A cheaper tsetse control method

RIU

Validated RNRRS Output.

An improved technique for tsetse fly control is available that even poor producers can afford. The new method, known as restricted insecticide application, relies on the fact that tsetse tend to only bite the legs and stomachs of cattle. Spraying just these areas with an insecticide every two to four weeks kills tsetse fly for a cost of only around 1 British pound per animal per year. There are other benefits too. For example, the technique means that animals still get bitten by ticks when they are young. This allows them to build up an immunity to the diseases carried by ticks. In Uganda, Zambia and Burkina Faso, the technique has already been shown to have reduced the incidence of trypanosomiasis—the devastating disease which tsetse carry.

Project Ref: **LPP14:**
Topic: **2. Better Lives for Livestock Keepers: Improved Livestock & Fodder**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Livestock Production Programme**

Document Contents:

Description

LPP14

A. Description of the research output(s)

Research into Use
NR International
Park House
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Geographical regions included:

Eastern Africa, Southern Africa, Western Africa,

Target Audiences for this content:

Livestock farmers,

1. Working title of output or cluster of outputs.

Tsetse control through restricted application of insecticide to cattle

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

The research projects that contributed to the development of this output were supported by: DFID's Animal Health (AHP) and Livestock Production (LPP) programmes, FAO, the Zimbabwe Department of Veterinary Services and the Onderstepoort Veterinary Institute (South Africa). Complementary work aimed at controlling West African species of tsetse, initiated independently of the DFID-related projects, was supported by the French government largely through research and development projects associated with the Centre International de Recherche-développement sur l'élevage en zone Subhumide (CIRDES) and the Institut de Recherche pour le Développement (IRD)

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.

Funding agency	***Project no.***	***Project title***
AHP/LPP	R6559	Preliminary study of the effects of host physiology on the efficacy of cattle as baits for tsetse control.
AHP	R7173	Cattle management practices in tsetse-affected areas.
AHP	R7364	Improving the control of tsetse: The use of DNA profiling to establish the feeding responses of tsetse to cattle.
LPP/AHP	R7539	Environmental risks of insecticide-treated cattle in SA livestock systems.
AHP	R7987	Message in a bottle: disseminating tsetse control technologies.
AHP	R8214	Integrated vector management: controlling malaria and trypanosomiasis with insecticide-treated cattle.
LPP	ZC0254	General model for predicting the effect of insecticide-treated cattle on tsetse populations.

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*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.*

Tsetse-borne **trypanosomiasis** is a severe constraint to the livelihoods of poor **livestock** owners across ~10 million square kilometres of **sub-Saharan Africa**. Trypanocidal drugs can help but are subject to problems such as widespread resistance, so that the most reliable policy against the disease is vector control. The cheapest method of controlling **tsetse** is the use of **insecticide-treated cattle** (ITC). Treating an animal with insecticide does not prevent tsetse from biting it directly but, rather, like other forms of tsetse control, reduces the overall abundance of tsetse and hence disease transmission. To achieve adequate control, a critical density of cattle (ca. 4 treated animals/km^2) must be treated over a relatively large area (>100 km^2), hence requiring the participation of many livestock keepers. For the poorest livestock keepers however, use of this method is constrained by the relatively high cost of **insecticides** and the risk that widespread treatment of cattle with insecticide to control tsetse may exacerbate **tick-borne diseases** (eg**, anaplasmosis, babesiosis, cowdriosis**) and cause environmental damage, especially through impacts on dung beetles.

Means of minimising these problems were suggested by studies in **Burkina Faso**, **South Africa**, **Tanzania** and **Zimbabwe,** showing that tsetse feed mainly on the legs and belly of older cattle. By treating only those body regions of older animals at 2-4 week intervals, insecticide costs are reduced by 90%, environmental damage is negligible, and young, untreated, cattle are still bitten by **ticks**, and hence develop a natural, life-long **immunity** to several tick-borne diseases.

The **restricted application** of insecticide to cattle (**RAIC**) costs ~£1/animal/year which is comparable to the cost of a single dose of **trypanocide**. Consequently, even the poorest livestock keepers can afford RAIC and avoid the real costs of living with trypanosomiasis, which are likely to include repeated trypanocidal applications and loss of productivity associated with morbidity. The method has reduced tsetse numbers and the incidence of human and animal trypanosomiasis in **Uganda**, **Zambia** and **Burkina Faso.**

The African Union's Pan-African Tsetse and Trypanosomiasis Eradication Programme (**PATTEC**) has initiated **area-wide** operations to eliminate tsetse in **Angola**, **Botswana**, **Burkina Faso, Ethiopia**, **Ghana**, **Kenya**, **Mali**, **Uganda** and **Zambia**. These operations will use a variety of tsetse control methods including insecticide-treated cattle. The method is also being promoted by local **NGO**s and government agencies in most tsetse-affected countries, involving smaller-scale operatons to **control**, rather than **eliminate** the flies. By adopting the RAIC refinement, the cost-effectiveness of these interventions will improve radically.

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

The use of RAIC to control tsetse-borne trypanosomiasis will improve the health of livestock, including not only cattle but also pigs, goats, sheep, donkeys, horses and camels. Humans also suffer trypanosomiasis, in the form of sleeping sickness, and for the Rhodesian form of the disease cattle are an important reservoir host. Hence RAIC also improves human health, as demonstrated in Uganda.

Improvements in the health and productivity of draught animals – particularly cattle –have indirect benefits for the productivity of mixed crop-livestock systems. In Ethiopia, the absence of draft animals due, for example, to trypanosomiasis leads to delayed planting, lower crop yields and higher production costs. Crops likely to benefit particularly from the improvements in the health and availability of draught animals include maize, cotton and sorghum.

Research by AHP-supported projects indicates that this approach could have an impact on malaria in those regions of sub-Saharan Africa where the malaria parasite is transmitted predominantly by *Anopheles arabiensis* which feeds on humans and cattle. Such areas include the Greater Horn, southern Africa, the Maasai steppe of East Africa and the Sahel.

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	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.

The two main factors preventing farmers from controlling tsetse effectively are (i) the relatively high cost of current control methods and (ii) inadequate technical understanding and hence poor planning and execution. The present output addresses the first constraint while two others (**Tsetse Muse; Tsetse Plan**) provide detailed information on the safe and effective use of various methods of tsetse control, including RAIC used alone or with other forms of tsetse control.

Experience in Uganda (see Q6) shows that RAIC can reduce significantly the incidence of Rhodesian sleeping sickness. Accordingly, links between this output and '**Diagnostics that can identify human-infective trypanosomes in cattle blood'** and '**Treatment of cattle to eliminate the animal reservoir of *T. b. rhodesiense'*** would contribute to the promotion of human health.

Trypanosomiasis is only one of several diseases affecting the health and productivity of African livestock, so that interactions between all of the diseases affect their impact and management strategies. For instance, on the one hand animals affected by trypanosomiasis are more susceptible to tick-borne diseases while on the other the treatment of cattle with insecticide impacts on both ticks and tsetse. For livestock keepers in sub-Saharan Africa, the management of tsetse and trypanosomiasis forms only part of a wider livestock strategy and the prompt and accurate diagnosis of animal diseases is crucial for cost-effective management. Accordingly, there are synergistic links with the AHP output '**Simple decision tools for diagnosis of endemic diseases in Africa**' which includes tools to improve the diagnosis and management of trypanosomiasis and other vector-borne diseases.

Since livestock are an integral part of mixed farming systems in sub-Saharan Africa the improved health and productivity of humans and livestock enhances crop production. Accordingly, this output has links to the CPP output concerned with '**Draught animal power**' and the LPP's '**Draught animal toolbox**'.

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)**.*

1. Direct observation of tsetse (*Glossina m. morsitans*, *G. pallidipes*, *G. brevipalpis*, *G. austeni*, *G. tachinoides*, *G. palpalis palpalis*) showed that tsetse consistently land and feed on the legs of cattle (Vale *et al*., 1999; Bourn *et al*., 2005; Torr *et al*., 2006; Bouyer *et al*., 2006a).

2. Field studies of the feeding behaviour of tsetse using arrangements of electric nets (Torr & Mangwiro, 1999) and DNA markers (Torr *et al*., 2001) showed that tsetse feed selectively on older/larger cattle in a herd.

3. Studies of the mortality of tsetse exposed to cattle treated with pyrethroids applied to the legs and belly of cattle indicated that compared to the standard whole-body application of insecticide, RAIC reduces the amount of insecticide used by 80-90% and has only a slight reduction on efficacy (Torr *et al*., 2006; Bouyer *et al*., 2006a).

4. Studies of non-target invertebrates exposed to insecticide-treated cattle show that large numbers of the beetles and flies associated with cow dung are killed (Vale et al., 1999; Vale & Grant, 2001) if the whole body of an animal is treated, but that this can be obviated by RAIC (Vale *et al*., 2004; Bourn *et al*., 2005).

5. In West Africa, field trials showed that for dairy cattle in a peri-urban zone, RAIC reduced the abundance of tsetse and ticks, the incidence of trypanosomiasis and cowdriosis and improved animal productivity (Bouyer *et al*., 2006b). In East Africa, field trials demonstrated that RAIC reduced the prevalence of *Trypanosoma* spp in cattle from 15% to 5% (Brownlow et al., 2006). While RAIC has not been widely employed beyond these few trials, the above evidence (1-4) indicates that it will be at least as effective as the standard whole-body treatment for which there are numerous examples of significant impact on trypanosomiasis and cattle productivity (eg, Fox *et al*., 1993; Bauer *et al*., 1999; Baylis & Stevenson, 1999; Hargrove *et al.,* 2000).

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)****.*

1. Landing sites of tsetse were studied in Burkina Faso (Bobo-Dioulasso), South Africa (KwaZulu-Natal), Tanzania (Tanga region) and Zimbabwe (Mashonaland) between 1999 and 2005.

2. The relative attractiveness of different cattle was investigated in Zimbabwe (Mashonaland) between 1999 and 2002.

3. The efficacy of insecticides applied to the legs and belly of cattle was measured in Zimbabwe (2002-2005) and Burkina Faso (2002-2004).

4. The environmental impact of the standard (whole body) and RAIC regimens was assessed in Zimbabwe (Mashonaland) between 1999 and 2005.

5. The RAIC method was successfully used to control trypanosomiasis in Burkina Faso (Bobo-Dioulasso; peri-

urban dairy producers) and Uganda (Busoga region; mixed crop-livestock farming system) in 2004-05. Following the first large-scale use of insecticide-treated cattle to control tsetse in Zimbabwe in the late 1980s, the standard (whole body) method has been used successfully in many sub-Saharan countries including:-

- Burkina Faso: mixed crop-livestock farmers in Sideradougou
- Ethiopia: mixed crop-livestock famers and pastoralists in the Ghibe Valley and Konso district of southern Ethiopia.
- Kenya: mixed crop-livestock famers (eg, Busia), pastoralists (eg, Narok) and commercial ranchers (Galana)
- South Africa: mixed crop-livestock keepers and commercial farmers in KwaZulu-Natal Province.
- Tanzania: government and commercial ranches, pastoralists and mixed crop-livestock farmers in Kagera and Tanga region.
- Uganda: mixed crop-livestock keepers in Busoga region.
- Zimbabwe: mixed crop-livestock farmers in Mashonaland.

Current Situation

C. Current situation

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

In Uganda, a public-private partnership between the Ministry of Agriculture, Animal Industries and Fisheries (MAAIF), the Coordinating Office for Control of Tsetse and Trypanosomiasis (COCTU), Makerere University, veterinary and pharmaceutical companies (CEVA; Coopers) and local livestock owners will treat ~200,000 cattle with a combination of trypanocides followed by monthly treatment with deltamethrin using RAIC. The intervention aims to alleviate human and animal trypanosomiasis and halt the northward expansion of Rhodesian sleeping sickness.

In West Africa, various French-supported development projects are promoting the use of RAIC. In Burkina Faso, the ARIOPE (Appui au Renforcement Institutionnel des Organisations Professionnelles d'Eleveurs Modernes) project has constructed ~20 footbaths for use by peri-urban dairy producers while the PAEOB project (Projet d'aide à l'Elevage dans l'Ouest du Burkina) aims to promote the technique among traditional Burkinabe livestock keepers. Other French-supported projects in the region, including the WECARD (West and Central African Council for Agricultural Research and Development) programme in Benin and Mali and the ARDESAC (Appui à la Recherche Régionale pour le développement durable des Savanes d'Afrique Centrale) project working in

Cameroon, the Central African Republic and Chad also plan to construct footbaths to promote RAIC.

While the current use of the RAIC is limited, there is widespread use of the standard whole-body method. For instance, Appropriate Applications Ltd (UK) has recently supplied 1500 L of deltamethrin 1% pour-on to Uganda and 8200 L to Ethiopia. This total (9700 L) is sufficient to treat ~32,000 adult cattle for a year using the standard method compared to >150,000 cattle using RAIC.

*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).***

The RAIC method is being used by cattle owners in the Apac, Lira and Kabamaido districts of Uganda and peri-urban dairy farmers in the vicinity of Bobo-Dioulasso, Burkina Faso.

The whole-body method is being used in all tsetse-affected countries for the control of tick- and/or tsetse-borne diseases. Specific examples of areas where this method is being used on a large scale to control tsetse include southern Ethiopia and northern Zimbabwe. Ethiopia has recently imported 8200 L of deltamethrin pour-on to treat cattle. The cost-effectiveness of this operation would be improved if the whole body method were replaced by RAIC. In Zimbabwe, the Department of Veterinary Services is currently treating ca. 95,000 cattle to control trypanosomiasis in north Mashonaland and the costs of this programme could be reduced enormously if RAIC was adopted.

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

In Uganda, the initial trial of RAIC was conducted in 2005 and involved the treatment of ca. 1000 cattle from 12 villages. A large-scale tsetse and trypanosomiasis control operation was initiated in September 2006 and this will involve the treatment of ca. 200,000 cattle from three districts where ca. 2 million people live. In Burkina Faso, the initial trial of RAIC was performed in 2003 and involved the treatment of ca. 80 cattle. Currently, ca. 60 peri-urban dairy producers are regularly treating ~2500 cattle in the vicinity of Bobo-Dioulasso. The use of the technique is expected to expand in both countries, since each has major tsetse control operations planned as part of the PATTEC initiative. These operations, supported by loans from the African Development Bank, aim to eliminate tsetse from 15,000 km^2 of Uganda and 40,000 km^2 of Burkina Faso and are expected to rely heavily on insecticide-treated cattle.

*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 use of RAIC has not reached its full potential, either as a replacement for the standard (whole body) treatment that has been used for ca. 20 years, or as a new method for extending tsetse control into areas where control was formerly too costly. However, we can draw several lessons from the uptake of the standard treatment.

1. Uptake is likely to be faster and more widespread where there is an existing use of pyrethroids for controlling tsetse and/or ticks. This is likely to occur where there is a risk of acute tick-borne diseases (eg,

East Coast Fever) or where cattle breeds are particularly susceptible to tick- and tsetse-borne diseases as, for example, in the Tanga region of Tanzania where 'improved' breeds of cattle are used for dairy production. In the case of RAIC, it seems likely that the method will be more readily adopted in areas where farmers are using insecticide-treated cattle to control tsetse.

2. The use of insecticide-treated cattle has been more widespread in countries where: (i) private companies are able to import different insecticide formulations readily; (ii) market forces reduce the cost of insecticide to the farmers and (iii) the potential market for tsetse control products is sufficiently large to encourage insecticide companies to label and promote their products adequately.

3. Regional programmes such as the EU-supported Regional Tsetse and Trypanosomiasis Control Programme (RTTCP) in southern Africa and the Farming in Tsetse Controlled Areas (FITCA) played a key role in transferring new technologies between countries. The PATTEC initiative could replicate this role.

4. National governments and their veterinary departments can promote the use of insecticide-treated cattle by: (i) supporting a dipping infrastructure and establishing legal obligations and levies to ensure that livestock keepers treat their cattle regularly (eg, Zimbabwe, South Africa) or, more commonly, (ii) disseminating technical advice and motivational messages to farmers on the effective control of tsetse and its advantages over treating cattle with trypanocides.

5. Veterinary schools and training establishments are crucial in strengthening the capacity of government departments, NGOs, private companies and local veterinarians/livestock advisers to promote best practice.

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.

All tsetse control methods have two potential types of impact on the environment. One relates to the direct impact of the technique and the other concerns the consequences of improving the health and productivity of livestock.

The RAIC method developed, in part, as a consequence of concerns regarding the environmental impact of the standard (whole body) method of treating cattle with insecticide. The RAIC system reduces the amount of insecticide used and hence the impact on non-target organisms. Moreover, since the method does not require plunge dips, the environmental and health hazards associated with their use are avoided.

With effective land-use planning and implementation, the use of insecticide-treated cattle to control tsetse can alleviate environmental degradation associated with the concentration of people and livestock into areas naturally free of tsetse.

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

The method does not have any significant direct impact on the environment. However, without effective land-use planning and implementation, the use of insecticide-treated cattle to control tsetse could lead to environmental-degradation arising from inappropriate land-use.

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)***

Predictive models of climate change suggest that there will be shifts in the areas suitable for pastoral and mixed system and in the distribution of tsetse (ILRI, 2000; Thornton et al., 2006). For the morsitans group of tsetse, which includes the major vectors of animal trypanosomiasis, there will be a decrease in suitable habitat along the northern margin of the west African belt and over a large area of southern Sudan and southern Zambia, and an increase along the southern edge of the west African belt and scattered parts of Kenya, Uganda and Ethiopia. RAIC can play an important role in controlling tsetse in current and predicted areas of infestation.

More generally, livestock are important in reducing vulnerability to natural and man-made disasters (see Q21). The use of insecticide-treated cattle, including RAIC, is particularly useful in this role since the treatment is applied to cattle whereas other methods of control (eg, aerial and ground spraying) are geographically fixed. Hence, livestock keepers fleeing, say, a war zone can move with their treated cattle and expect to achieve some measure of control. By contrast, if the area had been controlled by, say, aerial spraying the benefits would be lost.

Annex

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