

**PROGRAMME FOR ENHANCING THE IMPACT OF IMMUNIZATION  
AGAINST EAST COAST FEVER WITH AN IMPROVED SUB-UNIT VACCINE  
ON THE SMALLHOLDER DAIRY SECTOR IN EASTERN AFRICA**

**Abstract**

*The abstract should provide the following information:  
the project title, the main research outcomes/impacts, the replicability perspectives (scaling-up/out) and  
the overall context in which the research has been conducted  
(geographical, political, socio-cultural and economic dimensions).*

In eastern, central and southern Africa improvement in livestock productivity has been severely constrained by several tick-borne diseases of cattle. One of the most important diseases is East Coast Fever (ECF) caused by the protozoan parasite *Theileria parva*. The losses in the form of high morbidity and mortality, especially among improved (exotic or cross-bred) cattle, are particularly relevant in the case of the dairy industry. The prevailing strategy for the control of ECF is based on the short interval use of acaricides to control the tick vector, *Rhipicephalus appendiculatus*. However, this method is limited by high cost of acaricides, increasing problem of resistance to acaricides in some tick species and negative environmental impact. Consequently, scientists at the International Livestock Research Institute (ILRI) developed a prototype vaccine for ECF based on the major surface protein of the infective sporozoite stage of the parasite referred to as the p67. Immunization of boran (*Bos indicus*) cattle with a recombinant of the p67 protein, formulated in adjuvant, consistently reduced the incidence of severe ECF in 50% of vaccinated animals, in both laboratory and field trials. The main advantages of the recombinant vaccine is that it can be easily administered, protection is not strain specific and a strict cold chain is not required for its deployment. The research programme No. 376 “*Programme for enhancing the impact of immunization against East Coast Fever with an improved sub-unit vaccine on the smallholder dairy sector in eastern Africa*” aimed to evaluate the impact of this recombinant vaccine against ECF in smallholder dairy systems of eastern Africa. At this level of efficacy it became apparent that the p67 vaccine is unlikely to be developed into a commercial product. The project therefore re-oriented to assess the impact of the alternative live ECF vaccine known the “infection and treatment method” (ITM). This vaccine technology was developed over 30 years ago but is not widely available to livestock keepers in the region. The major difference with the recombinant vaccine is that the live vaccine requires a cold chain, it does not protect against all potential strains and may cause severe post-vaccination reactions in a small proportion of immunised cattle. There are three main areas by which the research might play a significant role in enhancing the role of livestock in poverty alleviation, namely: better understanding of the epidemiology, socio-economics and impact of livestock diseases, insights into the delivery of animal health services and development of specific technologies for disease control. The project has been implemented in the humid and sub humid climatic areas of Kenya, Tanzania and Uganda in East Africa where the most widely distributed production system is the agropastoral system although the smallholder market-oriented dairy production and the extensive pastoral systems are important in some areas. The agropastoral production system is characterized by mixed crop and livestock enterprises on a largely subsistence basis, except in areas where cash crops are also grown (sugar cane, cotton and rice). Most of the cattle under this system are raised under ECF risk and the cost of this disease is immense (estimated at USD220 million in 2002). However, the impact of ECF varies greatly in the three types of production systems. The project registered the following impacts on the human capital (e.g. increased local knowledge and technical skills and good quality data collected on different topics), social capital (e.g. strengthening of public private sector institutional relations and potential for new market opportunities) and natural capital (e.g. reduction of the dipping practices and their negative environmental impacts on non-target organisms).

**Main successful technical  
components of the  
research programme:**

- Development of a comprehensive design for the evaluation of the vaccine against ECF;
- Data analysis, impact assessment and study of vaccine delivery mechanisms.

## **SECTION ONE: THE INSTITUTIONAL CONTEXT**

*The project within the IFAD context, relevance to/linkages with other IFAD programmes/initiatives, implementing partners and main activities carried out.*

- Existing linkages with other IFAD initiatives:
  - Grants:
  - Loans:
- Target regions and implementing partners:

Grant No. 596, ILRI: “*ITM adoption of immunization against east coast fever for poor livestock keepers in Eastern Africa*”.

- Kenya, Tanzania and Uganda.
- ILRI as the implementing agency, NARS (NARO and KARI) and OAU-IBAR.

## **SECTION TWO : THE PROGRAMME IMPLEMENTATION**

### **The research programme:**

*Description of the technology/participatory methodology/approach developed, costs of the inputs used to implement the research programme, rural areas and context where the research has been implemented (specifying environmental conditions)*

The major cattle disease in the smallholder dairy and pastoral production system in East Africa is ECF; it is responsible for about 50% of calf morbidity and three quarters of the mortality. The disease is currently controlled through short interval treatment of cattle with chemical acaricides which are largely unsustainable by resource poor farmers. The research programme evaluated the impact of an alternative control strategy based on immunization of cattle using the “infection and treatment method”. The method involves inoculation of cattle with live *Theileria parva* parasites preserved as sporozoites and simultaneously treating them with a long acting tetracycline. The parasites induce a mild reaction in the majority of animals leading to a life long immunity to a homologous challenge. The programme aimed at giving answers to a number of key questions and the following four particular activities have been developed:

- To confirm the efficacy of the p67 recombinant vaccine in smallholder dairy units in different agro-ecological zones in Kenya
- To evaluate mechanisms for the optimal delivery, adoption and impact of the live ECF vaccine;
- To determine the impact of the live vaccine in smallholder dairy systems on a series of livestock productivity and economics indicators;
- To evaluate the socio-economic benefits to livestock keepers and consumers of livestock products of reduced ECF risk.

In order to address the above issues, the research has been organized around eight interrelated activities, namely:

(i) The characterization of dairy production system in East Africa, (ii) An evaluation of the perceived vulnerability of farmers to the effects of ECF and ECF risk management strategies, (iii) A field assessment of the actual vulnerability, (iv) A study of the role of the vaccines against ECF, (v) A study of the delivery and adoption of ECF vaccine technologies, (vi) A synthesis of regional experiences with ECF vaccine delivery, (vii) A regional evaluation of the spatial vulnerability to ECF using GIS, (viii) A study synthesis.

The research applied a range of different methodologies, some for the very first time in livestock research with the aim of elucidating the perceptions of farmers to the disease and its control. The programme first conducted a Participatory Learning and Action (PLA) analysis, which is rapid, participatory and consultative permitting the gathering of a full range of views, practices and perceptions of farmers.

This was followed by a more detailed study of a representative sample of the farmers in the full range of the zones where smallholder dairy is practiced by means of a structured questionnaire and finally a detailed monitoring of farms has been undertaken through a longitudinal study in order to validate and consolidate the results of the cross-sectional study.

To this effect, a comprehensive design was developed to ensure the inclusions of all indicators relevant to the evaluation of vaccine impact on the range of end-users and project beneficiaries.

High quality data have been collected from productivity and socio-economic components and an impact assessment study on livestock productivity and socio-economic indicators have been carried out, including studies of: (i) the demand by smallholder farmers for improved genotypes of dairy cattle, (ii) the demand for forage and feed, and (iii) the link between changes in disease-control expenditure and milk production with enhanced human welfare, income, employment and family education opportunities. Also, a comparative study on appropriate vaccine delivery mechanisms has been implemented.

### **Target group and impact:**

*Description of the target group, the beneficiaries and the benefits and the main research outcomes/impacts*

*(vulnerable groups, project impacts and effects on the human, social and natural capital).*

- *Impacts on the human capital:*
- *Impacts on the social capital:*
- *Impacts on the natural capital:*

#### *Project target groups:*

Smallholder livestock keepers of rural areas in East Africa. The smallholder market oriented dairy production systems, the agropastoral production systems and the extensive pastoral production systems were targeted because these form the most important livestock systems in the above areas, involving more than half of the rural poor.

#### *Impacts on the human capital:*

- Increased knowledge and technical skills;
- Good quality data collected on: production characteristics of the regional livestock production systems, disease measures (biological data on prevalence, incidence and case fatality rates), vector population dynamics, various constraints to the delivery of livestock services in general and ECF vaccines in particular;
- Development of a series of maps showing varying degrees of risks of ECF in Kenya.

#### *Impacts on the social capital:*

- Strengthening of social relations;
- Creation of potential for new market opportunities;
- Strengthened collaboration among private sector, NARS, national veterinary authorities and advanced research institutes.
- Positive changes on policies on ticks and tickborne disease control

#### *Impacts on the natural capital:*

- Reduction of the dipping practices and their negative environmental impacts on non-target organisms;
- Increased milk/meat productivity;
- Increased cattle survival within pastoralist systems.

### **The gender dimension:**

*Women's role in the research programme, impacts on the gender equity and women's empowerment.*

In many communities of East Africa, women are responsible for the management of the dairy enterprises and, in these areas, there is high proportion of female-headed households. Improved efficiency in dairy production proportionately benefits more women. The activities designed to intensify the livestock production systems would lead to an increase of women's workload but wider adoption of the outcomes of this research would reduce their workload (less labour needed as acaricide treatments are reduced).

### **Accessibility:**

*Identification of the physical availability of the research outputs in different time and places as well as their affordability by the rural poor.*

- The sustainable use of the prevailing strategy for control of ECF, based on the use of acaricides to control the tick vector, though widely available, is doubtful given the high cost of acaricides, increasing problem of resistance to acaricides in some tick species and negative environmental impacts. The live vaccine evaluated during the research programme though complex and requiring a strict cold chain is deliverable in all production systems if the correct policies are put in place. There are however certain circumstances where donor support is required to ensure the benefits of the technology are equitably distributed.
- The demand and acceptability of the technology despite the existing constraints were corroborated by the direct involvement of farmers in the trials. Through the trials, farmers have acquired a good knowledge of their context, identified risks and constraints and evaluated various options for their avoidance.
- One attribute that strongly favours the use of the live vaccine by farmers is the fact that only one injection is needed in a lifetime, as they expressed their preference for a product administered as few times as possible.
- The adoption of the vaccine does not strongly depend on the price of the product, as farmers are prepared to pay a significant amount to prevent the effects of the disease. However, the price of the vaccine is quite high relative to the value of the animals in some production systems thus limiting the affordability by a section of poor farmers;
- The accessibility of the ITM to more livestock keepers could be enhanced by a greater involvement of the private sector.

### **Constraints faced during the programme implementation:**

*Difficulties faced during the implementation of the research programme, specifying the internal (limited infrastructure, lack of inputs etc) and the external (socio-political and environmental aspects) constraints.*

Constraints related to:

- *Internal conditions:*
- *External conditions:*

#### *Constraints related to the internal conditions:*

- The major constraint faced was when the recombinant vaccine did not give the expected efficacy and the project had to reorient on evaluating the live vaccine.
- It was difficult to evaluate some of the impacts of the live vaccine in smallholder dairy systems as the vaccine was not being widely used;
- Difficulties in getting data to develop an in-depth GIS analysis of the ECF risks in other countries except Kenya.

#### *Constraints related to the external conditions:*

- Reduced local extension services;
- Inadequate physical infrastructures
- Lack of veterinary services in general;
- Inappropriate government policies and institutional constraints (ex. the wider use of ITM and its commercialization).

### **Institutional sustainability and degree of farmers' involvement in the research**

Preliminary studies have been undertaken in order to understand farmers' point of view of the ideal vaccine and their perceptions of the risk they face from ECF. The main research questions have been developed on the basis of

### **programme:**

*Underlying the degree of farmers' meaningful involvement in the definition and implementation of the main research steps/research process - which determines also the level of social and psychological acceptability- and explanation of the measures taken to support the institutional, organizational and professional changes at all levels.*

the farmers' needs and ideas. The main attributes of the product have been identified through the evaluation of the characteristics considered relevant by the farmers. The continuing challenge is to nurture the public private alliance developed to ensure sustainability of production and delivery of the vaccines.

### **Dissemination pathways:**

*Description of the ways through which the project results are made available at the village level and at the national/international level (workshops, reports, seminars etc).*

- *The communication strategies at the village level:*
- *The communication strategies at the national and international level:*

#### *The communication strategies at the village level:*

- Training courses and activities on the field;
- Face to face meetings with farmers ;
- Farmer-to-farmer communication.

#### *The communication strategies at the national and international level:*

- Regional, national and international workshops;
- Scientific reports and publications;
- Establishment of databases;
- Five Technical Advisory Notes.

### **Further research needs:**

*Identification of the new areas considered to be relevant and needed to be taken into account since they influence the adoption and/or the relevance of the research results (new problems or links not investigated by the research).*

- To expand the vaccine researches in order to include vaccine among some pastoralists and agro-pastoralist farmers;
- To continue research into improvements on the subunit vaccines
- To improve the delivery pathways in order to ensure reliable vaccine availability and supply;
- To involve policy makers in incorporating vaccination into revised strategies for the control of ticks and other tick-borne diseases;
- To validate theoretical predictions of risk and impact through the application of models in current vaccine situations;
- To conduct environmental impact studies pre- and post-vaccination and to investigate opportunities for increasing cattle off-take through appropriate marketing strategies;
- To address the policy, institutional and technical constraints the hinder wide access to ITM by the majority of the rural poor in East Africa.

## **SECTION THREE: USEFUL INFORMATION**

### **Vocabulary:**

*East Coast Fever*: a tick-borne protozoal infection of cattle in East and Central and southern Africa. The disease is transmitted by infected ticks, *Rhipicephalus appendiculatus*. Because the ticks usually attach to the ear, it is often called the "brown ear ticks".

### **Keywords:**

East Coast fever (ECF), protozoan parasite *Theileria parva*, agropastoral system, smallholder dairy, tick vector, *Rhipicephalus appendiculatus*, Immunization of boran (*Bos indicus*), p67 protein.

### **Useful links:**

[Development of a Live Vaccine Delivery System for East Coast Fever](#)

[Introduction – The \*Theileria parva\* Genome Database](#)

[Parasite variations and polymorphism](#)

[www.ifad.org/gender/thematic/livestock/live\\_toc.htm](http://www.ifad.org/gender/thematic/livestock/live_toc.htm) - Women and Livestock

### **References:**

- Online documents: [www.fao.org/ag/againfo/programmes/en/paat/home.html](http://www.fao.org/ag/againfo/programmes/en/paat/home.html)

Main subjects are:

*Animal Health; Animal Production; Livestock and Environment; Food and Feed Safety; Genetic Resources & Reproduction; Poverty Alleviation; Sector Analysis and Policy; Veterinary Public Health and Livestock & Gender.*

- Project Completion Report and a list of articles published from the study are available at IFAD upon request.

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### **Acronyms:**

DIFD: Department for International Development, UK

IFAD: International Fund for Agricultural Development

ILRI: International Livestock Research Institute

KARI: Kenya Agricultural Research Institute

MAFC: Ministry of Agriculture, Food and Cooperatives, Tanzania

NARO: National Agricultural Research Organisation

AU-IBAR: Inter-African Bureau for Animal Resources of the African Union