Controlling the threat of rabies

RIU

Validated RNRRS Output.

In Tanzania, vaccinating domestic dogs has proved to be a very effective way of fighting rabies—because they are the major reservoir for the disease. In fact, in areas where trials have been run, they slashed both the number of cases of rabies in dogs and the number of dog bites by more than 90%. Currently rabies badly affects the poor in rural and semi-urban areas, causing illness, death and livestock losses. The poor, for example, can least afford treatment and so are most likely to develop the disease once they have been bitten. Children are also particularly vulnerable to rabies, and are most likely to die from the disease if they develop it.

Project Ref: **AHP03:**
Topic: **7. Spreading the Word: Knowledge Management & Dissemination**
Lead Organisation: **Centre for Infectious Diseases, University of Edinburgh, UK**
Source: **Animal Health Programme**

Document Contents:

Description

AHP03

Research into Use
NR International
Park House
Bradbourne Lane
Aylesford
Kent
ME20 6SN
UK

Geographical regions included:

Tanzania,

Target Audiences for this content:

Livestock farmers,

A. Description of the research output(s)

1. Working title of output or cluster of outputs.
In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

Design of rabies control programmes for domestic dogs

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

RNRRS Programme; Animal Health Programme, Zoonoses cluster

Other funding sources subsequent to RNRRS funding: Wellcome Trust, Global Wildlife Trust, Intervet, World Society for the Protection of Animals, World Health Organisation, Fauna and Flora International, National Institutes for Health / National Science Foundation.

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R5406 – Rabies in the Serengeti region of Tanzania.
Centre for Tropical Veterinary Medicine, University of Edinburgh with London School of Hygiene and Tropical Medicine, Institute of Zoology, London, Ministry of Agriculture, Tanzania National Parks, Tanzania Wildlife Research Institute, Sokoine University of Agriculture, and National Institute of Medical Research.

*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? **(max. 400 words)**. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

The output is the design of effective **rabies control programmes,** based on **dog vaccination** campaigns**,** to protect **human and animal health** and reduce the **economic burden** of the disease. The **primary beneficiaries** of rabies control are **subsistence farmers** and those living in **semi-urban environments,** classified as **moderate poor** and **extreme vulnerable poor.** Rabies control would particularly help **children** who are disproportionately bitten by rabid dogs and suffer the highest burden of deaths, and the **very poor** who can least afford treatment costs and therefore are most vulnerable to developing rabies.

The RNRRS output was focussed on rabies control in the Serengeti region of Tanzania, where it has been a growing problem since the early 1980s, and has had a large impact on the **rural poor.** Rabies cause **human deaths, intense fear, high treatment costs** of dog bites**, economic costs** of missed work during the prolonged course of post-exposure treatment**, livestock losses** and **threats to biodiversity.** Prior to the onset of the RNRRS programme, no effective rabies control measures were in place, and questions remained about the most effective and cost-effective strategies for reducing human, domestic animal and wildlife threats.

The project, in **partnership** with local government veterinary departments established the first rabies **surveillance** and **diagnostic facilities** in the region, provided **training** to local veterinary/livestock officers, and facilitated **community participation** in the control of rabies. The first estimate of a **true burden** of rabies in the study area was made and widespread **under-reporting** was quantified. The study established that domestic dogs were the most important reservoir for human and wildlife rabies, allowing an effective control strategy to be designed for the first time. A preliminary rabies **vaccination program** of domestic dogs was implemented and **feasibility studies** completed. By **empowering** the local community through leaders and school teachers and **training** local veterinary officers, the **uptake** of vaccination was high and considerable progress was made towards a **sustainable** long term strategy for rabies control. The project involved **inter-sectoral collaboration** between local veterinarians, wildlife officers, hospital staff and diagnostic scientists.

This project ended in 1994, but has provided a solid baseline of dog population and rabies data on which many further productive studies have relied (see q9).

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	*Technology*	*Service*	*Process or Methodology*	*Policy*	*Other Please specify*
		X	X		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment.

Livestock which suffer losses from rabies.
The human health impact of the disease reduces **productivity.**

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	*High potential*	*Hillsides*	*Forest-Agriculture*	*Peri-urban*	*Land water*	*Tropical moist forest*	*Cross-cutting*
X	X			X			

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	*Irrigated*	*Wetland rice based*	*Smallholder rainfed highland*	*Smallholder rainfed dry/cold*	*Dualistic*	*Coastal artisanal fishing*
X				X		

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

Considerable value could be added by clustering this output with outputs from several other projects. Within the 'Research Into Use' initiative, these include links with the Animal Health Programme cluster on **zoonoses** (R7570, R8383, R7357, R7985), which would strengthen existing veterinary-medical capacity, inter-sectoral integration and policy development for effective zoonoses control in East Africa.

Links with the **dissemination and delivery** cluster would enhance training of medical and veterinary practitioners, which is essential for rabies surveillance and appropriate treatment of animal-bite victims, both crucial components of long-term sustainable and cost-effective rabies control strategies.

The original RNRRS project has developed valuable links with several subsequent non-RNRRS projects, including research on dog rabies vaccination strategies funded by the Wellcome Trust (1996-1999; 2003-2006), studies on rabies surveillance and estimates of global disease burden funded by the WHO (1999, 2003), and larger-scale epidemiological/dog vaccination studies in the Serengeti funded by NIH/NSF (2003-2007). These projects have significantly extended the outputs of the RNRRS project to address knowledge gaps at both **nationa**l and **international levels**, resulting in a raised profile and awareness of the disease burden (nationally and internationally), recognition of the feasibility and effectiveness of dog vaccination to control rabies in humans and animals (domestic and wildlife), and development of new and appropriate techniques to improve rabies surveillance in local settings.

Further important linkages include contributions of the RNRRS outputs to the World Health Organisation expert consultation on rabies. Out of this collaboration, a newly-formed NGO, the Alliance for Rabies Control (ARC), has been established which harnesses the expertise of the international rabies, health and wildlife research communities to catalyse and support the implementation of practical rabies control measures in developing countries of Africa and Asia. A partnership between DFID and ARC could draw on this expertise to further strengthen the design of rabies control initiatives.

Validation

B. Validation of the research output(s)

*10**. How** were the output(s) validated and **who** validated them?*

Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation,

private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation ***(max. 500 words)****.*

The impact of dog vaccination on human health is clear, and has been **replicated** in all areas where the control strategy has subsequently been adopted. A dramatic decline (> 90%) in dog rabies cases and human dog-bite injuries has been documented after 2-3 dog vaccination campaigns, first in the original trial villages (R5406) and, subsequently, in six districts where dog vaccination programmes were later adopted. The design and impact of these rabies control strategies have been **published after peer-review** (1,2,3). The **feasibility** and **acceptability** of these strategies have been validated through the high **uptake by primary stakeholders**, both **end-users** (villagers), with 60-90% vaccination coverage achieved, and **local district councils**, which have provided written commitments to support continued dog vaccination.

The results have been validated by **replication in other settings in East Africa**, with adoption by **secondary stakeholders** and intermediary organisations over an expanded geographic range. Based on the Serengeti model, **Tanzania National Parks** (TANAPA) have adopted dog rabies control programmes adjacent to several other protected areas (Tarangire, Arusha and Kilimanjaro National Parks) in Tanzania, **Vétérinaires Sans Frontières** (VSF) in southern Kenya and the **Ethiopian Wolf Conservation Programme** (EWCP) in Ethiopia. The original project also stimulated similar research in Bolivia and Peru.

The work was selected for detailed evaluated by Alexandra Shaw (see Annex), based on the measurable impacts that had been produced, including a **cost-benefit analysis** and calculation of **cost per disability-adjusted life year (DALY) saved**.

Estimates of disease burden in terms of deaths and DALYs have been validated by publication in peer-reviewed journals (3,4,5) with uptake by WHO in the form of a commissioned study to re-evaluate the rabies burden for Africa and Asia, which demonstrated the disproportionately high impact of rabies on the rural poor (5). The estimated number of human rabies deaths has been externally validated by recent independent, directly-observed studies in India and China and the economic burden further verified through a detailed household-level economic analysis in northern Tanzania (6).

The new rabies diagnostic test (dRIT) has been verified for use in local settings in Tanzania by comparison with gold-standard assays (FAT) by the **Centers for Disease Control and Prevention**, Atlanta and results published in a **peer-reviewed journal** (7). These tests have also been adopted by several laboratories in Tanzania (Mugumu veterinary office, Mwanza VIC, Sokoine University of Agriculture).

The overall outputs have been **adopted** by the **government of Tanzania** in the newly-drafted **national policy on rabies control**, in which these data provide the cornerstone for policy development and design of a national rabies strategy. The inter-sectoral collaboration achieved by the projects has further resulted in a inter-Ministerial rabies task force involving seven Ministries (see Annex).

Outputs from the study have also been taken up by intermediate agencies involved in **dissemination**, including media agencies developing radio/TV broadcasts (Channel 4, BBC World Service, BBC News, CNN, Wren Media), and by the NIH/NSF project in the form of zoonoses leaflets that provide information on the prevention and control of rabies (together with other zoonoses).

*11. **Where and when** have the output(s) been validated?*

*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

The initial R5406 studies and subsequent dog vaccination trials (Wellcome Trust, NIH/NSF projects) were conducted in the Serengeti ecological region in Tanzania, involving pastoral communities (36 villages in Ngorongoro district) and agropastoral communities (initially 29 villages in the Mara region and extended to include 145 villages in Mwanza, Magu and Shinyanga Regions). These communities comprise **semi-arid** and **high potential** systems, involving **smallholder rainfed dry/cold** (pastoral) and **smallholder rainfed humid** (agropastoral) farming systems. Validation through uptake by primary stakeholders(villagers) and government livestock/veterinary officers took place **from 1993 and has continued to the present date.**

Throughout the development of the outputs, validation has continued through peer-reviewed publications, PhD theses, conference proceedings and reports, with publications available from **1993 to the present date** (see Annex for further details).

A formal evaluation of the RNRRS project was commissioned by DFID and published in 2000 (8).

Regarding **uptake by secondary stakeholders:**

The TANAPA dog vaccination programmes adjacent to selected protected area systems in Tanzania were implemented in 2000 and 2001, the EWCP dog vaccination programme (Bale Mountains National Park, Ethiopia) initiated in 1998, and the VSF dog vaccination (Masai Mara National Reserve, Kenya) was initiated in 2005. All programmes continue to the present date. These systems comprise smallholder rainfed dry/cold and smallholder rainfed humid systems.

WHO consultations incorporating project outputs on dog rabies vaccination strategies have taken place in 1998, 2001, 2004. The WHO-commissioned study to re-evaluate the burden of rabies in Africa and Asia took place in 2004-5.

In 2006, the Tanzania government established an inter-Ministerial rabies task force and initiated the development of new national strategy for rabies control, based on project outputs.

Validation of the dRIT diagnostic test at the CDC, Atlanta, took place in 2004-5, with adoption by laboratories from 2004 to the present date.

Current Situation

C. Current situation

*12. **How and by whom** are the outputs currently being used? Please give a brief description **(max. 250 words**).*

The current dog rabies control strategy is being coordinated by **local veterinary officers** from the Ministry of Livestock Development, collaborating with **district executive directors**. **Local communities** (via community leaders and schools) are being motivated to bring dogs for vaccination using a central-point village-based strategy.

In Tanzania, **local diagnostic laboratories** have adopted the dRIT, a simple, reliable test to improve rabies surveillance and provide diagnostic support for clinicians, so that post-exposure treatment can be directed more cost-effectively to patients.

End-users, particularly children, are using simple public health messages (such as the importance of immediate wound washing after animal bites) which are disseminated as part of dog vaccination programmes and through diagrammatic leaflets.

The **Tanzanian Government** is using the outputs as the basis for formulating a national strategy for rabies control in Tanzania.

Intermediate agencies are replicating dog vaccination programmes in Tanzania, Ethiopia and Kenya to reduce human health risks, while protecting endangered species (such as the African wild dog and Ethiopian wolf). The uptake of this project output by **Tanzanian National Parks** shows how local institutions can effect good rabies control with little external support.

The **World Health Organization** is using the outputs in WHO publications and press releases to provide global advice on dog rabies control and to raise awareness about the global burden of rabies in the public health community.

The **Alliance for Rabies Control** is using the outputs to generate awareness and stimulate development of large-scale dog rabies control programmes throughout Africa and Asia.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

Currently dog rabies control programmes, with concomitant public health messages, are currently being used in seven districts bordering the Serengeti National Park in Tanzania, with smaller-scale programmes in areas adjacent to Kilimanjaro, Arusha and Tarangire National Parks.

The national policy is designed for control of rabies through the whole of Tanzania.

The dRIT is being used in laboratories in **northern (Mugumu), western (Mwanza) and southern Tanzania (Morogoro)**. The test is also being considered for implementation in Kenya and Sri Lanka.

The World Health Organization is using outputs to raise **global awareness** about rabies and appropriate measures for dog rabies control.

14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading ***(max 250 words).***

Currently dog rabies control programmes in the Serengeti ecological region encompass 180 villages in 7 districts affecting ~ 350,000 people. With effective strategies identified, establishment of vaccination in new areas can be implemented in less than a year, and large impacts on dog rabies can be realised within 2 years of vaccination campaigns starting.

Adoption of the dRIT in three local laboratories (where the test was piloted) also occurred relatively rapidly, as the technique is simple, requires no specialised equipment and only minimal training. Usage is not currently spreading, but with provision of the specific monoclonal reagents (which have been committed by CDC) and funding to support simple training courses for technicians, the test can be developed in new laboratories in a short space of time.

Awareness of the effectiveness of dog rabies control for improving public health in Africa and Asia and providing substantial economic benefits to poor communities, as well as to government public health budgets, has been gradually spreading, and in partnership with secondary stakeholders, such as the WHO and ARC, will continue to spread to government agencies and other donor agencies.

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

The principal platforms that have assisted with the promotion of outputs and capacity building include:

High levels of **participation** among villagers, with support from community leaders, and effective routes for disseminating information through the primary school network.

Recognition by villagers of the risks associated with dog rabies and awareness of the rapid impact of dog vaccination on rabies incidence, which provides considerable motivation for dog-owners to bring dogs to central vaccination points.

Effective and simple strategies identified for all major rural and urban settings in Tanzania, with no additional technological developments required.

High levels of **political support** and commitment from local and national government agencies and authorities, with the Minister of Livestock Development spearheading the formulation of new national policy on rabies control for Tanzania. Locally, involvement of district veterinary officers, district executive directors, community leaders and school teachers has been invaluable.

The standardised infrastructure of local communities and regional administration, which has allowed basic

protocols to be developed and implemented throughout Tanzania.

Effective inter-sectoral integration through the establishment of an inter-Ministerial task force on rabies control and policy development, with involvement of different sectors essential for design of a strategy that is sustainable over the longer term.

Capacity strengthening, with PhD training for a Tanzanian veterinary officer, who has a long-term commitment to rabies control in Tanzania **and training** of veterinary assistants and veterinary officers with expertise and experience in implementing dog vaccination campaigns, who could effectively act as trainers for 'rolling-out' the Serengeti programme to other parts of Tanzania (and East Africa).

Delivery of vaccine free-of-charge to dog owners. It is clear that rabies control is a public good, with little direct benefit to an individual dog owner unless herd immunity can be achieved through vaccination of at least 70% of dogs. Without free vaccine delivery, vaccination coverage invariably falls well below that needed to control rabies, resulting in the mis-perception that dog vaccination 'does not work' or 'cannot be achieved in Africa'.

The development of effective public-private partnerships to secure **reliable supplies of dog vaccines**, through collaborations between Intervet, UK and the Ministry of Livestock Development.

Current Promotion

D. Current promotion/uptake pathways

*16. **Where** is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion **(max 200 words).***

At a local level, promotion takes place mainly in relation to the dog vaccination campaigns, with **visits to primary schools, community leaders and district leaders** being used to promote the uptake of dog vaccination and to disseminate public health information (such as the importance of wound washing, need for medical treatment of rabid dogs bites). This has generated some national and international press coverage with promotion of these messages (e.g. through BBC World Service) to the larger community in Africa and Asia.

The main promotional activities are taking place **at national and international level** using outputs from the DFID project to help in the development of a large-scale national rabies programme for the whole of Tanzania, and act as a flagship programme to catalyse rabies control programmes in other African and Asian countries. In Tanzania, promotion is taking place mainly through the Ministry of Livestock Development, in collaboration with six other Ministries, to help ensure the sustainability of any national strategy.

Promotion is also taking place through the Southern and Eastern Rabies Group (SEARG), WHO and ARC to raise awareness at a global level and stimulate interest for support of large-scale national rabies control programmes in Africa and Asia.

17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. ***(max 200 words)****.*

Tanzania

Although the project has shown that **existing local infrastructure and community support** can be harnessed to make rabies control practical and effective, adoption in new areas **requires resources** (e.g. to supply and store vaccines, provide specialist laboratory reagents, and train local technicians and vaccinators). Previously these have been supplied by grants to external researchers, but this is not a long-term solution.

The most cost-beneficial strategy is national implementation of control and a national rabies control **policy with strong inter-sectoral support** is well developed in Tanzania. However, **final agreement of this strategy,** particularly regarding self-sustainability and finances remain barriers to implementation. External investment of **funds** is required in the early phase (Years 1-5), prior to the strategy becoming entirely **self-sustainable** (i.e. when savings gained through reduced human post-exposure vaccination offset dog vaccination costs). However, this requires effective clinical evaluation of animal bites to ensure appropriate treatment.

Insistence upon cost-recovery from dog-owners is likely to act as a major barrier to success (see q15).

Elsewhere

In other countries, **coordination** between the different administrative agencies and authorities, **governmental support, political stability** and **local infrastructure** may not be as assured as in Tanzania, and could all act as barriers to effective rabies control.

18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues ***(max 200 words).***

A **final national control strategy** for rabies, along with sustainability plan and budget requirements is needed. This requires centralized coordination and allocation of resources. The Ministry of Finance must ensure financial sustainability and appropriate allocation of resources between sectors. In December 2006, a workshop will be held as part of this process, a full budget for the short-term intervention costs can be agreed, and strategies for seeking funding can then be developed.

Additional training of clinical officers in the appropriate treatment of animal bites is needed to ensure optimum use of human vaccines, with regular communication between vets and medical officers established to allow follow up and the potential for containment of the animal and/or diagnosis.

Widespread dissemination of information about dRIT test results and continued support and technical advice from the CDC will be necessary to provide assurances about test reliability for clinical management of animal bite injuries.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

A rapid demonstrable impact of the intervention (i.e. decline in dog rabies and rabid animal bite-injuries) has provided an enormous incentive for community participation and continued implementation/extension of the programme.

Publicity and advertising of any campaign is critical, suggesting that for large areas, a single day for vaccination when local or national news and radio could be used promotion would be the most cost-effective strategy.

Support from community leadership and primary school teachers is critical to ensure participation of dog-owners and to achieve sufficient vaccination coverage. The involvement and interest of political leaders and other advocates has also helped with dissemination of the messages of rabies control and contributed to awareness.

Readily available vaccine, provided at no cost to dog owners, is crucial to achieving high vaccination coverage in any given area.

Unexpected epidemics following any intervention can lead to adverse perceptions of dog vaccination, which can be long-lived. Strategies should be designed to minimise any risk of other disease outbreaks being triggered by dog vaccination campaigns (e.g. using multivalent vaccines, using multiple vaccination stations within a village or staggering vaccination times to reduce the number of dogs coming together at any one time).

Impacts on Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

REPORTS:

Shaw, A. and Sibanda, L. (2000) Evaluation of selected livestock research themes 1989-1999. Final report for DFID, see extract in Annex.
Evaluating the public health, institution and environmental impacts of the R5406 project, including economic evaluation of dog rabies vaccination incorporating research costs. (8)

WHO/DFID (2006) The Control of Neglected Zoonotic Diseases: A route to poverty alleviation. Report of a Joint WHO/DFID-AHP meeting, September, 2005, Geneva, Switzerland. WHO and DFID-Animal Health Programme. *Details social, environmental, institutional and economic impacts.* (9)

PUBLICATIONS:

Cleaveland S., Kaare M., Tiringa P., Mlengeya, J. Barrat (2003) A dog rabies vaccination campaign in rural Africa: impact on the incidence of dog rabies and human dog-bite injuries. *Vaccine*, 21: 1965-1973.(1)

Evaluating the impact of dog vaccination in terms of reductions in dog rabies incidence and demand for costly human post-exposure treatment.

Kaare (2006) Rabies control in rural Tanzania: optimising the design and implementation of domestic dog mass vaccination programmes. PhD Thesis, University of Edinburgh. (6)
Detailed evaluation of the impact of rabies at household level, including costs and consequences for householders affected by rabid animal bites. Cost-effectiveness analyses of different strategies in pastoral and agropastoral communities.

Knobel D., Cleaveland S., Coleman P.G., Fèvre E., Meltzer M.I. Miranda M.E.G., Shaw A., Zinsstag J. and Meslin F-X. (2005) Re-evaluating the burden of rabies in Asia and Africa. *Bulletin of the World Health Organization,* 83: 360-368. (5)
Quantifying the burden of rabies in Africa and Asia in terms of human deaths, DALYs lost, and economic costs associated with post-exposure treatment, livestock losses and rabies control measures.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*
- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded*

Tanzania
The RNRRS project focussed in two districts: Serengeti district (Mara Region), comprising ~ 110,000 subsistence agropastoralists and ~ 5,000 living in semi-urban environments and Ngorongoro district, dominated by ~ 42,000 Maasai people practising traditional pastoralism. These groups are classified as moderate poor and extreme vulnerable poor. The Mara Region has one of the lowest proportions of households over the poverty line nationally with severe/moderate malnutrition documented in 21.5% of children (10). Although pastoralists have some livestock assets, ownership is highly skewed and most families have insufficient livestock to meet nutritional and subsistence needs (11). In Ngorongoro District, more than 50% of families have been classified as living in poverty or acute poverty (12) with more than 55% of children malnourished or undernourished (13) and many families are now trapped into a declining cycle of poverty (14). Pastoralists are also marginalised politically, with limited voice and influence in national decision-making (11).

The benefits of rabies control in domestic dogs extended to every member of the population, regardless of poverty group, but disproportionately benefited those with least assets from which to raise treatments costs. In the absence of rabies control, funds for rabies post-exposure treatment costs were raised through sale of assets, drawing on family savings, and acquiring loans. These costs (including direct and indirect medical costs) are in the order of would be $66 for the recommended 5-dose vaccine regime, representing 11% of the 2003 per capita gross national income (6). All villagers benefited from the reduced fear of rabies within 2 years of vaccination

programmes starting.

Each life lost to rabies represents 31 DALYs, reflecting the years of productive life lost when the victims are so young (3). Economic evaluation of the impact of rabies control in the Serengeti (8), concluded that for the Serengeti region, the number of DALYs gained through the rabies control initiatives was 22,000.

Based on the extended Serengeti trial (2003-2006), within two years of implementing a dog vaccination campaign, human rabies deaths had declined from 11 deaths/100,000/year to 0 deaths in Ngorongoro district (Katie Hampson, unpublished data). Furthermore, in agropastoralist areas, the dramatic decline in the rate of bite injuries from suspected rabid animals (observed in each of the trial areas), would result in a saving of $71,800 per year for the community ($0.2/person/year), if these people all received a 5-dose course of post-exposure vaccination as required (Cleaveland, unpublished data).

Unpublished data currently under review for publication indicates that a national programme designed to eliminate all human rabies deaths, through a national dog vaccination campaign combined with full provision of human post-exposure vaccination for rabid dog-bite victims, would result in a net economic benefit after 4-5 years.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

Wildlife impacts

Rabies is a serious threat to many wildlife species, particularly carnivores and has previously caused local extinction of African wild dogs in the Serengeti and is considered the main extinction threat for the highly endangered Ethiopian wolf. These were both important reasons behind the implemention of rabies control programmes around the Serengeti National Park in Tanzania and the Bale Mountains National Park in Ethiopia. Since the implementation of large-scale domestic dog vaccination in pastoralist areas in Ngorongoro District, wild dog populations have become re-established and are currently increasing.

The potential biodiversity benefits of rabies control are also likely to be coupled with positive economic benefits to the wildlife tourism sector, which is one of the fastest growing economic engines in Tanzania and many other sub-Saharan African countries. Although economic evaluation of the impact of healthy African wild dog populations in the Serengeti has not been carried out, a contingent valuation survey in South Africa indicated that tourists were willing to pay an additional $12 to see wild dogs, resulting in generation of an additional $9,000 per year per wild

dog pack (17).

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

Soon after the introduction of vaccination campaigns in Serengeti, dog survival improved and dog populations increased. This could be problematic if growth rates continue to increase, but the effect was short-term. Dog populations stabilised as recruitment rates fell in line with increased adult survival. Reduced population turn-over, combined with more healthy populations, should result in more effective vaccination programmes and improve the health status of the population overall (with fewer susceptible puppies entering the population).

Disposal of large numbers of needles and syringes may create an environmental hazard, as commonly-used disposal methods (e.g. open pits) are likely to be unsatisfactory.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

None anticipated, except that a more healthy population is more likely to be able to cope with change.

Annex

MINISTRIES INVOLVED IN DRAFTING THE TANZANIAN NATIONAL RABIES POLICY
Ministries of Livestock Development, Health, Wildlife and Tourism, Finance, Regional Administration and Local Governments, Justice and Home Affairs.

REFERENCES

1. Cleaveland S., Kaare M., Tiringa P., Mlengeya, J. Barrat (2003) A dog rabies vaccination campaign in rural Africa: impact on the incidence of dog rabies and human dog-bite injuries. *Vaccine*, 21: 1965-1973.

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5.4 RABIES

5.4.1 Background

The animal health programme included three projects on rabies, two in Zimbabwe and one in Tanzania. The review selected the Tanzania project for further study, since it has developed into a project which is studying the epidemiology of the disease in humans, and is controlling the disease in the Mara region. The work done by the project is also being used by the Tanzanian authorities to design a national rabies control programme.

DFID's initial investment in rabies in Tanzania was, like its programmes in Zimbabwe, based on interest in the wildlife reservoir. A small research project was financed, triggered by the rapid reduction in the population of an endangered species, the wild dog in the Serengeti, and its possible impact on tourism. The researcher then went on to develop the work with other funding (see Annex 11), studying the epidemiology of the disease in more detail and developing an epidemiological model, which predicts disease incidence from data collected on numbers of bites, location of the bites, whether or not post-exposure treatment was carried out, etc.

5.4.2 Project Cost, Output and Uptake

As shown in Table 5.1, the initial DFID research project focussing on wild dogs was a small one, costing £31,000. The researcher has gone on do more work on rabies, with funding from the Wellcome Trust, the Global Wildlife Trust, the World Society for the Protection of Animals, WHO and a contribution from Channel 4 for which she made a documentary, entitled 'Mad dogs and an Englishwoman'. Total funding for rabies research at then current prices came to £190,000 (see Annex 11 for details).

The main outputs of the research work have been:

- epidemiological modelling, demonstrating via the number of infected dog bites in the study area that the incidence of the disease is likely to be far higher than the official figure of some 10 deaths per annum, the true figure could be nearer 1500 – 1700
- studying the ratio of dogs to humans in urban and rural areas, Muslim and Christian communities, and thus coming up with a figure for the country's dog population of some 3.5 – 4 million (as against the current official estimate of 800,000); having an accurate estimate of the dog population is obviously crucial for planning, one veterinarian told how he had embarked on a campaign recently with some 15,000 to 20,000 doses of vaccine, only to retreat in embarrassment when faced with a dog population of 100,000.
- working out that if 65% of the dog population is vaccinated, this would be adequate to remove the threat of disease from the human population
- managing a control programme initially in Serengeti District, and then extended to Mara Region, involving dog certificates and dog collars, and which shows that vaccination is feasible, and that most dogs have owners who are prepared to have them vaccinated.

There is clear evidence at the moment that rabies is reaching epidemic proportions in Tanzania, with as many canine cases being diagnosed this year to end April, at the veterinary clinic at SUA, as were found in the whole of last year. In contrast to the official annual toll of ten rabies deaths, on an anecdotal level the consultant heard of as many deaths, all in children, in the last six months. Urgent discussions to set up a rabies task force were taking place between the two main target institutions, the Ministries of Agriculture and Health while the consultant was in Dar-es-Salaam. A detailed plan for controlling rabies in Tanzania was produced as a document in 1994, (Tanzania Ministry of Agriculture, 1994), and cites the DFID researcher and her work. Given the urgency of the situation, it is now planned to base a national programme on this document.

Uptake of the project, in the form of a nation-wide vaccination campaign depends crucially on:

- dog-owners being prepared to pay for vaccination, the basic vaccine costs $ 0.40 locally, with administrative overheads this comes to $ 0.90, as estimated by the project;
- enough funding to enable the Tanzanian Ministry of Agriculture to make the initial purchase of some vaccines; once this has been done, and the money recovered from dog owners, the system would become self-sustaining;
- setting up a public awareness campaign, with full media support, to encourage people to have their dogs vaccinated
- together with this, a public health campaign emphasising the vital importance of washing all wounds from dog

bites

- legislative support (in terms of by-laws and fines) as a helpful support to a national rabies control programme.

These points were all raised and discussed at a stake-holder meeting held by the consultant at the Ministry of Agriculture.

It remains to be seen whether the rabies control programme can be extended beyond the project area in Mara to the rest of the country. The will is certainly there, while the consultant was in Iringa the district veterinary officer had instituted a dog vaccination campaign on this own initiative, following a dramatic upsurge in the number of rabid dogs, and the deaths of some children from rabies.

5.4.3 Project Impact

The disease has serious **social** implications, it is widely feared and leads to an ugly death. Deaths tend to be highest in children, since they are more likely to be bitten, and bitten near the head, in which case the outcome of an infective bite is more likely to be fatal. The estimated DALY's (disability-adjusted life years) lost per untreated case of human rabies is high, at 31 years, due to the youth of those who die. Many people are not able to get post-exposure treatment, which typically costs £50, as stocks in the country are low, and the drug is not always accessible to those in remote locations. Once again it is the poor, living in isolated rural areas who suffer most.

Unlike the other zoonoses studied, the **environmental** issues are of relevance in controlling this disease. The impact on wildlife conservation of effectively controlling rabies in dogs would be considerable. As the project has shown in Tanzania, dogs are the main reservoir of the disease. Controlling dog rabies in areas surrounding the national parks and game reserves would certainly reduce the threat of the disease to wild carnivores. The endangered African wild dog would be the species of main concern.

The **institutional** impact of the research work has been to help policy makers to focus on the issue and plan on the basis of accurate data. Once again, the problem of medical versus veterinary doctors exists. Rabies control is thought to be the responsibility of veterinarians. However, there is a great need for the Ministry of Health to become more involved, by providing post-exposure treatment and instituting a campaign to publicise the crucial message about thorough washing of wounds from dog bites. The Ministry of Health is actively involved in the current round of discussions.

For this project, a rough estimate of the **economic** implications has been made. This has been based on accurate data on dog bite rates and DALY's lost due to the disease obtained from the research project (Cleaveland et al. 2000). However, estimates of the human and dog populations are much more approximate, and have been used in a simplistic manner to project what might be the costs and benefits of control, looking initially at the existing project in Mara region, and then at what might be the implications on a country-wide level. The time period selected is 1992 to 2010, that is from the start of the research project, and then projected ten years into the future. The results are given in Table 5.3 and details can be found in Annex 11.

Looking firstly at the Mara region, effective rabies control over the period would save some 20,000 DALY's plus £250,000 (present value in the year 2000) of costs of post-exposure treatment. Including the whole cost of the research programme in the costs, brings these to £ 605,000, of which nearly 40% is research. Thus the net cost per DALY saved would be £16. This compares well with WHO's criterion of $25 per DALY as 'very attractive' and $150 as 'attractive'. For a poor African country this is relatively expensive. However, extending the campaign to cover the whole country would make the cost per DALY fall to £7.00. Thus, if a nationwide vaccination campaign can be organised, it would be a highly cost-effective exercise.

The calculations are extremely sensitive to the cost of vaccination. The vaccine used in Tanzania can be purchased commercially for US $0.40. The project found that the cost of administering the vaccine more than doubled the cost per dog to US$0.90. A slightly higher price was used for the Tanzania wide calculations. The sensitivity analyses showed that the total cost per DALY gained increased by £2.70 for every ten pence (£0.10) increase in the cost per dog vaccinated.

Table 5.3 Projection of Benefits and Costs of Controlling Rabies in Tanzania

Item	Serengeti and Mara Region	Whole of Tanzania

Total Costs	£ 0.61 million	£7.1 million
Benefit: treatment costs saved	£ 0.25 million	£4.4 million
Number of DALY's gained	22,000	380,000
Cost per DALY gained	£ 16.00	£7.00

Note: Monetary amounts are given at 1999/2000 prices, discounted at 5% per annum, to their present value in 2000.
Source: Annex 11

Looking towards long term **sustainability,** the key element will be public support, and the willingness of dog owners to pay, or be coerced by their neighbours into paying, for vaccination. The disease is one which people know and fear. An effective public awareness campaign, repeated annually would be required, as well as the involvement of local government officials, in particular at the grass-roots level, where local leaders are responsible for every ten households. The potential for successful cost recovery must remain a major question mark over the future of large scale rabies control in Tanzania.

The epidemiological results obtained by the project will also be applicable to Kenya and Uganda, where the rabies situation is similar. Interest in this work also exists in Sudan and Ethiopia.