildlife sectors and growing awareness among Directors and Ministers of the importance of integration between different Ministries.

- For both the human and cattle case-control study, outputs will be in the form of odds ratios, quantifying the relative importance of different risk factors. This will identify key areas for development of control strategies, in both cattle and people, that can be targeted directly to farmers, consumers of animal products, community-based animal/human health workers, local government, and policy makers within the relevant Ministries.

- Calculation of a DALY score for zoonotic tuberculosis will provide policy makers with information on the public health significance of the disease, which can be compared with other zoonoses in Tanzania to evaluate public health priorities.

Targets for the following year

- Analysis of the cattle case-control study will be completed by July 2001.

- Trace-back studies of cases of human EPTB and controls will be completed by the end of May 2001, with analysis of data and identification of risk factors completed by September 2001.

- DALY estimates will calculated by June 2001 to estimate the public health burden of zoonotic tuberculosis in Tanzania.

- Mathematical models will be developed by August 2001 to assess the impact of potential control strategies for bovine tuberculosis, including vaccination, if appropriate.

- Field data will be collected from longitudinal studies until July 2001, with analysis of demographic and morbidity data completed by September 2001.

Dissemination

- Presentations given to the Meeting of the Tanzanian Veterinary Association (2) and to the Scientific Conference of the Tanzania Wildlife Research Institute (1).

- Project workshop in Arusha, Tanzania, December 2000, allowed dissemination of results to colleagues and representatives within the veterinary, medical and wildlife sectors.

- Preparation of mural (1.5m²) for display in District centres and at the Arusha market, demonstrating both the benefits of milk consumption and the importance of boiling milk to avoid zoonotic diseases.

- Preparation and display of poster on zoonotic hazards of bovine tuberculosis, targeted to pastoralist communities, at the Agricultural Showground, Arusha – August 2000 to present.

- Participation in production of DFID videos on smallholder dairying and zoonotic diseases in Tanzania.

- Informal dissemination to cattle owners and householders during tuberculin-testing and questionnaire surveys. This has resulted in the decision of most cattle owners to sell reactor-positive cattle for slaughter.

- A presentation to the newly-appointed Minister of Water and Livestock Development, February 2001, emphasised the importance of integration and collaboration with the Ministry of Health and Ministry of Natural Resources and Tourism for control of zoonotic diseases in Tanzania.

Publications
HUMAN HEALTH IMPACTS of ANIMAL DISEASES

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Diagnostics and Decision Support Tools
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<td>R7196</td>
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Project Background
Contagious bovine pleuropneumonia (CBPP) is currently the most serious disease of cattle in Africa, with losses estimated to be in the region of US$2 billion per annum. Current vaccines (freeze-dried live attenuated) have been unable to control this pandemic, and suffer from poor stability and severe post-vaccinal reactions. In addition, it is unclear to what extent they can protect against newer isolates of the causal organism, Mycoplasma mycoides subsp. mycoides SC (MmmSC). Little is known about the pathogenic mechanisms of CBPP, nor which antigens confer protective immunity. The relative contributions of innate, humoral and cellular immunity are similarly unknown. A safer, more effective and better characterised vaccine is a pressing requirement to allow more effective disease control strategies to be implemented.

Development and Scientific Objectives
To produce more effective vaccines and diagnostic reagents which can be effectively applied in African field situations. Better disease control should result, and cattle health will improve. This should result in improved direct yields (milk & meat), improved draught capacity, and a reduction in costs to national veterinary services. The specific scientific objective of this project was to produce a capsular polysaccharide conjugate vaccine against CBPP; however, due to fortuitous circumstances our objectives have widened somewhat (development of a new thermostable vaccine medium, production of CBPP low cost diagnostic tests, epidemiological studies of field and vaccine strains of the causal agent, and an investigation of restriction enzyme stability).

Progress against Log-frame Indicators
On target in all cases. Field strain and serum samples have been collected and analysed - publications have resulted. CPS structure and variation between isolates has been determined, and immunological analysis has taken place (polygalactan, totally conserved, 3 epitopes, 2 protective. Shared with bovine lung galactan and mixed linkage glucan from cereal crops). CPS-conjugates have been produced and tested in laboratory animals (positive immune responses were observed and conjugates require testing in cattle). Monoclonal antibodies have been produced and tested (see above). Additional outputs include molecular epidemiology studies of MmmSC, data on restriction enzyme stability, new vaccine formulations exhibiting long-lasting stability, and production of low cost penside diagnostic tests.

Achievements in Current Year
CPS-conjugate vaccines have been produced and tested in mice. Significant immune responses were observed compared to controls. Immune response appears dependent upon mouse strain. Mouse antisera were not bacteriocidal in vitro (in contrast to rabbit antisera), even from mice which were protected against challenge. Protection in mice may be cell-mediated therefore. Mice are probably a poor model for assessing vaccine efficacy, and vaccines ought to be tested in cattle.

CPS has been studied using the monoclonal antibodies we have produced. MAbs reveal CPS to be totally conserved across all strains. We have identified at least three epitopes, two being bacteriocidal, one of these is shared with bovine lung galactan (BLG). This has important implications for the disease, since it would mean that cattle might need to produce antibodies that recognise their own lung tissue in order to fight an MmmSC infection (via CPS). This has been confirmed by showing that CPS-MAbs bind to BLG, and also BLG antibodies bind to CPS. Further study into the immunopathology of CBPP is very desirable (our CPS conjugates may be protective; alternatively they may cause immunopathology).

We have shown that anti-CPS bacteriocidal MAbs recognise a high molecular weight carbohydrate present in cereals (we have tested rice, corn, wheat and oats). The most likely material is mixed...
linked glucan. Therefore cereals could provide a cheap source of material for (a) diagnostic tests (instead of CPS), and (b) vaccine conjugates, since the carbohydrate contains an epitope cross-reactive, and bacteriocidal for MmmSC. This requires further testing by vaccinating animals with cereal polysaccharides. Interestingly, this may explain why many negative control cattle show a relatively high anti-CPS titre (from dietary-derived exposure to cross reactive carbohydrates). Whether this is a positive or negative phenomenon remains to be determined.

The current medium used to produce CBPP vaccines has been altered by changing the buffer to HEPES instead of phosphate. Current vaccines are only stable for a few hours at ambient temperatures. Our new formulation is stable for several months (a residual titre of $10^7$ cfu per ml after 2 months at 37°C has been observed). Only minimal changes to current formulations are required, therefore we hope to meet little resistance to change. A re-introduction of broth vaccines should be possible.

A rapid CBPP penside latex agglutination test has been developed based upon CPS antigen detection in infected animals. The test displays 68% correlation with the complement fixation test. The IAEA have agreed to field test the LAT. Ideally the format should be altered into a single use lateral flow device for ease of field use and interpretation, although this will require some investment and development.

Immune responses to MmmSC have been compared between infected and vaccinated animals. The latter show very poor responses (10-20%) compared to the former (90%). The data suggests that the route of exposure may be important for optimising the immune response. The mucosal route of vaccination should be investigated since it is apparently more effective than the current subcutaneous or tail-tip route.

Insertion sequence analysis of recent field strains of MmmSC has shown Tanzanian strains to be identical to Kenyan isolates - suggesting infection came from Kenya. In addition Namibian strains appear to be similar or identical to a novel biotype recently described by us (J. Clin. Micro. 2000) and isolated from Botswana. These strains were recovered from vaccinated cattle; thus this biotype may be vaccine resistant.

**Planned Activities for Next Year**

We would like to field test our new CPS-conjugate vaccines in cattle in Africa although lack of funding probably precludes this. We would like to further develop the CPS antigen detection diagnostic test into a single use lateral flow format and arrange field testing. In addition, testing of cereal-derived carbohydrates in vaccine formulations and as the basis of diagnostic tests would be highly desirable. A major portion of next year’s activities will probably comprise writing up our research findings to date. Publication and (hopefully) adoption of our new HEPES-buffered medium for production of CBPP vaccines. This will require collaboration with PANVAC.

**Output / Impact**

Restriction enzyme findings (last year) will have significant economic and scientific/health impacts in research and diagnostic institutes throughout the Third World- this should positively affect the health of both animals, and more importantly, humans. Vaccines and diagnostic reagents, if they prove to be successful in the field (as well as the laboratory), should have significant impact at the level of the individual farmer, but only if properly developed and implemented- this is likely to require further funding. Our stabilised vaccine formulation should have positive impact at the level of individual farmers, but again, only if publicised and implemented.

**Targets for the following year**

Begin field testing of new diagnostic reagents. To bring new buffered medium for the production of CBPP vaccines to the attention of FAO, OIE PANVAC etc and push for adoption. Publication of our research findings.
**Dissemination**

*April 2000 – March 2001*


Radio interview for New Agriculturalist/Agfax with Susanna Thorp on the problems of eradicating CBPP from Africa.

“Differentiation of Mycoplasma mycoides mycoides SC strains/isolates- prospects for molecular epidemiology.”


“Insertion sequence analysis of Mycoplasma mycoides subspecies mycoides small colony variant for strain typing and epidemiological studies.”

“The use of antigen detection latex agglutination tests in the detection of contagious caprine pleuropneumonia.”


“The use of undefined medium components in the growth of Mycoplasma mycoides subsp. mycoides small colony variant (MmmSC): Implications for vaccine production and extraction of the capsular polysaccharide.”

Poster presentation at the above meeting.

“Are African strains of Mycoplasma mycoides subsp. mycoides SC more virulent than European strains?”

“Capsular polysaccharide of Mycoplasma mycoides subsp. mycoides small colony variant: compositional and structural studies.”

“Analysis of the capsular polysaccharide purified from Mycoplasma mycoides subsp. mycoides small colony with monoclonal antibodies.”

Three seminars presented at EU ‘Mycoplasmas of Ruminants No. 5’ COST 826 meeting in Gran Canaria, Spain, June 14-16 2000.

“Construction and preliminary analysis of a Mycoplasma mycoides subsp. mycoides small colony variant expression library”

“Analysis of humoral immune responses following vaccination of cattle with $T_1$ vaccines”

Two poster presentations at the EU ‘Mycoplasmas of Ruminants No. 5’ COST 826 meeting in Gran Canaria, Spain, June 14-16 2000.

‘An investigation of immunological responses of $T_{144}$ and $T_{1SR}$ vaccinated animals before and after in vivo challenge with contagious bovine pleuropneumonia.’ U Mesghun, MSc Project Thesis, CTVM, University of Edinburgh, September 2000.


One further Honours project currently underway as part of this DFID project (The Development of a Defined Medium for the Growth of MmmSC).
**RNRRS PROJECT COMPLETION SUMMARY SHEET**

**R Number**  
R7356

**Date Sheet Completed**  
March 2001

**Title of Project**  
Incrimination of Vectors of Trypanosoma vivax in the New Outbreak Zone of Santa Cruz, Bolivia

**Programme Manager**  
Professor Ian Maudlin, CTVM, University of Edinburgh

**Sub-Contractor**  
Martin HALL, Natural History Museum

**RNRRS Programme**  
Animal Health Research Programme

**RNRRS Production System**  
High Potential/Peri Urban, Forest/Agriculture Interface

**RNRRS Programme Purpose**  
Performance of livestock of poor people improved through the control of disease

**Commodity Base**  
Livestock

**Beneficiaries**  
Cattle producers in areas of Bolivia affected by bovine trypanosomiasis, particularly those in the smallholder sector, smallholders’ immediate families and other dependents and, additionally, veterinarians at LIDIVET and UNIVEP.

**Target Institutions**  
Museo de Historia Natural, Santa Cruz, Bolivia (MHN), Laboratorio de Investigacion y Diagnostico Veterinario, Bolivia (LIDIVET), Unidad Nacional de Vigilancia Epidemiologia Veterinaria, Bolivia (UNIVEP)

**Geographic Focus**  
Bolivia (South America)

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1 **Project Purpose**  
To contribute to improved control of bovine trypanosomiasis in Bolivia by incrimination of potential insect vectors and by incorporation of vector control measures into integrated control strategies for bovine trypanosomiasis. Vector incrimination will enable: (i) more effective targeting of prophylactic applications to livestock and, (ii) vector control to be developed.

2 **Outputs**  
- Identification and incrimination of potential vectors of bovine trypanosomiasis, leading to improved information on the epidemiology of bovine trypanosomiasis in Bolivia.

The major activity of this project was strategic research towards achieving this particular output. Two smallholder farms in Santa Cruz Department were selected for monthly sampling of tabanid flies by trapping, Chocolatal farm in Guarayos Province and San Diego farm in Sarah Province (Fig. 1). Both had a recent history of cases of bovine trypanosomiasis. In addition to the sampling, studies were undertaken at Chocolatal on the interactions between cattle and tabanids, on the effects of chemical treatments of cattle on tabanid feeding and on an analysis of fly bloodmeals for the presence of trypanosome DNA.

![Fig. 1: Family of smallholder on dairy farm near to San Diego, Sarah Province, Santa Cruz, Bolivia.](image)
DIAGNOSTICS and DECISION SUPPORT TOOLS

Over 25,000 tabanids were trapped and identified during the project, the vast majority at Chocolatal, which had an abundance some 25 times that of San Diego. Chocolatal was located in the more humid northern region of Santa Cruz, on the border with the neighbouring department, Beni. Seasonality of tabanids at Chocolatal could be divided approximately into two time periods, a period of higher fly abundance around the warm wet summer months (November-March) and a period of lesser fly abundance around the cold and dry winter months (May-August) (Fig. 2 below). However, seasonal variation was less evident at Chocolatal than it was at a southern farm in a similar environment to San Diego (Saavedra, Fig. 2). The most numerous of the 33 tabanid species was Tabanus occidentalis (45-88% of monthly total) a medium sized species that feeds aggressively on the lower body and, especially, the legs of cattle, sometimes in large numbers (Fig. 3 [see Volume 1, Section 3.1]).

The directly disruptive effect of tabanid flies was measured by recording two cattle defensive behaviours, hoof stamps and tail swipes. The intensity of these cattle behaviours was directly correlated with the numbers of flies observed on the cattle, but varied markedly between individual cattle. Defensive behaviours were one factor responsible for the early ending of tabanid feeds. Hence, as the density of flies increased, the potential for mechanical transmission of trypanosomes by flies, through interrupted fly feeds, increased more than would be expected just from the increased numbers of flies. When cattle were treated with a pyrethroid insecticide, Cypermethrin, for control of tabanids, the proportion of cattle-visiting flies that fed to completion dropped from 40-60% to less than 20%. Of those flies that did feed, the feeding times were significantly reduced following treatment of cattle (Fig. 4 above). If those flies went on to take a further meal to complete their ingestion then the problem of mechanical transmission would be exacerbated. However, it is possible that they would not seek to complete their meal - this important question requires further study.

In the study of trypanosomes in vectors, 1164 polymerase chain reaction tests (PCR’s) were carried out on the bloodmeals of 582 flies captured on cattle at Chocolatal. Seven species of fly were found to have trypanosomes in their bloodmeals: one species was positive only for Trypanosoma vivax, one species only for T. evansi and five species positive for both. The most numerous species captured for analysis and that which was positive in greatest numbers for trypanosomes was Tabanus occidentalis. Trypanosomes were found in approximately 7% of completed bloodmeals.

Three species of tabanid have been reported in the literature to mechanically transmit trypanosomes. All three species are found in Santa Cruz Department. There is no physical reason to suppose that most other species of medium to large tabanid cannot also transmit trypanosomes, including the abundant Tabanus occidentalis. Because of the great number of tabanid flies and the extensive season of their flight activity, there is a much greater risk of mechanical transmission of trypanosomes on farms such as Chocolatal, in Guarayos, than on farms such as San Diego, in...
Sarah, that have fewer tabanids over a shorter season. It is perhaps not surprising, therefore, that the greatest numbers of positive cases of *T. vivax* reported by the veterinary diagnostic laboratory, LIDIVET, are from Guarayos Province.

- Information sheets on identification of biting flies produced in Spanish and English for local veterinarians and livestock workers.
  
  One leaflet has been prepared on bovine trypanosomiasis in Bolivia. A further leaflet on vectors and vector control will be produced in March/April 2001.

- Training of Bolivian staff in entomological and vector incrimination techniques, at NHM, CTVM and in Bolivia.

Mr J.L. Aramayo Bejarano made two visits to the NHM in London to work with the collections of biting flies and received one-to-one training in identification techniques both there and in Bolivia (Fig. 5 below). Additionally, he and two other MHN staff employed under the project (Ms M. Gutierrez and Mr G. Zarate) received field training in Bolivia in a number of techniques for trapping of flies and for study of their behaviour. One MHN student, Ms M. Coca Bruno, received training in larval biology and ecology and is preparing a project on that topic for her Licenciatura en Biologia thesis (Fig. 6 below).

- Production of plan for strategic timing of prophylactic measures against bovine trypanosomiasis formulated, based on synthesis of data on seasonality, abundance and distribution of incriminated vectors.

Deciding whether or not to apply prophylactics for trypanosomes and insecticides for fly control is a complex process. A farmer must weigh the cost of application of the preventive measures against the value of livestock and the potential losses should an infection result. Such losses are clearly related to the pathogenicity of the strain of trypanosome. In Bolivia acute infections have been recorded, but chronic infections with minimal overt symptoms also occur. In the application of insecticides, their use against other pests such as ticks should be considered, in order to reduce the risk of resistance. In general, the risk of mechanical transmission is greater in the northern Provinces of the Department than in the Provinces around Santa Cruz. Based solely on entomological evidence, the risks could be reduced by application of prophylactics throughout the period of high fly populations, the warm and wet months, when insecticidal applications to hosts should also be applied. However, due to year-to-year variations in climate and, hence, tabanid flight activity and abundance, ideally tabanid populations should be routinely monitored to provide a better guide to annual periods of high risk. Likewise, routine sampling of cattle can indicate areas
DIAGNOSTICS and DECISION SUPPORT TOOLS

of high prevalence of infection and consequent high risk of spread. The nature of mechanical transmission means that a separation of 200 metres between infected and uninfected hosts is generally considered sufficient to eliminate the risk of transmission by interrupted feeds. The major means by which bovine trypanosomiasis is spread in Bolivia is by movement of cattle, specifically the introduction of infected cattle into close proximity with uninfected cattle. Measures to reduce contacts of this nature will be of major importance in control of the disease.

- Preparation of plan for follow-on adaptive study to assess effect of direct vector reduction activities on bovine trypanosomiasis.

Plans are being prepared for studies to extend the present work on the effects of insecticide treatments on tabanids and to study the potential for insecticide-impregnated targets as an element within an integrated control programme.

3 Contribution of Outputs to Project Goal

The project goal is to improve the performance of livestock of poor people through the control of disease. Fundamental to control of diseases are, firstly, disease diagnosis and its availability to poor farmers at an affordable level and, secondly, measures for control, again at a cost to the farmer less than the losses that would occur without control. Better focus of prophylactics and insecticides for fly control on the periods when flies are most abundant, as indicated by the results of this project, will help to reduce the costs of control for smallholders and contribute to improved performance of their livestock.

4 Publications


5 Internal Reports


6 Other Dissemination of Results

- Oral Presentation: "Tabanids as vectors of bovine trypanosomiasis in Bolivia" (Hall, Aramayo, Chainey & Jones), Second Symposium on New World Trypanosomes and Other Hemoparasites, held in San Juan de los Morros, Venezuela, 13-15 October 1999.

- J.L. Aramayo Bejarano presented a poster and publication "Distribucion ecologica y etologia de los Tabanos (Diptera: Tabanidae) en Bolivia con particular referencia en Departamento de Santa Cruz" at the Feria de Ciencia Tecnologia Universidad Autonoma “Gabriel Rene Moreno”, Santa Cruz, Bolivia, 25-31 October 1999.


- Oral presentation by J.L. Aramayo Bejarano on work of the project at the IX Congreso Ibérico de Entomologia, held in Zaragoza, Spain (3-7 July 2000).

- Oral presentation by J.L. Aramayo Bejarano on tabanids and trypanosomiasis to field veterinarians and livestock workers at three seminars convened by LIDIVET collaborators for livestock workers in San José de Chiquitos (14 October 2000), Puerto Suarez (2 December 2000) and Santa Cruz (14 December 2000).
DIAGNOSTICS and DECISION SUPPORT TOOLS

- Poster presentation by J.L. Aramayo Bejarano on tabanids and trypanosomiasis at Feria of Universidad Autonoma “Gabriel Rene Moreno”, Santa Cruz, November 2000.
- Oral presentations by M. Hall, J.L. Aramayo Bejarano and T. Jones at Ciclo de Conferencia Internacional “Los Transmisores de la Tripanosomiasis Bovina” held on 14th March 2001 at LIDIVET, Bolivia, attended by 80 persons from the livestock industry.
- Production of Spanish Language leaflet on “La Trypanosomiasi s Bovina (Trypanosoma vivax) with one further leaflet on tabanids and control to follow, March/April 2001.
- Production of a 15-minute documentary video on the project work by “CANAL 11” television company, Santa Cruz.
- Preparation of WWW site detailing results from the project, for publication in April/May 2001 (http://www.nhm.ac.uk/entomology/).

7 Follow-up indicated/planned
Strategic research is indicated to develop the best method for application of minimal quantities of insecticide to cattle for effective repellence and killing of tabanid flies and to develop effective insecticide-impregnated targets. Both these areas can be followed through to an adaptive phase if the strategic research demonstrates that they can be effective tools.

8 Name and signature of author of this report
Martin J.R. Hall
20 March 2001
RNRRS PROJECT COMPLETION SUMMARY SHEET

**R Number**  R7361

**Date Sheet Completed**  March 2001

**Title of Project**  The Development of Simple Virus Detection Assays for Jembrana Disease Virus

**Programme Manager**  Professor Ian Maudlin, CTVM, University of Edinburgh

**Sub-Contractor**  Joe BROWNLIE, Royal Veterinary College

**RNRRS Programme**  Animal Health Research Programme

**RNRRS Production System**  High Potential

**RNRRS Programme Purpose**  To improve the performance of livestock of poor people through the control of disease

**Commodity Base**  Cattle (Bali cattle) - draught animals

**Beneficiaries**  Immediate beneficiaries are researchers in the Indonesian veterinary services and at the Bali Cattle Disease Investigation Unit. However, control of disease in Bali would have a direct benefit to farmers and village communities, for whom Bali cattle are socially and economically central.

**Target Institutions**
1. The Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield, Herts, AL9 7TA, UK
2. Bali Cattle Research and Development Centre, Faculty of Animal Science, Udayana University, PO Box 3704, Denpasar, Bali

**Geographic Focus**  Indonesia

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1 **Project Purpose**
To improve the health and performance of draught animals, critical to the agriculture of Indonesian rural communities, by the development and validation of diagnostic assays for diseases of Bali cattle, particularly fatal Jembrana disease. Robust assays based on recombinant protein will support Indonesian Animal Health programmes.

2 **Outputs**
In the project proposal we stated that "The most clearly identifiable output will be a viral detection system for Jembrana disease…The detection of virus and viral variants directly from field material will be essential for effective control and eradication measures.”. **During the period of research the virus antigen detection ELISA has been developed using new reagents created as a direct result of the funding.** Originally, the virus envelope protein was the perceived target for this assay but it became apparent that more appropriate reagents, and the ones finally used, were the virus capsid protein and a synthetic peptide derived from the virus envelope transmembrane protein. Using the experimental and field reagents available we judge this to be a highly sensitive and specific virus detection system. On the basis of work done to date we have been able to unequivocally detect recombinant proteins derived from JDV but produced in the lab. The sensitivity of the system developed is great; detecting recombinant protein at a level of only 3 nanograms/ml. It has not been possible to import JDV into the UK for direct testing and the political and economic situation which developed in Indonesia made it impractical for the proposed research trip to Bali to take place. However, we are actively pursuing the testing of this assay in ongoing collaborative work. Further
field testing in Bali would be required to assess its utility for detection of variant viruses that may exist within Indonesia.

A second major objective at the outset was "...to establish a continuous cell line that is permissive for JDV culture: such cell lines exist for HIV isolation and are central to HIV diagnosis and research. ...Replication of a lentivirus such as JDV initially involves trans-activation of the promoter of the integrated provirus by specific cellular nuclear factors such as NF-κβ, SP-1 and others. ... Tat in particular, is itself a potent trans-activator of the viral promoter, which leads to markedly upregulated transcription and expression of all viral proteins. It is proposed that a bovine cell line stably transfected with the JDV tat gene would be permissive to viral growth.". The development of a culture system for JDV was initiated as detailed. MDBK cells (an established bovine cell line) were stably transfected with the JDV tat gene. This gene was shown to be active through it's ability to stimulate expression from a plasmid containing the chloramphenicol acetyltransferase gene under the control of the tat dependent promoter. However, the susceptibility of this cell line to infection by BIV was not increased. At this stage it is unclear what is the nature of the molecular block to replication of BIV in these cells but it is still possible that JDV could be cultured in this cell line. This possibility was not tested as the political and economic instability in Indonesia restricted working visits to Bali.

3 Contribution of Outputs to Project Goal
The antigen detection assay developed as a result of this project is both a robust and sensitive means of detecting recombinant viral protein. If this translates into detection of field isolates of the virus in Bali then the test will be the only in vitro means of identifying viral antigen in potentially infected animals prior to import/export or in episodes of clinical disease. This means that there will be no ongoing requirement to use cattle as sentinels for the diagnosis or quantitation of this virus. As an end in itself this is a worthy outcome. Furthermore, use of the assay, if implemented, will be key to the diagnosis and control of the disease within Indonesia and bring economic benefit to the farmers dependent upon the local cattle for draught power, meat and leather. This could assist the maintenance of the disease-free status of areas of Indonesia and prevent the spread of this economically devastating virus infection.

4 Publications
P. Barboni, I. Thompson, J. Brownlie, N. Hartaningsih and M. E. Collins.
Evidence for the presence of two bovine lentiviruses in the cattle population of Bali. Veterinary Microbiology (2001) in press.


5 Internal Reports
P. Barboni. 4.3.00 Development of antigen capture ELISAs for bovine lentiviruses.

6 Other Dissemination of Results.
Professor Brownlie has presented seminars at key international conferences hosted in Bali.

7 Follow-up indicated/planned

8 Name and signature of author of this report
**Project Number**  R7362  
**Project Title**  Pen-side Diagnostics for the Detection of Antibodies against a Marked Rinderpest Virus (RPV) Vaccine Allow Differentiation of Vaccinated from Infected Animals  
**Project Leader**  John ANDERSON  
**Institution**  Institute for Animal Health, Pirbright  
**Project Dates**  Start – May 1999      End – April 2002

**Project Background**  
This project is designed to improve the epidemiological tools available for the eradication of rinderpest. At the present time it is impossible to differentiate vaccinated from infected animals. If vaccine were to be used to control an outbreak, it would be impossible to determine the spread of the disease as the antibody response to vaccination is indistinguishable from the immune response to natural infection. The use of a marked vaccine and pen-side diagnostic tests will help delineate the extent of an outbreak and facilitate the use of ring-vaccination to control the spread of newly emerging rinderpest outbreaks. Pen-side diagnostic antibody tests are also being developed to detect antibodies to peste des petits ruminants (PPR) viruses to allow a better understanding of the epidemiology of this important disease.

**Development and Scientific Objectives**  
The development of such devices and vaccines will improve and assist the in the interpretation of serum surveillance data following an outbreak and encourage the use of immune barriers to prevent the spread of rinderpest and PPR from endemic and disease free countries. The use of rapid diagnostics and marked vaccines will have enormous benefit in poor farming communities in Africa and Asia currently either affected or at risk from rinderpest and PPR. By reducing the incidence of rinderpest and PPR such communities will be more able to move cattle and livestock, thereby increasing trade. This rapid diagnosis will speed up the implementation of control measures and should reduce livestock losses and help in eradicating the disease.

**Progress against Log-frame Indicators**  
The H and N proteins of rinderpest and the N protein from PPR have been produced in large enough quantities to optimise the binding to latex and the nitrocellulose strips. The protein production and purification process is now well established. Work is underway here and in Sweden to produce devices which can be validated in the field and used in accelerated thermal stability testing. Panels of sera have been tested to establish any cross reactivity with GFP in the field.

**Achievements in Current Year**  
Purification of the baculovirus expressed H and N from rinderpest and PPR protein has been optimised and is working well. Various baculovirus cell lines have been evaluated for their ability to produce large amounts of protein required. Each cell line had to be optimised for each protein. Work has been carried out with our Swedish collaborators to determine the optimal binding conditions for each protein. Various blocking agents have been evaluated to determine their ability to reduce the frequency of false positives. A panel of specialised conjugate release pads for the use with whole blood samples has been evaluated to determine which is the most effective at reducing the spread of red blood cells up the nitrocellulose strips. This is an important aspect since it is envisaged that the final device will be used with whole blood samples in the field. Panels of negative bovine sera from several geographical locations have been tested by ELISA, to ensure that there are no cross-reaction against the GFP antigen. It was considered unlikely that bovines would have come into contact with this antigen, however this had never previously been fully evaluated.
Planned Activities for Next Year
Re-engineering of the H protein baculovirus construct to include a his-tag. It is hoped that this will ease the purification process and therefore enhance the binding of the protein to latex. Accelerated thermal stability testing will be carried out in collaboration with our Swedish partners. A field trial is planned for later this year to test the prototype pen-side antibody detection devices (both for rinderpest and GFP). Continued efforts will be made to increase the expression levels of the recombinant expression systems.

Output / Impact
A new pen-side diagnostic test to differentiate between PPR and rinderpest infected and vaccinated animals. The ability to differentiate between infected and vaccinated animals will improve the efficiency of diagnosis, assist in delineating rinderpest outbreaks and facilitate ring vaccination. This should reduce livestock losses and increase the livelihood and food supply of local farmers. Because of the nature of the devices, they can be used by personnel in the field who have had relatively little training and are ideally suited to the Community-based Animal Health Workers (CAWS).

Targets for the following year
Re-engineered the rinderpest H protein baculovirus construct to ensure the high level of expression required to produce large enough quantities of the proteins for commercial production.

Produce enough prototype devices to detect antibodies to rinderpest and PPR which can be used on whole blood in the field so a large scale field study can be carried out.

Final optimisation of the device to detect antibodies to the GFP marker in the marked rinderpest vaccine. Further evaluate the potential of the poultry influenza HA antigen as a rinderpest vaccine marker and its use as an antigen in rapid diagnostics.

Dissemination
A progress report was presented to the technical Consultation on the Global Rinderpest Eradication Programme in Rome, Italy, May 29-30th

Progress reports were made to the Pan African Control of Epizootics (PACE) Advisory Group meeting in Addis Abbaba, Ethiopia, January 2001.

Attended “The Latex Course” sponsored by Bangs Laboratories in Amsterdam

Invited to attend the Millennium Diagnostic Conference organised by Whatman
DIAGNOSTICS and DECISION SUPPORT TOOLS

**Project Number**  R7364
**Project Title**  Improving the Control of Tsetse: The Use of DNA Profiling to Establish the Feeding Responses of Tsetse to Cattle.
**Project Leader**  Stephen TORR
**Institution**  Natural Resources Institute, Chatham
**Project Dates**  Start - April 1999   End - March 2001

**Project Background**
Tsetse flies transmit trypanosomiasis over 10 million km² of sub-Saharan Africa. The disease greatly reduces the productivity of domestic livestock and is ultimately fatal. The effects of trypanosomiasis are particularly severe in some of the most deprived regions of the continent.

**Development and Scientific Objectives**
The use of insecticide-treated cattle promises to be one of the most cost-effective methods of tsetse control for poor, livestock-owning communities. For such communities however, the technique can still be prohibitively expensive and can undermine the natural resistance of traditional cattle to tick-borne diseases. Indigenous breeds of cattle develop this resistance by being exposed to tick-borne diseases when they are young. Consequently, the use of insecticides to control tsetse can prevent this exposure and hence the natural development of resistance. This project aims to improve the cost-effectiveness of the technique by determining whether the insecticide can be applied selectively to only a proportion of an owner’s livestock.

**Progress against Log-frame Indicators**
All the indicators for project outputs were successfully achieved. Indeed, in most cases the project exceeded in its targets; the DNA microsatellite profiles for >30 Mashona cattle and >1000 tsetse were produced and the individual source(s) of blood from >600 fed tsetse were identified. Using these data, the host preferences of tsetse feeding on cattle were inferred and the findings were used to make recommendations on the feasibility of treating specific types of cattle to control tsetse. The practical recommendations were disseminated directly to collaborators in the target countries (Tanzania and Zimbabwe) as well as NGOs concerned with controlling tsetse in Ethiopia.

**Achievements in Current Year**
Activities for this year were mainly concerned with using a form of DNA fingerprinting to determine whether tsetse feed preferentially upon particular types of cattle. In Zimbabwe, scientists from NRI and the Zimbabwe Department of Veterinary Services undertook field studies of the feeding behaviour of tsetse attracted to small herds of Mashona cattle, a breed of shorthorned sanga indigenous to Zimbabwe. The experimental herds comprised two calves (<100 kg), four cows + steers (~300 kg) and two oxen (>400 kg). The composition of the herds reflects the size, condition and age structure of those found in the tsetse-affected communal areas of northern Zimbabwe.

An incomplete ring of electric nets was used to capture tsetse as they approached or departed from a herd of cattle. A sub-sample of >600 tsetse were analysed at the Wildlife Forensic DNA Laboratory at Trent University in Canada. Primer sets for seven different ungulate loci were used to obtain individual microsatellite DNA profiles for each fly and these were matched with profiles previously recorded from the individual cattle. Using the entire suite of seven primers, the individual specific source(s) of >90% of the bloodmeals could be unequivocally identified. The results showed that feeding was greater on animals known to have lower rates of host defensive behaviour and this was highly correlated with animal size; ~80% (range, 67% - 91%) of meals were from the two largest animals within the herd and only 0 – 3% were from the calves.

These findings have two important practical implications. First, the practice of not treating young animals, to allow the development of natural resistance to tick-borne disease, does not compromise the efficacy of using insecticide-treated cattle to control tsetse. Second, by confining insecticide treatments to the larger adults further reductions in insecticide costs can be achieved without any significant reduction in efficacy. For instance, the results indicate that treating either half or a
quarter of the herd would reduce efficacy by ~5% and ~20% respectively. Such reductions would have no significant effect on the impact of a tsetse control operation.

A paper establishing the methodology for characterising the individual specific source(s) of bloodmeals in tsetse was published, in the international journal Medical and Veterinary Entomology, within four months of submission. The scientific findings, and practical implications for owners, were presented at scientific meetings in Africa and North America and at various informal meetings with livestock owners, specialists and institutions in Ethiopia, Tanzania and Zimbabwe.

Planned Activities for Next Year
The project finishes in March 2001. However, the findings will be disseminated more widely via a workshop to be held in Zimbabwe in April 2001, and papers presented in international journals and meetings. The outputs will also be promoted via an AHP-funded project specifically concerned with disseminating tsetse control technologies to NGOs. These activities will be closely linked to community-based tsetse control schemes being undertaken in Ethiopia and Tanzania.

Output / Impact
The outputs will contribute towards developing a sustainable, environmentally beneficial and cost-effective strategy for controlling trypanosomiasis using insecticide-treated cattle. The work indicates that a selective dipping strategy, based on the treatment of the larger animals within a herd can achieve more cost-effective control. Such a strategy will be particularly cost-effective for poorer livestock-keepers in Zimbabwe, Tanzania and Ethiopia who typically have small heterogeneous herds of cattle. The findings are being used in the design of community-based tsetse control operations being conducted in Ethiopia and Tanzania and government-funded operations in Zimbabwe.

Targets for the following year
Not applicable

Dissemination

Dr Torr presented results to livestock specialists and/or owners at workshops in Zimbabwe (April 2000; October 2000) and Ethiopia (July 2000).

Publications
See Volume I – Annex B
**Project Number** R7596
**Project Title** Decision Support System for the Control of Trypanosomiasis in South-East Uganda: Improving Public Health and Livestock Productivity through the Cost-Effective Control of Trypanosomiasis in Livestock

**Project Leader** Paul COLEMAN / Sue WELBURN
**Institution** CTVM, The University of Edinburgh
**Project Dates** Start – April 2000      End – March 2003

**Project Background**
In SE Uganda trypanosomiasis constitutes a major health problem that affects both man and his livestock. Cattle are the primary reservoir of Trypanosoma brucei rhodesiense, the causative agent of rhodesiense sleeping sickness. Sleeping sickness is fatal if not treated and control of the disease has traditionally relied on tsetse control and active case detection and treatment – expensive activities dependent on public funding and a high degree of community participation to ensure sustained impact. A recent extension in the geographic distribution of sleeping sickness to the north of the traditional disease focus in SE Uganda has been linked to movement of cattle as part of a restocking programme in Teso. Thus, the role of cattle as a reservoir of sleeping sickness may further constrain rural development through restricting trade, movement and restocking of cattle.

**Development and Scientific Objectives**
The project will help resolve the role of cattle in the maintenance and spread of human sleeping sickness in SE Uganda, and the lack of cost-effective and sustainable control options for animal trypanosomiasis and human sleeping sickness. The project will enable policy makers, public institutions, communities and individual smallholder framers to identify appropriate and cost-effective methods for the sustainable control of trypanosomiasis in cattle of SE Uganda, through development of cost-effective and appropriate strategies to sustainably control diseases of livestock that affect the livelihoods of the poor, thereby (1) improving the performance of smallholder livestock, and (2) reducing the public health burden due to sleeping sickness.

**Progress against Log-frame Indicators**
Significant progress has been made towards the project purpose to development of cost-effective and sustainable control interventions of livestock that affect the livelihoods of the poor. Progress had been made towards the analysis of the spatial and temporal patterns of sleeping sickness in SE Uganda, molecular identification of trypanosome species, analysis of the population structure of T. brucei parasites, and towards developing an analytical description of the persistence of these parasites in cattle and humans.

Prevalence surveys were undertaken in year 1 in three districts of SE Uganda and samples were collected from 250 cattle (activity 1.1). Molecular characterisation of these parasites using PCR has been completed at the trypanosome species level (T. brucei, T. vivax, and T. congolense) and also to differentiate the four sub-types of T. congolense (Savannah, Forrest, Tsavo and Kilifi) (activity 1.2). Over 90 of the T. brucei samples have also been examined for the presence of a gene that confers human infectivity. These activities are essential for:

- the planning of field trials to determine the cost-effectiveness of alternative control interventions (logframe activity 1.6)
- determining the economic burden of sleeping sickness (logframe activity 1.3)
- determining the risk to the rural poor of the domestic livestock reservoir of T. b. rhodesiense (logframe activity 1.3)
- towards development of theoretical frameworks to investigate the cost-effectiveness of alternative control options (logframe activity 1.5)

Significant progress has been made towards the determination of the risk to rural poor of domestic livestock reservoirs of T. b. rhodesiense with the completion of a case controlled study in Soroti district (activity 1.3). This case controlled study on the origins of the new sleeping sickness outbreak to be published in The Lancet will be of direct relevance to policy makers concerned with
the control of trypanosomiasis in both the medical and agricultural sectors of east Africa and international agencies (such as WHO).

**Achievements in Current Year**

A case control study has been completed which shows that the outbreak of sleeping sickness in humans in Soroti District began around the Brookes Corner cattle market suggesting that imported cattle from the endemic focus of sleeping sickness brought this disease to a new district (accepted for publication in the Lancet). Cattle (250) in 3 villages in each of three districts of SE Uganda (new focus in Soroti; 1990 focus in Tororo and 1950-1980 focus in Busoga) were collected and screened for animal and human infective trypanosomes. Diagnosis was made using PCR at trypanosome species level (T. brucei, T. vivax, and T. congolense) and also differentiation of T. congolense into four type (Savannah, Forrest, Tsavo and Kilifi). Over 90 of these samples have been characterised for the presences of a gene that confers human serum resistance (human infectivity) - a novel marker for the diagnosis of T. b. rhodesiense parasites.

An analytical framework developed describing the importance of cattle to the persistence of sleeping sickness. A succinct and intuitive expression was developed giving the criteria necessary for preventing outbreaks of human sleeping sickness by controlling T. b. rhodesiense infections in cattle.

A theoretical framework has been constructed for estimating the level of sleeping sickness under-reporting.

**Planned Activities for Next Year**

Prevalence surveys will be undertaken in three districts of SE Uganda to screen animals present in villages and also cattle being traded at markets to assess risk of human sleeping sickness through market trade of cattle (logframe activity 1.1). Surveys will be undertaken in villages and markets within the traditional endemic regions of disease, within the new disease focus and also in areas outwith the present outbreak to determine the risk posed to the rural poor from livestock keeping and trading (logframe activity 1.4).

Molecular fingerprinting of T.brucie isolated in SE Uganda will be undertaken to determine the genetic relatedness of the parasites circulating in the new epidemic focus with those circulating in the traditional endemic sleeping sickness foci. These parasites will be compared to those collected during the previous epidemic of sleeping sickness in SE Uganda in 1980 (logframe activity 1.2). This will enable an estimation of persistence of these parasites over time which will necessary for the planning of field trials to determine the cost-effectiveness of alternative control interventions (logframe activity 1.6) to assess the risk of livestock trading to the rural poor (logframe activity 1.4) and for construction of decision support framework (logframe activity 1.7) and development of media formats (logframe activity 2.1).

The novel marker for human infective parasites will be tested for robustness by screening previously characterised parasites from man and livestock collected in 1980 and worked up as a test for rapid identification of T. b. rhodesiense parasites in domestic livestock in the field (logframe activity 1.2). Investigation of SRA as a marker for T. b. rhodesiense will enable the determination of the risk to rural poor of domestic livestock reservoirs of the parasite (logframe activity 1.3).

Further development of a mathematical framework to estimate the level of sleeping sickness under-reporting will be undertaken together with completion of the DALY score assessment for sleeping sickness (logframe activity 1.5).

**Output / Impact**

The case controlled study on the origins of the new sleeping sickness outbreak to be published in The Lancet will be of direct relevance to policy makers concerned with the control of trypanosomiasis in both the medical and agricultural sectors of east Africa and international agencies (such as WHO).
The construction of a risk map for human and animal trypanosomiasis in SE Uganda on which to base and cost control and policy options for both animal and human disease.

**Targets for the following year**
Completion of prevalence surveys for human and animal trypanosomiasis in endemic and epidemic foci in SE Uganda. Completion of activities leading to publication of a DALY for T. b rhodesiense sleeping sickness. An assessment of the risk posed to rural people through the introduction of new strains of parasites into tsetse habitat from cattle movements from endemic foci of disease.

**Dissemination**
Research activities have been highlighted in an article in the New Agriculturalist ‘Waking up to reality? New Agriculturalist on-line 3/6/01. Research outputs have been accepted for publication in 2000 in the peer refereed journals ‘The Lancet’; in the Proceedings of the National Academy of Sciences, USA; Parasitology Today; Trends in Parasitology and Experimental Parasitology.

**Publications**
See Volume I – Annex B
Project Number: R7597

Project Title: A Low-Cost Haemoglobinometer as a Decision Support Tool for Bovine Disease Diagnosis in Sub-Saharan Africa

Project Leader: Mark EISLER

Institution: University of Glasgow Veterinary School

Project Dates: Start – April 2000      End – March 2003

Project Background
In Africa specifically, annual US$ costs of trypanosomiasis, theileriosis, heartwater (SADC Region alone), and babesiosis/anaplasmosis have been estimated at 700 million, 168 million, 37-47 million and 6.9 million respectively. These endemic diseases of African cattle are a major constraint to sustainable rural livelihoods but their control is constrained by contraction of veterinary services, with devolution of diagnosis and treatment to non-professional cattle keepers and extension workers who lack clinical knowledge or diagnostic tools. Effective diagnosis is required for rational treatment and control, but this is impeded by the unavailability of suitably trained professional staff and of field-level diagnostic tests. The project will improve the quality and accessibility of disease diagnosis to resource poor cattle keepers, through the development of a rapid, reliable and cheap haemoglobinometer as a diagnostic test for anaemia, a key indicator of the health status of animals in the tropics, and a decision support tool enabling simple diagnosis and treatment of these disease.

Development and Scientific Objectives
- The development of a hand-held, field haemoglobinometer as a rapid, reliable and cheap tool validated for robustness and suitability for measuring haemoglobin in the blood of cattle under field conditions in East Africa as an aid to the diagnosis and treatment of the major endemic disease constraints.
- A decision support tool in an inexpensive and simple slide-rule format, for the diagnosis of endemic disease in cattle in Africa by people without professional veterinary training. Intended primarily for use with the haemoglobinometer, but nevertheless also useful even without the haemoglobinometer.
- Extension messages targeted at farmers, extension workers and animal health assistants, in formats such as leaflets, booklets and laminated cards on diagnosis of and commonly available treatments for the major endemic diseases of cattle in East Africa, and designed for use in conjunction with the haemoglobinometer and decision support tool.
- Information on regional prevalence, clinical diagnostic signs and haematology of common endemic diseases of cattle in Kenya and Uganda.
- Improved clinical diagnostic skills among the veterinary scientists in the African collaborating research institutes NVRC and LIRI conducting the fieldwork, and among animal health assistants and extension workers who will be involved in the research.

Progress against Log-frame Indicators
Progress has been made towards the project purpose of development of development of cost-effective and appropriate strategies to sustainably control diseases of livestock that affect the livelihoods of the poor, and the other all the Log-frame indicators relevant to the first year of the project. Stakeholder meetings have been held in Kenya and Uganda for identification of end-users, dissemination methods and end-user requirements for the haemoglobinometer and decision support tool. A rapid, reliable and cheap hand-held field haemoglobinometer has been validated for use in cattle under African conditions. Correlation of results of prototype haemoglobinometers with traditional haematological measures of anaemia has been conducted, and determination of normal reference ranges for healthy cattle in Africa has been initiated. Information on prevalence, diagnosis and haematology of endemic cattle diseases in Uganda and Kenya, has been collated and compiled by:
- a critical and quantitative review of literature, reports, and databases pertaining to distribution and of key clinical and haematological diagnostic features of bovine endemic diseases in project areas has been conducted
DIAGNOSTICS and DECISION SUPPORT TOOLS

- initiating a Delphi survey of expert opinion of distribution of bovine endemic diseases in project areas, and of key clinical and haematological diagnostic features
- a comprehensive veterinary and microbiological and parasitological examination of 450 healthy and naturally diseased cattle in SE Uganda.
- Development of decision support tool for use with the haemoglobinometer has been initiated.

Achievements in Current Year

The project was initiated with stakeholder meetings conducted in Africa involving the UK-based and African project partners to fine-tune the project objectives of development of a hand-held haemoglobinometer and associated decision-support tool as an aid to the diagnosis and treatment of the major endemic disease constraints to cattle of poor people in East Africa, and to plan the work for the year. Several candidate systems for measuring haemoglobin have been identified and evaluated under laboratory and field conditions. These range from simple colour charts for use with filter paper strips to hand-held colorimetric haemoglobinometers. In the laboratory, these systems were tested for precision and accuracy, and sources of error were pinpointed. The most promising system was a haemoglobinometer with a simple, combined pipetting device, pre-filled reaction chamber and measuring cuvette.

Significant progress has been made towards compiling an evidence-base for the diagnosis and treatment of endemic bovine diseases in East Africa. A Ugandan scientist based in Glasgow for much of the current year has conducted a critical review of the literature and initiated a Delphi survey of expert opinion both in Uganda and internationally. In addition a field survey of 450, mainly small East-African zebu, cattle has been conducted in 9 villages in 4 Districts of South Eastern Uganda. This involved a comprehensive veterinary examination for key clinical signs of disease, together with detailed parasitological and microbiological examination for causal organisms of disease. Haemoglobin levels were measured using two candidate haemoglobinometers. Cattle were categorised as diseased, in which case at least one clinical sign was present, or clinically normal. Normal cattle were used to provide references ranges for haemoglobin, while associations between causal organisms of disease and clinical signs and haemoglobin were investigated and added to the evidence base.

Finally, a concept-form low-technology decision-support system has been designed and a strategy for further formulated with information technology partner at the University of Strathclyde.

Planned Activities for Next Year

The Delphi survey of expert opinion for the evidence-base for the diagnosis and treatment of endemic bovine diseases in East Africa will continue with analysis of the first round of questionnaire feedback from the participants and if necessary a second round will be conducted to clarify areas of disagreement between them. The most promising haemoglobinometers identified in year 1 are arguably over-specified for the purposes of the project; hence dialogue with companies producing it will be aimed at further developing lower-cost systems with acceptable performance. Sampling of cattle at village-level in Uganda will continue for enlarge the evidence base in terms of number of animals and the range of diseases encountered. This will be achieved by further cross-sectional studies and it is also proposed to conduct a longitudinal study in 8 villages in SE Uganda to obtain additional information on the incidence and impact of endemic diseases in various age groups of cattle in the target production system, and on their interactions, particularly that of trypanosomiasis and anaplasmosis. This will provide invaluable information on the frequent cases of mixed infection the specific diagnoses of which are not always readily resolvable in the field, and optimal treatment strategies for these situations. The development and production of the decision support tool will continue, taking into consideration the additional results to be obtained by the cross-sectional and proposed longitudinal studies, and associated extension messages for use with the haemoglobinometer will be designed.

The findings of the first year will be disseminated at a workshop to be held at LIPI, Tororo, Uganda at the beginning of year 2. This will include UK and African project collaborators, and also members of relevant stakeholder groups such as the District Staff of the Ministry of Agriculture, representatives of the EU FITCA Project and the Ugandan coordination unit for Trypanosomiasis control (COCTU).
Output / Impact
The information on clinical signs and haemoglobin levels obtained will be disseminated in a scientific publication and also extension material to be specifically distributed directly to animal health workers in East Africa in a range of institutes from ILRI, Ministry of Agriculture District Veterinary Offices and NGOs working in the target production systems. Modalities for the wider distribution of the haemoglobinometer and associated decision support system to animal health workers in the field will be investigated in order to achieve the greatest possible impact on animal health.

Dissemination
Year 1 findings will be disseminated at a stakeholders meeting to be conducted at ILRI, Uganda. Radio interviews have been conducted with the Wren media group on behalf of DFID for overseas broadcasting, and the project has been highlighted in a film made by the UK foreign office to promote collaboration British Universities overseas. Publications closely related to the project are in press, and a publication detailing the projects first year achievements is in preparation. Finally the DFID AHP/LPP publication “Livestock Talk” featured the project in its leading article in a recent edition.

Publications
See Volume I – Annex B
**Project Number**  R7599  
**Project Title**  Development of Alternative Foot and Mouth and Tick-borne Disease Control Strategies to Benefit Resource Poor Farmers in Southern Africa  
**Project Leader**  Wilna VOSLOO  
**Institution**  Onderstepoort Veterinary Institute  
**Project Dates**  Start – April 2000      End – March 2003  

**Project Background**
We want to develop alternative, more cost-effective strategies for the control of foot and mouth disease (FMD) and ticks and tick borne diseases (T&TBD) in specific regions in South Africa. These regions border on the Kruger National Park (KNP) where FMD is endemic in the African buffalo (Syncerus caffer) and to ensure that the disease does not spread into livestock and from there to the rest of the country that is FMD-free, vaccination and strict movement control measures are used. Currently the control regulations for FMD inhibit commercial agricultural development for resource poor farmers. It is necessary to investigate alternative control strategies, such endemic stability, for T&TBD that affect production and the quality of the produce. After the outbreaks of FMD in the study areas it is also necessary to investigate alternative ways of marketing animal products from the control zones.

A situation analysis will indicate the perceptions and attitudes of the affected communities towards diseases and disease control and will give an estimate of the collaboration expected from the communities. It will also more clearly define their specific needs. The epidemiological data will give an indication of how effective disease control strategies are at present and be used to plan future policies that will better ensure that FMD does not “spill over” from infected buffalo into livestock again. Altered vaccination strategies will also be investigated to improve FMD control. More cost-effective control of T&TBD will lead to the improvement of stock quality and better prices for their animals. Information transfer regarding diseases and disease control will benefit the poor farmers by changing negative perceptions about disease control and improving own disease surveillance. Information regarding new control strategies and improved opportunities for marketing must reach small-scale farmers.

**Development and Scientific Objectives**
Information on FMD, T&TBD, disease control, the difference between vaccination and treatment, animal improvement, etc. will be disseminated to the animal health technicians, dip tank assistants as well as to the resource poor farmers. Emphasis will be placed on the marketing possibilities of animal products from the FMD control zone, as the number of farmers negatively affected by the FMD control strategies following the recent FMD outbreaks, have increased significantly.

Epidemiological data will be compiled using the serological survey information to determine the efficacy of FMD vaccination in certain areas where there had been no evidence of disease. The sera will also be tested to determine if small, localised outbreaks may have occurred in such areas, but at a sub-clinical level since vaccination suppressed the development of clinical disease. A study will also be performed in one of the focus areas using different FMD vaccination strategies, as well as alternative adjuvants, to improve the protection against FMD.

In one of the study areas state sponsored weekly dipping is used for surveillance of FMD, while also controlling T&TBD. In the other study area this practise has been terminated due to financial restrictions and at some dip tanks the farmers had started their own programs at their own cost. Serological data will be used to determine the prevalence of TBD such as cowdriosis, anaplasmosis and babesiosis and compare the two study areas. This will give an indication of whether it will be possible to create endemic stability and adjust the dipping policy to suit the financial situation of the small-scale farmers.

Mathematical modelling will be performed to determine FMD risk and cost benefit of existing FMD and T&TBD control measures.
DIAGNOSTICS and DECISION SUPPORT TOOLS

Progress against Log-frame Indicators
Information was gathered from rural communities to define perceptions and attitudes towards disease control and summarised in Mr. Ainslie’s report. Consent was obtained for co-operation in this project from National and Provincial role players. The statisticians had determined sample sizes and randomly identified dip tanks to be included in the study. A method of sampling has also been determined.

Achievements in Current Year
The FMD outbreaks in the study areas have caused the emphasis of the project to change. The initial aim was to lift movement control in areas further away from the KNP. However, the recent outbreaks of FMD had occurred in regions within the control zone, but where vaccination was not used for control, and movement could occur after quarantine. These animals have now all been vaccinated and several had been infected and no movement of live animals will be allowed out of these areas for several years. This will severely impact on farmers who could previously move their animals out of the control zone after a 2-week quarantine period. In future, the project will focus more on informing rural farmers about FMD and tick borne disease and the importance of control, and investigate alternative ways of marketing animal products and not necessarily live animals. The information gathered from the serological surveys and mathematical modelling will be used to assist the Directorates of Veterinary Services to develop improved control policies.

During the last year Mr. Andrew Ainslie performed a partial feasibility study of the project and handed in a report. He concluded that the stakeholders will welcome the outcomes of the study and concluded that overall, the community perceptions towards dipping and disease control are positive and that there are mostly good relationships between the farmers and the Veterinary Services staff. Several recommendations were made that will be considered.

Prof. Dirk Pfeiffer and Dr. Dan Haydon visited the Onderstepoort Veterinary Institute (OVI) during the week of 18-22 September 2000 to discuss the statistical methodology of sampling for the project. They have submitted a report where they indicated that 25 dip tanks throughout the study areas should be included in the study. The feasibility of visiting these proposed dip tanks has been discussed with the collaborators in the two study areas. Prof. Pfeiffer has compiled a questionnaire that will be used at the dip tanks in this study to determine whether the livelihoods of the farmers will be improved by the outcomes of the study.

The historical serological data for foot and mouth disease obtained from the Nsikasi and Nkomasi districts, Mpumalanga, is being compiled for Dr. Dan Haydon for statistical analysis. This activity was also negatively influenced by the outbreaks of FMD, as we experienced a severe staff shortage due to the extra workload. Data on ticks and tick borne diseases has been compiled for the Venda district and may be used as baseline information for the dip tanks in the Northern Province and Mpumalanga where we want to perform our study.

The team from the OVI and members from the Institute at Irene are busy planning a “roadshow” to take to the dip tanks where the sampling will be performed to get the local farmers involved. Information on FMD and control, TBD and control, improvement of livestock and livestock management and marketing possibilities will be covered. Posters, infopacks and slide shows will be made available to dip tank assistants. Some of the infopacks will be handed out to farmers.

Planned Activities for Next Year
Due to the FMD outbreaks in both provinces targeted for this study, the sampling for serological surveys has been delayed. Mpumalanga has indicated that they now have staff available again to assist in the fieldwork. This will start in April 2001. Authorities in Northern Province have indicated that they will have staff available within a month. During April 2001 the project team will visit two staff meetings of field workers in Mpumalanga to familiarise them with the training material. Dip tanks will also be visited where training and sampling will occur simultaneously. Information packages will be distributed to the farmers at the chosen dip tanks and the questionnaires filled in.

The market analysis was also delayed as a result of the FMD outbreaks and will be performed early this year. The emphasis of this analysis will now shift away from marketing live animals to
marketing animal products. The possibility of establishing feedlots and abattoirs in the control area and then accessing local markets will be investigated.

Prof. Pfeiffer will visit South Africa in April 2001 and not during year 3 as was previously indicated. He will assist with the planned extension work at the dip tanks. The serological data generated during the year will be analysed and used for mathematical modelling.

**Output / Impact**
The market feasibility study will enable us to contact various stakeholders for possible funding should we see that feedlots and abattoirs will assist the people currently affected by the FMD control policies in marketing their livestock. Such possibilities need to be discussed with the Directorates of Veterinary Services as they are responsible for movement policies out of the control zones.

The small-scale farmers will receive information packages on several very relevant topics and training on animal improvement and marketing. The FMD information packages will be distributed outside the FMD control areas to sensitise more farmers about the importance of the disease.

The serological data will be used in mathematical modelling and risk analysis. This data is very important to the Directorate of Veterinary Services to investigate the efficacy of their current disease control strategies and to propose changes so that a repeat of the FMD outbreaks does not occur.

**Targets for the following year**
- Training of extension staff in the provinces participating in the study.
- Dissemination of training material to the Veterinary staff and small-scale farmers.
- Generation of serological data to be used in mathematical modelling.
- Gathering information from the small-scale farmers using the questionnaire.
- Starting an experiment where different FMD vaccination strategies and different adjuvants will be tested under field conditions.

**Dissemination**
Apart from the quarterly reports to DFID and internal reports to the Agricultural Research Council, we have not disseminated the contents or progress of the project.
Dissemination and Delivery of Animal Health Knowledge
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DISSEMINATION of ANIMAL HEALTH KNOWLEDGE

**Project Number**  R7050
**Project Title**  Sustainable Use of Wildland Resources: Ecological, Social and Economic Interactions
**Project Leader**  Ken CAMPBELL
**Institution**  Natural Resources Institute, The University of Greenwich
**Project Dates**  Start – October 1997   End – March 2001

**Project Background**
The illegal hunting of resident and migratory wildlife has long been a problem for the management of Serengeti National Park, Tanzania. Poaching has reduced populations of resident herbivores, whilst over-harvesting of migratory herbivores may ultimately threaten the integrity of the Serengeti ecosystem. This project examined hunting from the perspectives of those arrested and those living in communities adjacent to the park with a view to understanding key factors responsible for promoting game meat hunting as a viable livelihood activity.

**Development and Scientific Objectives**
The main aim of the project was to identify linkages between rural livelihoods and game meat hunting, and to identify key social, economic and environmental factors linked to game meat hunting, including the role played by poverty.

**Progress against Log-frame Indicators**
The project has developed questionnaires and systems for recording data from people arrested by rangers in the national parks. The project has also worked with the national park’s Community Conservation Service, through training in both participatory techniques and questionnaire surveys, to develop methods for obtaining information from villages and households adjacent to the parks.

**Achievements in Current Year**
Involvement in illegal game meat hunting is related to a lack of opportunities for alternative employment and livelihood options, access to markets, and to a basic scarcity of opportunities for income generation. Illegal game meat hunting is also clearly related to levels of rural poverty. There is evidence that changing levels of taxation and the impact of structural adjustment programs may result in increased levels of rural poverty near to the national parks.

Illegal hunting in Serengeti National Park is closely linked to poverty. Arrested hunters come from the poorest sections of the community, whilst those questioned in village surveys overwhelmingly identify hunting with the poorest people. Wildlife are primarily hunted for economic reasons, to generate cash, rather than in response to a direct need for food, with 75% of arrested hunters indicating that they are hunting for cash or trade. The need to pay taxes, village development contributions and levies and to purchase of clothing were identified as the most important factors, responsible for 79% of the need to generate cash.

Food derived from the park by illegal hunting forms an important contribution to rural livelihoods. Within surveyed villages, hunting was widely seen as a source of food and cash during difficult times, as well as a strategy for coping with problems such as stock theft. Rather than the food value per se, the results suggest that it is the ability to sell the meat and to subsequently use the cash proceeds for other goods and services that is the most important contribution of wildlife to rural livelihoods.

Household survey data indicate that between 14% and 54% of households in areas adjacent to the park are involved in game meat hunting inside the park. In addition to poverty, a number of key factors have been identified that relate to the incidence of hunting, including: distance from markets and access routes, distance from Lake Victoria and the frequency of fish in the diet (Fig 1), household income obtained through cash crops, and details of livestock ownership. Increased access to markets and increased livestock ownership – especially of sheep and goats – is likely to have a significant impact on rural poverty as well as on the incidence of illegal hunting.
Planned Activities for Next Year
Additional funding will be sought to extend current work to cover key issues highlighted by the research, including the roles played by (illegal) trade in wildlife meat, its role in rural livelihoods, economic importance and risk from unsustainable offtake.

Output / Impact
Methods were developed for collection of information from arrests by ranger patrols and were adopted by Tanzania National Parks for wider use in all parks - by the end of the project providing valued management-related information with potential for influencing policy-level decisions. Participatory techniques and household questionnaires, with training in their use, were employed in villages adjacent to the park. Together these data enabled an analysis of key linkages between rural livelihoods and poaching. The training provided will enable similar work to be carried out in other areas by Park’s Community Conservation Service staff.

Dissemination
Workshop held during March 2001 to discuss research findings with Tanzania National Parks senior management and CCS staff, together with village representatives and other stakeholders.

Publications
See Volume I – Annex C
1 Project Purpose
Sustainable and cost-effective management strategies for the control of diseases in co-existing livestock and wildlife developed and promoted (DFID/NRRD Animal Health Programme Output 3 under Purpose 2, 1998).

2 Outputs
Output 1. - Improved understanding, attitudes and current use of PA/EVK systems in public and private veterinary services, wildlife services and research institutes in Africa.
This output was fully achieved, primarily by a questionnaire survey of veterinarians working in Africa (see 4 below).

Output 2. - Validated PA/EVK methodologies with associated statistical methods for use in veterinary epidemiology, needs assessments, planning and evaluation.
This output was partly achieved with 6 PA methods validated and 7 statistical methods applied to data derived from PA. Field research was conducted in 2 countries. Funding for field research in a third country was included in a 1-year project extension that was approved for funding by DFID in November 2000. Funding was later withdrawn in March 2001.

Output 3. - A participatory appraisal manual targeted at veterinary and wildlife professionals and covering applications of PA/EVK in public and private sector veterinary activities.
This output was not achieved. Key dissemination activities, including manual production, were included in a 1-year project extension that was approved for funding by DFID in November 2000. Funding was later withdrawn in March 2001.
**DISSEMINATION of ANIMAL HEALTH KNOWLEDGE**

3 Contribution of Outputs to Project Goal

The limited dissemination of research findings suggests limited contribution of Outputs to Project Goal.

4 Publications


5 Internal Reports


6 Other Dissemination of Results

- Article for Livestock Talk.
- Article for New Agriculturalist.
- Participatory approaches to veterinary investigation: Initial experiences from the PAVE Project in Southern Sudan. Presentation at the Kenya Veterinary Association Annual Scientific Conference, April 26th-28th 2000, Mombassa, Kenya.
- Research findings from southern Sudan were presented at the Joint PAAT/ICPTV Workshop in Addis Ababa in September 2000.
- The project conducted a three-day workshop in participatory epidemiology for post-graduate students at the Free University of Berlin. Students were from Kenya, Ethiopia, Zambia, Sudan and Thailand.
- A paper 'Globalisation of Veterinary Medicine: Challenges facing basic service provision in less-developed countries' was presented at the Annual Convention of the American Veterinary Medicine Association, Salt Lake City.
- Poster displays of project results were presented at the OIE Africa Regional Meeting, Arusha, January 2001.

7 Name and signature of author of this report

Andy Catley
DISSEMINATION of ANIMAL HEALTH KNOWLEDGE

Project Number  R7271
Project Title  Optimising Milk Production on Smallholder Dairy Farms in Tanzania: Studies of the Epidemiology and Socio-economics of Animal Disease and the Quality and Safety of Milk
Project Leader  Mike BRYANT
Institution  Department of Agriculture, The University of Reading
Project Dates  Start – September 1998    End – February 2002

Project Background
Small-scale dairying is an important agricultural activity in many parts of the developing world, producing a valuable food product and providing a regular income and work for poor households. However, dairying suffers the disadvantage of requiring a substantial capital investment in the cattle and thus involves the household in considerable risk. Given that the cattle kept for dairying purposes are almost always exotic crossbreeds, susceptible to a wide variety of disease and parasitism, the investment must be protected by costly preventive measures, both in terms of husbandry methods employed and pharmacological and immunological interventions. Such measures considerably add to the costs of producing milk and restrict the growth of the dairying enterprise. A further, emerging threat is the possible occurrence of zoonoses, in particular bovine tuberculosis, and the occurrence of antibiotic residues in milk. As the majority of milk is sold untreated, and to consumers whose immune systems may be already compromised by other disease challenges, further information on the disease status of the dairy cow population is imperative.

Development and Scientific Objectives
The overall aims of the project are to quantify disease threats and their economic consequences in terms of lost productivity and investment in preventive measures in the small-holder sector, and to establish the potential health hazards posed to the consumers by the milk produced, with the objective of devising acceptable and cost effective control measures. This will be achieved by:
- identifying the importance of small holder dairying to households
- quantifying the key determinants of health and productivity of cattle
- identifying the current preventive practices and the reasons for these
- assessing the risk of milk-borne zoonoses and antibiotic residues to human health
- devising sustainable, environmentally sound and cost-effective strategies for minimising disease

Progress against Log-frame Indicators
- A greater understanding of the role of smallholder dairying in Tanzanian societies was obtained through exploratory PRA activities and wealth ranking.
- A cross-sectional survey provided estimates of the frequency of mortality and morbidity in dairy cattle, particularly tick-borne disease and mastitis.
- The same survey provided estimates of the contribution of independent variables to the risk of disease and to productivity.

Achievements in Current Year
Serology results from Tanga indicate that Babesia bigemina and Trypanosoma parva occur throughout the study area with overall sero-positivity of 27% for B.bigemina and 23% for T.parva. The overall prevalence of sero-positivity for B.bovis was low (6%) and the distribution of this pathogen appears to be more limited. Age sero-prevalence profiles suggested that, overall, none of these tick-borne pathogens exist in a state of endemic stability in most smallholder dairy farms of the region. However, considerable variation appears to occur with sero-prevalence varying amongst the five agro-ecological zones and the eight administrative zones that comprise the study region. The sero-prevalence of B.bigemina was the most variable (ranging from 15 to 53%) but variation in the sero-prevalence of T.parva and B. bovis was also observed (15 to 37% and 0 to 9%, respectively).

A mastitis-awareness campaign was carried out in Iringa during the last reporting year. Evaluation studies of dissemination of knowledge about mastitis indicated that, prior to the campaign, 39% of
DISSEMINATION of ANIMAL HEALTH KNOWLEDGE

Respondents checked their cow for mastitis prior to milking by either observing or palpating the udder, or by inspecting the foremilk. Six weeks after the campaign this figure had risen to over 45% of respondents, and sixteen months after the campaign to 75% of respondents. Pain was volunteered as a clinical sign of mastitis by 38% of respondents before the campaign and by 48 and 57% of respondents six and sixteen weeks after the campaign, respectively. A cartoon poster, used during the campaign, illustrated seven effects of mastitis. Respondents who had seen the poster were more likely to volunteer the risk of death (or culling) of the cow (risk ratio = 5.4, P value = 0.0009), and the risk of contracting zoonotic disease by drinking infected milk (risk ratio = 3.17, P value = 0.0149) as effects of mastitis, than respondents who had not seen the poster.

Planned Activities for Next Year
The project will be in its final year. Field work will be completed and results analysed. Practical outcomes will be disseminated at workshops held at the two project sites.

Output / Impact
- Estimates of the frequency of mortality and morbidity in dairy cattle, particularly tick-borne disease and mastitis.
- Estimates of the contribution of independent variables to the risk of disease and to productivity.
- Effective dissemination methods of mastitis knowledge. Impact: Veterinary Departments, NGOs (dairy development programmes), smallholder farmers.

Targets for the following year
- To complete the longitudinal surveys in Iringa and Tanga (in July 2001).
- To determine the efficacy of different dissemination methods of mastitis knowledge in Tanga.
- To analyse all collected data and report the results of the project.

Dissemination
Transmissions of a radio interview with Professor Fitzpatrick were heard in Tanzania, Kenya, Nigeria, Rwanda, Burundi, Congo and Somalia. Material was translated into Swahili, Hausa and 26 local languages.

Publications
See Volume I - Annex C
Livestock are a vital component to the livelihoods of both the rural and urban poor in developing countries. According to recent estimates, 70% of the rural poor are livestock keepers (LID, 1998). For the households involved, livestock have a vital role in cementing social relationships, securing household income and supplying food products (Heffernan and Misturelli, 2000). For many farmers and herders, the loss of an animal is directly related to impoverishment and destitution. Thus, livestock and poverty are intricately related.

However, until recent years, development activities have not explicitly utilised livestock as a force for poverty reduction (Heffernan et al., 2001). Indeed, many projects actively encouraged households to pursue non-livestock related activities (Heffernan et al., 2001). Nevertheless, although livestock are increasingly recognised as being important to the poor, little further information is available regarding who the poor livestock keepers are, and what factors are important to the sustainability of their livelihoods. As such, major impediments exist in the implementation of pro-poor livestock health and production programmes. First, identifying poor livestock keeping households is problematic. Second, livestock share-rearing arrangements, an important form of social capital, have not been studied in a systematic manner. Third, little information is available regarding the animal healthcare needs of the poor. Finally, methodologies to assess the impact of animal healthcare projects on poverty reduction are poorly developed. Many participatory techniques are either inappropriate to livestock keeping or biased in their assumptions (Heffernan and Misturelli, 2000; Misturelli et al., 2001).

Developmental Aims and Scientific Objectives
To address the above needs, the objectives of the study are as follows:
• To create a methodology to target poor livestock keeping households.
• To examine the viability of livestock share-rearing arrangements as an indicator of social capital for the poor.
• To assess key parameters important to the uptake of animal healthcare projects by the poor.
• To create policy recommendations to improve the delivery of veterinary services to the poor on a global level.
• To critically analyse current techniques in participatory livestock development in order to eliminate bias. To this end, the project is associated with the DFID Social Development funded project: Poverty and Participation: An analysis of bias in participatory methods.

Progress against Log-frame Indicators
♦ The Livestock Poverty Assessment methodology has been developed from fieldwork in Kenya and Bolivia and will be further refined in India.
♦ Primary data on the role of livestock as a form of social capital has been collected in Kenya and Bolivia.
♦ The findings from the fieldwork in Kenya have been written up and distributed to stakeholders. The Bolivia data is currently being analysed.
♦ A Critical Analysis section has been added to evaluate bias in participatory methods ranging from stakeholder meetings to visual representations.

Achievements in Current Year
During the past year, the fieldwork has been completed in Bolivia. Over 60 communities in four government departments participated in the study. In total, 900 household interviews were performed. The database has been completed and the data is currently being analysed utilising both qualitative and quantitative tools. Presentations were made regarding results from the
fieldwork in Kenya at three international conferences. In addition, the fieldwork for India was planned.

The key findings from the Bolivian fieldwork are as follows:
- Knowledge regarding veterinary services is lower than in Kenya and both traditional and formal animal healthcare information pathways are weak.
- Access to veterinary services and affordability appear to be equally constraints to poor households.
- Among subsistence farming communities, livestock play less a role in enhancing social capital between households and individuals than in Kenya.
- Social capital is stronger at the community than individual levels.

The key methodological findings from the study are as follows:
- Data Collection: Fourteen participatory methods were utilised to collect data in the field. By critically assessing the design and application of the methods, the study has demonstrated bias in many participatory methods as currently practised. However, the bias was found to be specifically related to the methods themselves and not solely attributed to the characteristics of the actors and the socio-cultural differences between the communities and researchers. Further, the study has demonstrated that the reliability and validity of participatory methods is enhanced by combining sets of related methods.
- Data Analysis: Discourse analysis is a useful tool to examine community level perceptions and values regarding poverty.

Planned Activities for Next Year

The focus of activities in the coming year will be on the completion of the fieldwork and the dissemination of project outputs. A report is being written outlining the results of the fieldwork in Bolivia and India. Results will be disseminated through scientific papers, reports and presentations and via the web. Equally, an end of project conference is planned for October 2001.

Output / Impact

- Livestock Poverty Assessment: A methodology to identify poor livestock keeping households based upon a simplified SL framework and Participatory Poverty Assessments. Clients of the LPA include CGIAR centres, research institutes, governments, donors, NGOs and indeed farmers and pastoralists themselves who will benefit from better targeted more appropriate animal healthcare projects.
- An Assessment of Livestock in the Livelihoods of the Poor: By illuminating the role of livestock in the livelihoods of the poor, NGOs, donors and research institutes may evaluate the relevance of their activities to poverty alleviation strategies. Further, understanding livestock as a means of both acquiring and maintaining social capital is fundamental to improving the impact and uptake of animal healthcare projects specifically and livestock development projects more generally. The findings will be useful for a large variety of stakeholders: research centres, donors, governments, NGOs, CBOs and ROs at both the policy and implementation levels.
- Key parameter assessment: A methodology to identify key parameters important for the uptake of animal healthcare programmes has been developed. By creating a system that evaluates needs prior to project implementation and determines poverty impact after start up, donors, NGOs and governments will gain from the improved cost-effectiveness and sustainability of programmes. Herders and farmers will also benefit from projects that are directly responsive to their needs.
- Policy Recommendations: Finally, by establishing mechanisms to enhance the collaborative links both with and between donors and NGOs, the results of the research will support the development of pro-poor livestock development policy at a global level. All of the above named stakeholders will benefit from the collaborative linkages.

Targets for the following year

During the next year, the fieldwork portion of the research will be complete and the findings from each country presented to stakeholders. The final report will also be completed and work published from each of the four elements of the project.
**Dissemination**

- Paper presented at the conference: Small Holder Livestock production Systems in Developing Countries: Opportunities and Challenges, 24th to 27th November 2000; Trissur, India.
- Papers have also been presented at student seminars.
- Project reports have been disseminated via the web: [www.livestockdevelopment.org](http://www.livestockdevelopment.org)
- Developed virtual centre for the delivery of livestock services to the poor: [http://www.rdg.ac.uk/~vis98spk/global](http://www.rdg.ac.uk/~vis98spk/global)

**Publications**

See Volume I - Annex C
Project Number | R7360
---|---
Project Title | Field Methods and Tools for Resource-poor Farmers and Extension Workers to Improve Targeting and Appropriate Use of Drugs Used for Control of African Bovine Trypanosomiasis
Project Leader | Ian MAUDLIN
Institution | CTVM, The University of Edinburgh
Project Dates | Start – April 1999      End – March 2002

Project Background
Bovine trypanosomiasis is an important disease constraint to agricultural production in sub-Saharan Africa. Area-wide tsetse control projects are expensive but rarely sustainable. Although pour-on insecticides may be available at the farmer level, their efficacy depends on community uptake, they are not appropriate in all areas and may compromise enzootic stability of tick-borne diseases. Trypanocidal drugs remain the only widely available control method affordable by farmers.

Patterns of veterinary drug use in Africa are in a state of transition; privatisation of veterinary services means that drug administration is now in the hands of farmers rather than professional animal health workers. Farmers are unskilled in differential diagnosis and lack knowledge on appropriate drug use.

Despite wide availability, trypanocidal drugs are either not used or used improperly, e.g. to treat conditions for which they are ineffective (non-infectious diseases, tick-borne diseases, helminthiasis). Misuse/overuse of drugs is uneconomic, environmentally unsound and may lead to drug resistance. This problem is important in high potential and peri-urban interface production systems of Western Kenya/Kenya Coast, where prevalences of bovine trypanosomiasis up to 40% have been reported recently.

Education of stakeholders for improved drug usage is imperative if productivity under trypanosomiasis challenge is to improve. The key to improved drug usage lies in education of farmers and extension workers.

Developmental Aims and Scientific Objectives
- To improve the performance of livestock of resource-poor people through control of trypanosomiasis, which will better their livelihoods through sustainably enhanced supply and value of animal products and increased contribution of livestock to crop production.
- To develop sustainable, environmentally-beneficial and cost effective strategies to control trypanosomiasis in high potential and peri-urban production systems in Kenya.
- To develop improved methods of targeting chemotherapy of bovine trypanosomiasis by smallholder farmers. Trypanocidal drugs are among the few animal health interventions available to the smallholder farmer in Kenya. More efficient and appropriate use of these products is therefore essential to the goal of improvement in livestock performance through disease control.
- To educate smallholder farmers and extension workers in order to reduce misuse and overuse of trypanocidal drugs and to improve their benefit/cost ratio. In an environment of privatisation of veterinary services, drugs are becoming increasingly available to farmers, and inappropriate trypanocidal drug use should be reduced and the risk of drug resistance lessened.
- To develop, test and promote robust delivery media and formats for education of smallholder farmers and extension workers, and to assess their impact on farmers understanding of trypanocidal drug use practices.

Project Targets for this year
- To investigate the organs/body systems that farmers examine as diagnostic indicators of the health status of their cattle in Busia and Kwale Districts.
- To investigate the ability of farmers to distinguish diagnostic indicators for trypanosomiasis, ECF and fascioliasis.
To compile a list of animal health messages needed to address the findings of the activities in Years 1 and 2 of the project in readiness for field testing and validation at the beginning of Year 3 of the project.

Results / Highlights of the year

The work in Western and Coastal Kenya which focused on animal health delivery mechanisms was extended to tsetse-infested areas of South Eastern Uganda, and data were obtained on farmers’ knowledge, attitudes and practices in interviews with 105 cattle keepers. These activities essentially completed this phase of the project; veterinarians, animal health assistants, meat inspectors and local traders in veterinary products were interviewed.

Further analysis of the data obtained in Year 1 showed that in Busia and Kwale Districts, 52 of 114 (45.6%) trypanocidal drug treatments were administered inappropriately, i.e. to cases perceived to be diseases other than trypanosomiasis. There was no significant difference ($\chi^2 = 0.331, p = 0.565$) in this respect between Busia and Kwale Districts. The remaining 62 of the 114 (54.4%) trypanocidal treatments were administered appropriately, i.e. to cases perceived to be trypanosomiasis.

Only 11 of 100 (11.0%) treatments with drugs other than trypanocides were administered inappropriately, i.e. to cases perceived to be trypanosomiasis. Again, there was no significant difference ($\chi^2 = 1.057, p = 0.304$) between Busia and Kwale Districts in this respect.

The difference between the two categories of drug in terms of the conditions they were used to treat was highly significant ($\chi^2 = 130, p < 0.001$).

Sixty-two of 73 (84.9%) cases perceived to be trypanosomiasis were treated appropriately with trypanocides, the remainder having been treated inappropriately with other drugs. There was no significant difference ($\chi^2 = 2.72, p = 0.0989$) in this respect between Busia and Kwale Districts. However, over one third (52/141 [36.9%]) of cases perceived to be other diseases were also treated, inappropriately, with trypanocides. Again, there was no significant difference ($\chi^2 = 0.715, p = 0.398$) in this respect between Busia and Kwale Districts.

Participatory clinical examinations of cattle were conducted with smallholder farmers to understand what systems or organs they use to decided the health status of their cattle, and also to assess their ability to distinguish between a collection of useful predictors of disease syndromes including trypanosomiasis, East Coast Fever and fascioliasis. Twenty-six farmers in Busia District and 16 in Kwale District were included in this study. The organs/systems of cattle that were mentioned by at least 30% of farmers that they usually examine include appetite, coat/skin condition, animal’s demeanour, faeces and general body condition. The farmers’ ability to distinguish among trypanosomiasis, ECF and fascioliasis was poor.

The areas needed to be addressed by animal health messages for farmers based on the findings from the data in Years 1 and 2 include the following:

- Increase level of awareness of trypanosomiasis transmission by tsetse flies
- Increase level of awareness of drug specificity, e.g. trypanocides are indicated for use against diseases transmitted by tsetse flies
- Increase awareness of other organs/systems of animals that can be examined to ascertain their health status and predict most likely condition affecting animal
- Increase level of awareness of similarities and differences of endemic vector-borne diseases, i.e. there are other diseases that can be mistaken for trypanosomiasis, e.g. tick-borne diseases and helminthiasis (especially liver fluke disease in adult cattle)
- Increase level of initiative by farmers to actively seek information about trypanosomiasis and other endemic diseases and their correct treatment from government or private animal health practitioners

Summary of Achievements

Areas from which to formulate animal health messages have been highlighted by the results from the data collected in Years 1 and 2 of the project. The basic messages to be conveyed to farmers include raising the levels of awareness of trypanosomiasis transmission, drug specificity, useful
DISSEMINATION of ANIMAL HEALTH KNOWLEDGE

indicators of disease in animals, similarities and differences of endemic vector-borne diseases, and the importance of seeking information for correct treatment of diseases.

Output / Impact
The project will contribute directly to the Livestock Production and Animal Health Programme – Peri-urban Intensive Purpose: 'Improvement in the performance of livestock through the control of disease', Output 4 ‘To evaluate smallholders’ perceptions of trypanosomiasis’ and Output 5 ‘To develop animal health messages for knowledge transfer to smallholder farmers’.

Ultimate beneficiaries will be resource poor households dependent upon livestock for maintenance of livelihoods, smallholder farmers, particularly women who play a key role in livestock management in Africa.

Intermediate beneficiaries from community education material will be schools, Women’s Groups, community based organisations and NGOs.

Target Institutions are Kenya Agricultural Research Institute (KARI), Kenya Trypanosomiasis Research Institute (KETRI) and other NARS; EU Regional Projects: Farming in Tsetse Controlled Areas (FITCA) - East Africa; Regional Tsetse and Trypanosomosis Control Programme (RTTCP) - Southern Africa, FAO/IAEA, Programme Against African Trypanosomiasis (PAAT), DFID-NRRD.

Targets for the following year
- Conduct a situation survey of the agricultural knowledge and information networks of farmers in Busia and Kwale Districts of Kenya.
- Testing and validation of animal health messages.
- Formulation and field validation of strategies for improved targeting and application of trypanocidal drugs.

Dissemination
- Presentation of project activities and achievements at meeting in LIRI, Tororo, 24 May 2000 entitled: Meeting for research scientists involved in trypanosomiasis research projects in S.E. Uganda, 24 May 2000. Presented by Noreen Machila.
- Oral presentations of results obtained from activities in year one at the IXth International Symposium for Veterinary Epidemiology and Economics (ISVEE), 6 - 11 August 2000, Colorado, USA, and also at the ICPTV workshop on socio-economics in Addis Ababa, Ethiopia, 19-22 September 2000, and also at the DFID-AHP workshop on information dissemination to stakeholders held in Nairobi on 23 October 2000. Title: Cattle Owners’ Perceptions Of African Bovine Trypanosomiasis And Its Control In Busia And Kwale Districts Of Kenya. Authors: Machila, N, Eisler, MC, Wanyangu, SW, McDermott, JJ, Welburn, SC and Maudlin, I.
RNRRS PROJECT COMPLETION SUMMARY SHEET

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1 Project Purpose
Promotion of tested strategies to control disease of livestock that affect the livelihoods of the poor
A community animal health service is one strategy available in Africa for controlling livestock disease. To promote this service further as an economically and culturally sustainable livestock disease control strategy, the literature must be analysed in order to provide recommendations to donors and implementers of CAH services on how they can be improved.

2 Outputs
Literature review relating to CAH services and impact assessment methods
This has been achieved, see “The Impact of Community Animal Health Services on Farmers in Low-Income Countries: A Literature Review”. This will be submitted as the final technical report.

Contribution of review analysis to related DFID-funded projects
Achieved, see LID publication “Community animal health workers: threat or opportunity” to be published in 2001.

Identification of “Best Practices” in CAH impact assessment
Achieved, see literature review as above.

Recommendations for further work
Achieved, see literature review as above.
3 Contribution of Outputs to Project Goal

Benefits for poor people generated by the application of improved management of livestock disease

The literature review has provided the target audience of funders and implementers of community animal health services with information on the impact of these services on poor farmers.

Based on the analysis of the literature, it is possible to make recommendations for improving the assessment of impact of community animal health programmes. This can be extrapolated that the management of community animal health programmes will benefit from better impact assessment and that the management of livestock disease will also benefit as a result.

4 Publications


See Volume I - Annex C

5 Internal Reports


6 Other Dissemination of Results

- Oral presentation of Cochrane methods to veterinary clinicians, Royal “Dick” School of Veterinary Studies, University of Edinburgh
- Oral presentation of results to graduate students, Centre for Tropical Veterinary Medicine, University of Edinburgh
- Oral presentation of results to graduate students, Moredun Research Institute, Midlothian, Scotland.
- Oral presentation of results to undergraduate students, faculty, VSF Europa representatives and members of DLO (VSF Netherlands), Veterinary Faculty, Utrecht, the Netherlands
- Oral presentation of results to members of civil society at the Farm Africa offices, London. Present included representatives from the Brooke Hospital for Animals, Acord, VEERU, DFID Livestock Production Programme, and Farm Africa.
- Poster presentation, Cochrane Colloquium, Cape Town.

7 Follow-up indicated/planned

Funding pending, a follow-up is planned. This is the design of a generic framework for assessing the impact of community animal health services.

Planned publication. Martin and Moran, Preventive Veterinary Medicine.

8 Name and signature of author of this report

Marina Martin
Research Project Manager, VETAID
DISSEMINATION of ANIMAL HEALTH KNOWLEDGE

Project Number  R7598
Project Title  Identification of the Role of “Dukas” in Animal Health Information and Service Delivery
Project Leader  Keith SUMPTION / Henry WAMWAYI
Institution  CTVM, The University of Edinburgh / KARI
Project Dates  Start – April 2000      End – March 2002

Project Background
The project seeks to help identify promotional pathways for increasing the impact of animal health and disease control knowledge dissemination on the livelihoods of the poor. It will survey and characterise “dukas” (rural small pharmacies and shops) in different production zones since they occupy a central position in medical/veterinary/agricultural chemicals and drug supply. Farmers’ views on the role of dukas, their contact rate with veterinarians, paravets and healers will be assessed as well as the impact of simple information and training in selected animal health topics.

Development and Scientific Objectives
This project seeks to help identify promotional pathways for increasing the impact of animal health and disease control knowledge dissemination on the livelihoods of the poor.

The objectives are to:
• survey and characterise “dukas” (rural small pharmacies and shops) in different production zones since they occupy a central position in medical/vet/agricultural chemicals and drug supply, and
• the impact of simple information provision and training in selected animal health topics.

Workshops with various stakeholders involved in animal health service provision will be carried out and reports and recommendations for dissemination of health information through the dukas, which will apply to a greater part of East Africa with similar production systems, will be produced at the end of the study.

Progress against Log-frame Indicators
Activity 1.1 (Survey of the distribution and characteristics of agro-vet dukas in different livestock production zones in the targeted study sites) has been 80% completed by the start of March, and is therefore approximately 6 weeks behind schedule, including data analysis.

Activity 1.2 is therefore planned to commence in May after a consultation process with stakeholders.

Achievements in Current Year
Distribution and characterisation studies undertaken and partially analysed in 4 districts of Kenya that will enable selection of shops for training in year 2.

Mapping of the distribution of dukas was conducted in Bungoma district (Kimalili, Municipality, Webuye, Malakisi and Tongaren divisions), Nakuru district (Bahati and Njoro divisions) and Kiambu district (Kikuyu, Lari, Limuru, Ndeiya and Githunguri divisions). Decoy studies were carried out by the social anthropologists in selected shops in each of these areas. The three districts are in AEZ 1-4 but have contrasting livestock production systems, household resources, and availability of animal health services. Mapping was also undertaken in Kajiado district (AEZ 3-5) to provide data on pastoral production systems. Full analysis will be conducted once the studies in Kajiado have been completed. Data on the 384 shops studied to date shows:

In all areas, a high level of use of these shops (between 1 and 2.25% of households (HH) in the area each day), and between 0.5% and 1.45% of HH in the area per day buy animal health products. The highest % was in the pastoralist areas of Kajiado, the lowest in the poorest area studied, Bungoma. There was enormous variation in area served by shops, from 6-7Km² in 3 divisions in Kiambu to 462 km² in Magadi division of Kajiado. With the exception of Kajiado, shops served less than a 4km radius in all divisions. The highest contact rate for animal health interactions in shops was among those owned by Government vets (43 per day) but these were few in number; the agro-vet stores had 10 contacts per day and over the 4 districts saw 44% more clients than shops owned by vets. These agrovet stores were far more frequent in poor, rural areas than those owned by private vets. The number of cattle per shop varied from about 500 in Kiambu to about 17,000 in parts of Kajiado.
DISSEMINATION of ANIMAL HEALTH KNOWLEDGE

Shopkeeper interviews have been conducted for 114 shops and decoy studies undertaken in 98 of these, to obtain a “client perspective” on service and information provided. In addition, 249 client farmer interviews have been carried out in selected shops. The studies have shown widespread distribution of dukas in all the areas. The ownership profiles and products sold are diverse. The quality of information provided to client farmers varies but some farmers consider them an important source of advice and information on animal health.

The opinion on the role of animal health “shops” was sought among community leaders and animal health professionals as well as rapid rural appraisals with farmer groups in Kiambu; the findings were: Farmers find duka services inadequate to meet their animal health product and information requirements; dukas are profit driven without due emphasis to provision of quality service to farmers; cost of drugs and services was considered high in need of regulation; farmers expressed a need for improved duka services through more dukas, better trained staff, regular inspection of dukas by a relevant authority, stocking of drugs recommended by the government drugs control board. In relation to animal health information delivery they considered radio and television as poor methods for dissemination of AH information, and chiefs' barazas and posters/leaflets given to school children or posted at local shops were preferred. They considered training in use AH products and advice should be given to both duka owners and farmers representatives.

Project staff compiled documents relating to activities of veterinary surgeons and shopkeepers in the provision and retail of animal health products in Kenya.

Planned Activities for Next Year

A workshop will be held in early May with Government and private stakeholders representing the formal animal health sector to discuss the first years research findings, and to develop a consensus on the training programme involving shop owners (since the policy is under change regarding the involvement of this sector in drug sales). Studies of the impact of simple information and training will be conducted through months 3 to 9 in selected animal health topics upon quality of services and information delivered by the dukas, with analysis of results followed by a further stakeholder's workshop in month 11/12.

Output / Impact

The following reports will be written:

♦ Report on the distribution and characteristics of agro-vet dukas in different livestock production zones of Kenya;
♦ Report on the effectiveness of rural dukas in the delivery of drugs and information on animal health in the target communities, and possible strategies for improvement;
♦ Report on the impact of simple information and training in selected animal health topics upon quality of services and information delivered by the dukas.

The results (also from 1 and 2) will be presented, discussed, reviewed and documented at a stakeholder's workshop held towards the end of the project.

♦ Recommendations for dissemination of animal health information through dukas; guidelines for animal health information dissemination, research and extension workers; will be made available to stakeholders in East Africa, (Vet Dept, KARI, at OAU/IBAR, donors (DFID/AHP) and will include non-governmental organisations active in the field.

Targets for the following year

▪ Undertake training programmes and produce outputs mentioned above.
▪ Identify potential modes for sustainable linkage of information providers and small shop keepers that enables improvement of animal health information and services and produce a proposal for development of this activity

Dissemination

❖ Paper presented to DFID AHP stakeholders workshop, Nairobi, 23rd October 2000 and paper report of project should be an outcome of this meeting (under preparation by Keith Sones for the AHP).
❖ MSc dissertation of Steven Lewis completed and made available to KARI, and to staff of related projects.
❖ Short article on the project in New Agriculturist, on-line magazine (free access), January 2001.
Publications
See Volume I – Annex C
Vaccine Development
## VACCINE DEVELOPMENT

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**Project Number**  
R7358

**Project Title**  
Development of a Subunit Vaccine against East Coast Fever in Cattle Using a Novel Prime-boost Immunisation Strategy

**Project Leader**  
Sarah GILBERT

**Institution**  
The University of Oxford

**Project Dates**  
Start – October 1999      End – September 2001

**Project Background**  
East Coast fever is a major impediment to introduction of productive exotic cattle in market-orientated, smallholder-dairy systems in Kenya. Existing methods of disease control involving dipping of cattle with toxic acaricides or live vaccination with virulent parasites are not sustainable.

**Development and Scientific Objectives**  
The project purpose is to develop an environmentally friendly and cost effective subunit vaccine against ECF, using a novel prime-boost vaccination strategy. The main outputs will be an experimental vaccine against ECF and a generic method of inducing CD8+ T cell based immunity in ruminants. The latter output will have a broader relevance to development of subunit vaccines against other livestock diseases.

**Progress against Log-frame Indicators**  
A DNA vaccine and two recombinant viral vaccines (MVA and FPV) all expressing the same Theileria parva model antigen, namely a glutaredoxin homologue (11E) have been constructed. Plasmid and MVA viral constructs were also generated for the polymorphic immunodominant molecule (PIM), but these did not express the antigen. The preparation of vaccines expressing several additional T. parva antigens is under way. A bovine ELISPOT assay for assessing the response to the vaccines after immunisation in cattle has been established at ILRI, where the vaccines will be tested, using a model antigen.

**Achievements in Current Year**  
In order to test prime-boost immunisation in cattle whilst the preparation of T. parva vaccine constructs was still underway, the model antigen Mycobacterium tuberculosis 85A was used, as DNA and MVA vaccines expressing this antigen were already available. An initial experiment with two animals primed with DNA (both ID and IM) and boosted with MVA (IV) resulted in the generation of a T cell response in both animals, detected by interferon gamma ELISpot, after the MVA boost but not after the DNA prime. Initially it was difficult to interpret results obtained using this assay because of high background but depleting the peripheral blood mononuclear cells of $\alpha$T cells resulted in low background and the assay, which is essential for monitoring the effect of immunisation, is now working well. No responses were detected in control animals immunised with the DNA and MVA vectors alone.

Further experiments using the model antigen Mtb 85A are under way to test fowlpox (FP) - MVA prime-boost and to establish the best route for DNA priming (ID or IM).

DNA and FP vaccines expressing T. parva glutaredoxin (11e) have been produced, and a set of overlapping peptides (20mers overlapping by 10) has been purchased for use in assays. Although this is a small antigen two out of four cattle immunised with DNA and FP (prime-boost) have both CD4 and CD8 peptide-specific responses to this antigen, after the FP boost but not the DNA prime. All four animals have an antibody response which was detectable two weeks after the DNA prime. The IFN-\(\alpha\) responses are mirrored by proliferation assays in which cells responded to the same peptides as in the IFN-\(\alpha\) ELISpot. Efforts are underway to grow both CD4 and CD8 peptide specific T cell lines and determine whether they respond to T. parva infected cells. An MVA vaccine also expressing 11e is in production, and could be used in FP-MVA prime-boost regimes, which in mice generate stronger T cell responses than DNA-MVA prime-boost.

DNA and FP vaccines expressing a string of three telomeric open reading frames from T. parva (known as TELORF) have been constructed and can be used for immunisation.
VACCINE DEVELOPMENT

There have been concerns over the possible replication of MVA in bovine testicular tissue after some MVA replication was detected in in vitro cultures using this tissue. A bull calf was immunised intravenously with MVA (thought to be the route most likely to allow the virus to reach the testes, whereas immunisations with viral vaccines would normally be given intradermally) and tissue samples were examined four weeks later. PCR assays to detect MVA were negative and histopathological analysis demonstrated the tissue to be normal. The experiment will be repeated, sampling at 5 days and 4 weeks post immunisation but there is no evidence for the replication of MVA in testicular tissue after immunisation from this initial experiment.

Planned Activities for Next Year
An important activity for the coming year will be to define whether gamma interferon detected using the ELISPOT after prime-boost vaccination with the Mycobacterium p85A model antigen and the T. parva glutaredoxin homologue (11E) correlates with a cytolytic T cell response against either peptide loaded target cells, or in the case of the 11e antigen, T. parva infected lymphocytes. Such a demonstration would constitute an important milestone in ECF vaccine development, and in the case of 11E open up the possibility of a challenge experiment using T. parva sporozoite stabilates, since the cytolytic response has previously been demonstrated to be protective in cattle.

Output / Impact
The project outputs will be progress towards an experimental sub-unit vaccine against East Coast Fever, through development of a generic technology for induction of antigen-specific, class I MHC restricted T cells in ruminants. If successful such a subunit vaccine will ultimately lead to reduced use of toxic acaricides and increased productivity for small scale farmers in Kenya and other Southern and Eastern African countries where ECF is endemic. A recent analysis of market potential for East Coast fever vaccine sales by system in the year 2025 revealed that 42% of the predicted market would be in the small scale dairy sector and 25% in Agro pastoral systems.

Targets for the following year
Completion of immunogenicity experiments in cattle to establish the best route for DNA immunisation and to compare DNA-MVA with FP-MVA prime-boost. Completion of the tests to establish whether MVA can replicate in bovine testicular tissue following immunisation. Initiate production of constructs for use in prime-boost vaccination using two additional antigens, specifically a conserved region of P1M, for which the initial full length constructs we have generated did not appear to express the antigen, and Tashat 2, a potentially secreted antigen of the T. parva schizont identified from genome sequence data.

Dissemination
Dr Sarah Gilbert and Professor Adrian Hill visited ILRI to discuss progress on this project and plans for other work on ECF vaccines with ILRI staff.
VACCINE DEVELOPMENT

**Project Number**  
R7363

**Project Title**  
Investigation of the Immunogenic Potential of Heartwater (Cowdria ruminantium) Grown in Tick Cell Lines

**Project Leader**  
Lesley BELL-SAKYI

**Institution**  
CTVM, The University of Edinburgh

**Project Dates**  
Start – April 1999      End – March 2001

**Project Background**  
The tick-borne rickettsial disease heartwater causes high mortality amongst susceptible domestic ruminants, particularly sheep and goats, throughout sub-Saharan Africa, and is a major constraint to livestock improvement programmes. Existing vaccines based on mammalian stages of the causative organism Cowdria have problems of cost, safety, efficacy, ease of administration, and/or cross-protectivity. Cowdria grown in tick cell lines will provide an additional source of antigenic material, comprising tick stages of the pathogen, which should contribute to development of improved vaccines and diagnostic tools.

**Development and Scientific Objectives**  
The project aims to contribute to more effective, safer and cheaper vaccines and diagnostic tools for heartwater by developing and characterising Cowdria/tick cell culture systems which will yield immuno-genic material different from and complementary to that produced in mammalian culture systems.

**Progress against Log-frame Indicators**  
In the first year of the project, growth of three Cowdria isolates was achieved in cell lines from three different tick species, including the vector Amblyomma variegatum. Cowdria in tick cells was shown to resemble tick stages in vivo by electron microscopy, and differences in antigenic profile between stages in tick and bovine endothelial cells were demonstrated using polyclonal sera and monoclonal antibodies. The Gardel isolate in the A.variegatum cell line AVL/CTVM13 was shown to be immunogenic; live material administered intravenously protected 7/8 sheep fully against an experimental challenge which caused severe heartwater in 8/8 naïve controls.

**Achievements in Current Year**  
With the establishment of three further isolates in one or more tick cell lines, Cowdria isolates representing a wide spectrum of geographic origins, antigenic and genetic types are now cultivable in tick cells. In collaboration with Utrecht University, differential transcription of the Cowdria map1 gene copies in tick and bovine endothelial cells was demonstrated using RT-PCR.

The ability of fresh, live cultures of Cowdria (Gardel) in AVL/CTVM13 cells (grown at 37°C) to protect against homologous EB stabilate challenge in the absence of clinical disease was confirmed in a further 8/8 sheep. However, when the same material was inoculated immediately following subjection to conditions simulating travel to Africa by courier, only 3/8 sheep were protected. Consequently, culture material dispatched to African laboratories, for testing in local sheep against experimental challenge with local heterologous isolates, was given a 4-7 day recovery period at 37°C, resulting in seroconversion patterns similar to those seen in sheep receiving fresh material. Due to restricted availability of suitable challenge isolates in West Africa (Senegal and Sankat 430, both of which have low levels of cross-protectivity with Gardel) and problems with stabilate viability in Kenya, it was not possible to draw conclusions on the level of protection induced by the Cowdria/tick cell material in these trials when compared to the naïve controls. However the same material at CTVM protected 6/6 sheep fully against experimental heterologous challenge with the Ball 3 isolate which caused severe heartwater in 7/7 naïve controls.

In a pilot experiment, 2/2 sheep immunised with the Ball 3 isolate in AVL/CTVM13 cells were fully protected against virulent homologous challenge; in addition, one each of two pairs of sheep inoculated with the attenuated Senegal or Pokoase 417 isolates in Rhipicephalus appendiculatus (RAN/CTVM3) cells incubated at 37°C for 8 days were protected against challenge with, respectively, virulent Senegal or Sankat 430.
VACCINE DEVELOPMENT

The project supplied tick cell lines and training in their maintenance to colleagues/collaborators at Liverpool University, Oxford University, Institute of Animal Health (Pirbright), University of Marseille and the Free University of Brussels.

Planned Activities for Next Year
The project will be funded for an extension year, during which the results obtained so far in immunising sheep with Cowdria/tick cells will be consolidated. Laboratory trials will be carried out in Kenya at ILRI, in collaboration with Dr S.P.Morzaria. The Gardel isolate in AVL/CTVM13, already shown to be protective at CTVM, will be used to immunise larger groups of sheep. Work will continue at CTVM to optimise the Cowdria/tick cell culture system, to extend the range of cultivable isolates, and to provide material to the EU cowdriosis network for molecular analysis. Collaborators at CIRAD-EMVT, Guadeloupe will carry out an immunisation trial in goats, using the Gardel isolate in AVL/CTVM13 cells.

Output / Impact
Cowdria grown in tick cells has induced a protective immune response in sheep against experimental challenge with both homologous and cross-protective heterologous isolates, confirming its immunogenicity and potential for contributing to improved heartwater vaccines. As part of the EU INCO-DEV project “Integrated diagnostic and recombinant vaccine development for cowdriosis and anaplasmosis” the Cowdria/tick cell culture system is contributing to investigation of differential stage-specific gene transcription. Tick cell lines supplied by the project to medical, veterinary and biological research laboratories in UK and Europe for viral, rickettsial and tick genome studies are raising the profile of DFID-funded tick cell culture work.

Targets for the following year
To confirm the ability of one or more Cowdria isolates in AVL/CTVM13 cells to protect larger groups of sheep against lethal experimental homologous and heterologous mammalian stage challenge, using material produced at CTVM, to train an ILRI technician in the culture techniques required to produce Cowdria/tick cell vaccine material, to write up the results for publication and to apply for funding to continue the research.

Dissemination
Lesley Bell-Sakyi attended the Seventh Biennial Meeting of the European Tick Study Group, held in Oxford in April 2000, where she presented a talk entitled “Which? tick cell line for rickettsias”. At a workshop held in Montpellier in January 2001 for the start of two EU-funded projects on cowdriosis she presented “Immunisation of sheep with Cowdria grown in tick cell lines” and copresented “Differential transcription of Cowdria outer membrane protein genes (map1) in ruminant endothelial and tick cells” with Dr C.P.J.Bekker, University of Utrecht. During visits to NVRC/KARI, Muguga, Kenya, and the Institute of Animal Health, Pirbright, Lesley Bell-Sakyi gave seminars on tick cell culture and the work of the project.
**Project Number**
R7365

**Project Title**
Identification of Antigens of Theileria parva that are Recognised by Bovine Parasite Specific CTL and Evaluation of their Vaccine Potential in Laboratory Trials

**Project Leader**
Shirley ELLIS

**Institution**
Institute for Animal Health, Compton

**Project Dates**
Start – October 1999      End – September 2002

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**Project Background**

East Coast fever is a fatal lymphoproliferative disease of cattle caused by the sporozoan parasite Theileria parva. The parasite, which is transmitted by ticks, has a complex life cycle in which infective sporozoite and schizont stages represent potential vaccine targets. Principle losses are due to mortality of susceptible cattle, and substantial production loss. Since the only effective control at present involves extensive use of acaricides, there is a great demand for an effective vaccine. Protection is associated with MHC class I-restricted cytotoxic T lymphocytes that kill schizont infected cells. The CTL response in immune animals is often restricted by a single MHC molecule, and such responses are usually parasite strain specific. This suggests that, despite the large complex nature of the pathogen, protection may be focused on a small number of antigenic determinants.

**Development and Scientific Objectives**

The main aim of this project is to identify the dominant CTL target antigens from *T. parva*, by isolating and characterising antigenic peptides bound to MHC class I molecules. A secondary aim is to evaluate the capacity of these antigens to induce a protective, long lasting immune response. The initial approach will be to isolate MHC class I molecules from *T. parva*-infected cell lines, and to elute antigenic peptides from them using reverse phase high-performance liquid chromatography (HPLC). These peptides will be assessed for their capacity to sensitise uninfected cells for recognition by parasite-specific CTL clones. Active peptides identified in this way will be used to target antigenic proteins in the parasite. This will be achieved either by screening sequence databases or cDNA/genomic libraries. Genes identified in this way will be sequenced and characterised. Candidate genes (single, or in combination) will be evaluated as vaccine components in laboratory trials. Information generated in project R7358 may be used at this stage in choosing the most effective immunisation strategy. Development of an effective vaccine will allow the use of improved livestock breeds by smallholders, resulting in a significant increase in milk yield.

**Progress against Log-frame Indicators**

In the previous year several peptide pools were generated from *T. parva* infected cells expressing a single MHC class I gene, HD6. The methods for stripping peptides from MHC molecules and reconstitution of those molecules with peptides from various sources were optimised.

**Achievements in Current Year**

Laboratory work on this project did not begin until November 1999, so this report is actually covering the 12 months from month 6 of year 1. The postdoctoral scientist (Wallace Bulimo) employed on this project left at the end of December 2000, and shortly after that the collaborator at ILRI (Niall MacHugh) was made redundant. Realistically therefore this report is covering only 9 months of work.

The procedure for reconstitution of MHC on acid-stripped cells (using a variety of sources of peptide) was optimised. This was done using control peptides, designed using the known binding properties of the HD6 molecules, and an HD6 self-peptide identified during HPLC analysis and subsequent peak-sequencing. In addition reconstitution was obtained using whole peptide pools eluted from MHC on *T. parva*-infected cells. The methods for handling such peptide pools (in terms of storage and reconstitution) were optimised.

Peptide pool generation from a number of cell lines is on-going. Single MHC class I genes have been transfected into existing lines to create new lines expressing different combinations of such genes. In addition some new *T. parva* lines have been made. In this way peptide pools can be
VACCINE DEVELOPMENT

generated from class I molecules such as A10 and KN104. HPLC of eluted material generates peptide pools and peptide fractions for testing in reconstitution and sensitisation assays. In addition a number of fractions and peaks are selected and individual peptide/protein components are sequenced. This has generated a small number of 7-10mer peptides. In some cases the sequences show that these are derived from self proteins, but in other cases no matches have been found. These peptides will be examined further, for example in sensitisation assays, to determine if they are T. parva-derived, and functionally important.

There are a number of CTL clones available at ILRI for use in this project, but work has so far focused on HD6 (A18) - restricted clones. Because the level of killing demonstrated by these clones was not considered optimal, an attempt has been made to generate additional clones. Animals were identified that express the HD6 gene (by mAb screening followed by class I sequencing), and these were subjected to T. parva infection (followed by treatment). CTL lines and clones thus generated are currently being assessed for their use in the project. HD6-derived peptide pools were sent to ILRI for testing but no results have been generated to date.

Four meetings between collaborators took place during this year, in May, June, August and October (detailed in previous reports).

Planned Activities for Next Year

It is impossible to predict activities for next year at present, given the uncertain nature of the continued collaboration between ILRI and IAH. CTL clones / lines are essential for the current / next stage of the project, and at present these only exist at ILRI. However, sufficient expertise is present at both IAH and the University of Edinburgh / Moredun Institute to generate new CTL clones, and this would make continued input from ILRI unnecessary. In addition we plan to employ the redundant ILRI collaborator in the UK to ensure that this stage of the project has a good chance of success. The negative aspects of this plan are that CTL clones could only be generated from European cattle, and the current FMDV outbreak in the UK makes animal work problematic. The major activity will be to test peptide pools, fractions and individual peptides for their ability to be recognised by CTL clones.

Targets for the following year

Identification of T.parva genes encoding key antigens will be an on-going process, as it is predicted that a number of different active peptides/peptide fractions will be identified in the initial screenings. While some genes may be identified through database matches, others will not, and in these cases it will be necessary to make primers and search cDNA/genomic libraries, followed by cloning/sequencing of the genes. This work will be carried out using material eluted from a number of class I genes.
LPP/AHP Joint Projects
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Project Number  R6625
Project Title  The Effect of Control Operations against Tsetse on the Incidence of Bovine Trypanosomiasis in Zimbabwe
Project Leader  Judith PENDER
Institution  Natural Resources Institute

Project Background
Tsetse flies transmit trypanosomiasis over 10 million km$^2$ of sub-Saharan Africa. The disease greatly reduces the productivity of domestic livestock and the effects are particularly severe in some of the most deprived regions of the continent. The aim of this project is to produce a readily accessible GIS documenting the extent and epidemiological effects of all tsetse control operations undertaken in Zimbabwe between 1980 and 1998. This output will provide a resource for developing and implementing trypanosomiasis control policies in Zimbabwe and other tsetse-affected countries in east, central and southern Africa.

Development and Scientific Objectives
The purpose of this project is to develop, promote and disseminate strategies to improve sustainably the production and productivity of livestock and the co-existence of wildlife in arid rangelands. The project aims to contribute to this purpose by quantifying the effects of tsetse fly control on the incidence of bovine trypanosomiasis in Zimbabwe. Since 1980, the Zimbabwe Department of Veterinary Services (DVS) has undertaken tsetse control, over an area of 50 000 km$^2$, using various techniques. Using DVS records trypanosomiasis, this project will develop a GIS to analyse the effect of various tsetse control strategies.

Project progress (against logframe indicators)

- **Achievements in the current year**
  In Zimbabwe, the project collated DVS records of all recorded trypanosomiasis cases recorded at cattle inspection centres since 1970 and marked the physical locations of inspection centres, dips and tsetse operations onto maps. At NRI, the epidemiological and spatial data were incorporated into a GIS which was used to analyse the epidemiological impact of tsetse control operations. The analyses show that tsetse control operations have reduced the number of recorded cases of trypanosomiasis from >10 000/year in 1984 to <100/year by the late 1990s. Large-scale ground- and aerial-spraying operations conducted in the 1980s produced large and rapid reductions in trypanosomiasis but the use of odour-baited targets and insecticide-treated was largely responsible for the ultimate eradication of disease from large swathes of northern Zimbabwe. The low level of disease is currently sustained by government-funded tsetse control operations conducted along 200 km of the Zimbabwe-Mozambique. This barrier protects >1 million communal cattle from trypanosomiasis. Gross aspects of the findings were reported in Bourne et al., (2001) and at a LPP workshop conducted in Zimbabwe in September 2000.

- **Planned activities for the next year**
The project findings will be presented at a dissemination workshop to be undertaken in Zimbabwe in April 2001. The findings will also be disseminated via paper(s) to be published in scientific journals and a final technical report.
**Project Number**  
R7539

**Project Title**  
Environmental Risks of Insecticide-treated Cattle in SA Livestock Systems

**Project Leader**  
Ian GRANT

**Institution**  
Natural Resources Institute

**Project Dates**  
Start – January 2000      End – August 2002

**Project Background**
African trypanosomosis constrains the productivity of cattle for milk, meat, manure and draught power. Treatment of cattle with insecticides to control tsetse fly is an effective, appropriate technology, being widely promoted and adopted by farming communities. Insecticides applied by dipping, spraying and pour-on may contaminate animal products via a number of routes including dermal absorption, ingestion and physical transfer (milking procedures). Insecticide residues found in the dung of treated cattle are affecting the activity of dung fauna. NRI is collaborating with private and public institutions in Zimbabwe to assess the residue levels in animal products, dung and soil in order to ensure that livestock products are not detrimental to consumer health or biophysical processes that are important for maintaining soil fertility and crop production.

**Project Objectives**
This project undertakes the research required to assess the residue levels in animal products, dung and soil. It will elucidate the pathway and fate of insecticide residues in dung and soil, evaluate the pour-on technology, recommending insecticides and best practice application for limiting residues in animal products and mitigating impacts on non-target fauna and function. Main objectives are:

- Confirm that there are risks involved in the cattle treatments (mostly completed in Y1)
- Elucidate the background to the risk, eg, how does the insecticide get into the dung? (mostly in Y2)
- Identify means of avoiding or minimising the risks (mostly in Y3)

The contribution to agricultural science is significant and expected to result in a series of scientific papers (4-6). Farmers (mostly rural-poor farmers in tsetse areas) will benefit by having a means to keep their stock free of trypanosomiasis without jeopardising their health and the health of others, their crops and the contributions of their animal’s manure to future soil fertility and productivity.

**Project Progress** (against logframe indicators)

- **Achievements in the current year**
  
  **Y 1: Is there a risk from cattle treatments?**
  
  Collection of background literature on risks, the establishment of scientific contacts (national & international) and liaison with national research institutions, environmental organisations, agrochemical companies and immediate end-users (Zimbabwean farmers) were achieved.

  **Activity 1:** define the relationship between application technique and the residue content of dung pats and animal products in relation to insecticide type and formulation.

  Chemical assays have confirmed that the dung of animals treated with two pyrethroids contain insecticides residues for up to two weeks after treatment. Residue concentration varied widely but in Jan, April and June were up to 0.4ppm d.w. No residues were found in October - the local lab procedures were reviewed and found wanting.

  **Activity 3:** Quantify the dispersion and degradation rates of residue containing dung

  Dung spiked with deltamethrin and alphacypermethrin at 10 ppm wet wt showed no detectable loss of insecticide during 64 days of exposure in the field. (dung water content variable with season - between 15& 30%)

  **Activity 4:** Estimate the sensitivity of non-target invertebrates (soil organisms) to insecticide residues in dung and identify positive and negative impacts at the level of organism, population and community

  Bioassays performed to assess the toxicity of 4 insecticides in the dung to dung fauna (eg.dung beetles, flies, wasps and termites) showed, in lab and field studies, that 50% of a range of beetles
and flies were killed (LD50) at around 0.05ppm w.w. Flumethrin was an order of magnitude less toxic in dung. In the lab, contaminated dung reduced the size of dung balls rolled by beetles. Adult flies that visit pats appear to be unaffected (but more work required).

Computer models of the abundance and distribution of dung fauna - developed to assess population impacts from mortalities and behaviour observed at contaminated pats - although incomplete, show that cattle treatments could severely depress beetle and fly populations where treatment is regular and when widespread i.e. over thousands of km².

**Conclusion:** In certain situations, there is a real risk to fauna and their ecological functions from insecticide treated cattle. The implications of these findings on livelihoods must related to the reduced functions of fauna in facilitating the breakdown and mineralisation of dung and subsequent soil fertility in semi-arid areas where mixed farming is the practice.(to be researched Y 2-3) It would be premature to comment on uptake at this stage of the research

- **Planned activities for the next year**
  - **Activity 4:** complete bioassays of beetles and flies, and extend these to termites and worms, and complete modelling.
  - **Activity 1:** evaluate the insecticide Fipronil using same criteria and complete work on elucidation of the insecticide transport mechanisms from animal to dung. Determine whether there are risks of contamination of milk and meat from insecticide treatments.
  - **Activity 2:** Monitor fate of insecticide from deposition to dissipation in soil.
  - Monitoring to determine the dynamics of breakdown of residues under field conditions will begin.
  - **Activity 6:** Determine mitigation options to reduce any biologically significant (negative) impacts. Work will begin that involves testing the types of treatment that have been identified in Years 1 and 2 as most likely to reduce contamination of dung. It will be required to determine the extents to which these treatments affect dung fauna while still giving good kills of tsetse. If time, funding and co-operative links with other organisation permit, preparations will be made for a large field trial to be conducted in Year 3.