Project title: Diagnostic and Control Tools and Strategies for *Taenia solium* cysticercosis (ASARECA/AB/2009/01)

Program / Unit name: Agro-biodiversity and Biotechnology Programme

**Project Report**

*Period covered* (September 2009 – December 2011)

**Partner Institutions**

1. University of Nairobi, Nairobi, Kenya
2. International Livestock Research Laboratories, Nairobi, Kenya
3. Sokoine University of Agriculture, Morogoro, Tanzania
4. Makerere University, Kampala, Uganda
5. Central Veterinary Laboratories, Burundi
6. Central Veterinary Laboratories, DR Congo.

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List of Acronyms
AGROBIO  Agri-biodiversity and Biotechnology Programme, ASARECA
ASARECA  Association for Strengthening Agricultural Research in Eastern and Central Africa
CWGES A  Cysticercosis Working Group in Eastern and Southern Africa
NCC      Human Neurocysticercosis
UON      University of Nairobi.

**1.0 Executive Summary**

The goal of this project is to enhance sustainable productivity, value added and competitiveness of the pig industry in the Eastern and Central African (ECA) region through easier, user-friendly and more accurate diagnosis, control and prevention of *Taenia solium* cysticercosis. The enhanced control and prevention of the infection is also expected to increase pork trade and food safety, prevent human infections and eliminate a health risk that has both social and economic implications.

This report highlights the results achieved through activities carried out at the University of Nairobi from the beginning of the project in September 2009 to December 2011. In summary these fall under all four Expected Results of the project in which the University of Nairobi was involved as shown below:

Expected Results 1:  User-friendly diagnostic test for *Taenia solium* cysticercosis in pigs developed and promoted

Expected Results 2:  Options for control of *Taenia solium* cysticercosis identified and promoted

Expected Results 3:  National capacity for surveillance, prevention and control of *T. solium* cysticercosis strengthened

Expected Results 4:  Availability of information on *T. solium* cysticercosis enhanced

**2.0 Background/Introduction**

This project was formulated after realising that concurrent with increased smallholder pig keeping and pork consumption in eastern and southern Africa (ESA), there were reports of a high and increasing prevalence of human epilepsy without a clear aetiology, and the appearance and increase in cases of porcine cysticercosis. *Taenia solium* a zoonotic tapeworm is transmitted among humans and between humans and pigs causes cysticercosis. Humans acquire taeniosis (tapeworm infection) when they eat raw or undercooked pork meat containing the cysticerci, the larval form of *T. solium*. The cysticerci establish in the intestine of humans, become adult tapeworms and shed eggs in human faeces that can infect in turn other humans and pigs. A principle site of cysticerci in humans is the central nervous system causing neurocysticercosis (NCC) Although theoretically easy to control and eradicate,
cysticercosis was neglected in ECA due to lack of information and awareness about the extent of the problem, suitable diagnostic and management capacity, and appropriate prevention and control strategies. This project aims at bridging this gap leading to improved control of the infections and had the following objectives:

1. To develop and evaluate a pen-side diagnostic test for *T. solium* cysticercosis in pigs;
2. To determine the prevalence and risk factors of *Taenia solium* cysticercosis/taeniosis;
3. To strengthen the capacity for surveillance, prevention and control of *T. solium* cysticercosis in pigs.
4. To enhance the availability of information on *T. solium* cysticercosis.

In Kenya, the field work has been carried out in Homa Bay County in Nyanza Province and the laboratory work at the University of Nairobi’s Faculty of Veterinary Medicine, Kabete Campus. In the field, the target groups were pig farmers and their pigs, the pig traders, butchers, health workers, the local administration and other stakeholders in the pig industry. The duration of the project was initially three years but an extension was provided to complete some of the pending issues.

3.0 Implementation and Project Results

Implementation of the project activities at the University of Nairobi started in September 2009 after a project planning and inception in Nairobi.

*Plate1: Members of the project team and officials from ASARECA during the inception workshop at the Hilton Hotel in Nairobi*

The initial work from September 2009 to December 2009 involved identification of the project sites in Homabay County where research work on cysticercosis was to be carried out.
Two masters students registered at the Faculty of Veterinary Medicine were also recruited during that period, and their research plans developed and approved by the University.

The following is a statement of the progress made for each result:

**RESULTS 1:** User-friendly diagnostic test for *T. solium* cysticercosis in pigs developed and promoted.

**ACTIVITY 1.1:** Transform laboratory immunodiagnostic test into a user-friendly field test. This activity was carried out by ILRI in collaboration with the UoN.

The current method for detecting infected pigs in the field relies on palpation of cysts under the tongue of a live pig. The method has been promoted as a potential screening test for farmers to perform themselves, although the sensitivity is very low (16%) Standard laboratory-based serological tests provide good sensitivity and specificity, but are not suitable for use in the field due to the delay in reporting the results. The provision of a suitable pen-side test with good sensitivity was viewed as a valuable tool in *T. solium* control. This was developed using purified *T. saginata* antigen for which monoclonal antibodies were raised and incorporated into a lateral flow system (Plate 2).

*Plate 2 shows the lateral flow assay showing the control line, a negative test result (301, 302, 305 and 310) and a strong positive test results (No 303)*

The serum sample from test animals, containing the circulating antigens (Ags) of *T. solium* is applied into the well at one end of the device, which has a monoclonal antibody (Abs) specific for the Ags and is labeled with colloidal gold. The Ab + Ag complex flows along the membrane in the device, where a second Ab captures the complex, resulting in accumulation of the gold colour indicative of a positive sample. A second Ab traps the gold labeled AB even without the Ag and serves as the control. In Plate 2, pig Nos 301, 302, 305 and 310 are
negative while No. 303 is positive for *T. solium* infection. This test is being optimized for filed trials in the region.

**ACTIVITY 1.2: Conduct training on use of the diagnostic test.**  
This activity was slightly modified once it was realized that the user-friendly test may not be available and the training on it carried out during the life of the project. Training on diagnosis of the cysts at farm level using lingual palpation and at meat inspection by incision and observation of the muscles was carried out for pig farmers, pig traders and butchers in Homa bay. The total number of trainees was 50. This activity has therefore been fully implemented.

**RESULTS 2: Options for control of *T. solium* cysticercosis identified and promoted.**

**ACTIVITY 2.1: Conduct *Taenia solium* vaccine trials**  
This activity has been completed and the following sub-activities have been carried out:

The vaccine was obtained from New Zealand in October 2010. A field vaccine trial was then carried out following a protocol developed by the vaccine producing company. Pigs purchased by the project were allocated to different farmers in the field. Some of the pigs were vaccinated while the others were left as unvaccinated controls. Collection of sera was then undertaken and the pigs slaughtered to determine the effectiveness of the vaccine. Data for this trial will be provided by the research team in Tanzania.

**ACTIVITY 2.2: Conduct risk assessment and impact studies on porcine cysticercosis and human cysticercosis/taeniosis in target areas:**

This activity has been implemented and the following sub-activities were carried out:

Questionnaire data on risk factors was collected from pig farmers in Homa Bay County in Nyanza Province, Kenya.

*Plate 3 and 4: One of the MSc students on the project (Dr. Fredrick Obonyo) conducting questionnaire interviews with pig farmers in Homa Bay. In the foreground of Plate 2, is a Technologist (Mr. Richard Otieno) and Researcher (Dr. Githigia) preparing to examine a*
pig for cysticercus by lingual palpation and collect blood samples for cysticercus antigen analysis using ELISA.

Examination of pigs for cysticercus and other parasites
- 392 pigs in Homa bay District were examined for cysts of *T. solium* by lingual examination.
- 233 Serum samples for analysis of *Taenia solium* antigens were also analyzed using ELISA.

**OUTPUT 3: National capacity for surveillance, prevention and control of *T. solium* cysticercosis strengthened**

**ACTIVITY 3.1: Develop training modules/guidelines on *T. solium* cysticercosis control options.**

- The project implementers participated in the production of a draft Training manual (See Annex 1).

**ACTIVITY 3.2: Train stakeholders on *T. solium* cysticercosis control options.**
This activity is 100% implemented. Approximately 500 pig farmers, pig traders, butchers, health workers, extension workers, veterinary staff and local leaders including chiefs, community mobilisers were trained in Homabay in October 2010.

Training was conducted following guidelines from a Training Manual developed under the project and demonstrations carried out using posters and preserved specimens of worms.

*Plate 5: A training session in Homabay with a poster highlighting the lifecycle, effects of infection and steps to control the parasite in the foreground*

**ACTIVITY 3.3: Develop National Action Plans on surveillance, prevention and control of *T. solium* cysticercosis**
A draft Action Plan developed has been developed and refined.
RESULTS 4: Availability of information on *T. solium* cysticercosis enhanced

**ACTIVITY 4.1: Package and avail relevant information on *T. solium* cysticercosis**

**ACTIVITY 4.2: Create stakeholder awareness on *T. solium* cysticercosis**

These two activities have been implemented through the production of leaflets and a poster in English, Kiswahili and Dholuo (Annex 2) and distributed to the training participants in Activity 3.2, schools and hospitals in Homabay County.

4.0 List of all publications/knowledge products produced

Please list the titles of scientific publications and conference presentations arising from the project under the following types:

**Theses and Publications**


5. Obonyo, FO, Maingi, N, Githigia, SM, Ng’ang’a, CJ
Farming practices and risk factors for transmission of helminths of free range pigs in Homabay District, Kenya. Accepted in Livestock Research for Rural Development

**Knowledge products**


5.0 Annexes

Annex 1: Training manual on Taenia solium cysticercosis

TRAINING MANUAL

ON

TAENIA SOLIUM CYSTICERCOSIS/TAENIOSIS

Prepared by

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Annex 2: Poster/pamphlet on *Taenia solium* cysticercosis (Kiswahili and Dholuo versions)
TUOCH MIKELO GI KUTE MILINY TO KOD MIINY MADONGO E I DHAHO TO KOD ANGURU

Gin tounch age mikelo kod miliny?
- Tuq miiny e i angur o tou mikelo gi kute miliny.
- Kute miliny kond o i ring' o, e i adundo kata o ilep toginyalo nen k a matindo tinco.

Anguro kata dhaho yudo tuo ni e i yoo mane?

1. Ti gi choo saache duto mag losruuk mondo wagang' tong njefti mondo kilconak anguro gi joneko.
2. Look tuei mbere gi se bang' losruuk kond o ka
4. Geng' ne anguro e i mondo kiluulcham loa
5. Oono icham ring anguro meoepent keene ayodere ni oongo tus.
6. Chwak ring' e mar a mondo kiluulcham ring' o i mapofa kwar kwar. Man matax mag njefti tees.

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Nyoilok kend o d’goouk xarn Miliny

- Tuq miiny gi miliny (1) galo tong e i losruuk.
- Dhaho bende nyal o yudo tuo ko kagichamo tong' miliny (2). Mano timore lo tamruuk tuoko kata tuo long e i choo kuta kopo ni pl kata aico kuem losruuk mar dhahe.
- Anguro yudo tuo (3) ko kago losruuk mar dhaheo weetong' o tonge mag anguro tong dongo tobehe kute matek to inyalo yade e i ring' o.