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.**

Name and Contact of Principal Investigator (where applicable)

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Date of submission of Report

March 2012

List of Acronyms

AGROBIO	Agri-biodiversity and Biotechnology Programme, ASARECA
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CWGESA	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).

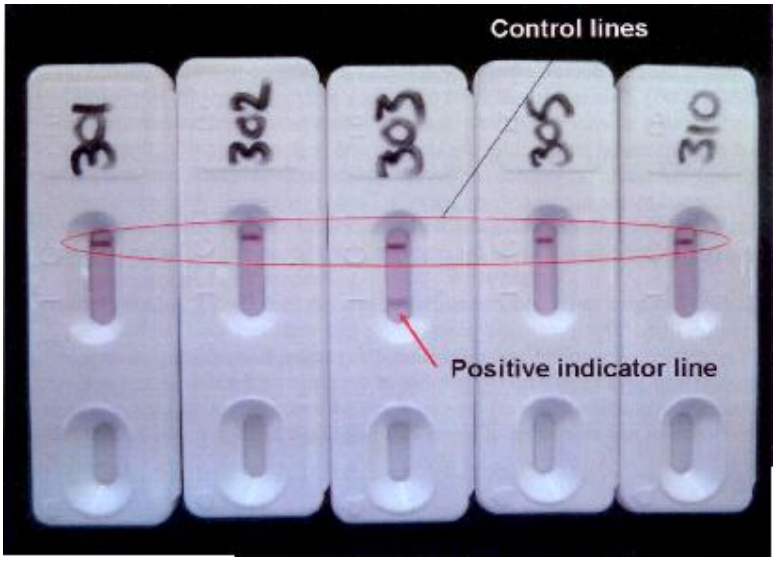

Plate 2 shows the lateral flow assay showing the control line, a negative test result (301, 302,305 and 310) and a strong positive test results (No 303)

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

Plate 4

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.

Plate5: 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

1. Obonyo F O. (2011) Prevalence, intensity and risk factors for helminth and hemoparasites infections in free range pigs in Homabay District, Kenya. MSc Thesis, University of Nairobi University of Nairobi

2. Eshitera, E.E. (2012) Prevalence of porcine cysticercosis and associated risk factors in Homa bay District. MSc Thesis, University of Nairobi

3. Obonyo F O, Maingi N, Githigia S M and Ng'ang'a C J. (2012)**:** Prevalence, intensity and spectrum of helminths of free range pigs in Homabay District, Kenya. Livestock Research for Rural Development. Volume 24, Article #048. Retrieved , from http://www.lrrd.org/lrrd24/03/obon24048.htm

4. Eshitera, E.E., Githigia, S.M., Kitala, P., Thomas, L., Fèvre, E.M., Harrison, L.J.S, Mwihia, E.W., Otieno, R.O, Ojiambo, F. and Maingi, N. (2012). Prevalence of porcine cysticercosis and associated risk factors in Homa Bay District, Kenya. *BioMedical Central Veterinary Research* 2012, 8:234 doi:10.1186/1746-6148-8-234. Article URL http://www.biomedcentral.com/1746-6148/8/234

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

1. Maingi, N. .Saimo, M., Lubega , G., Lekule F.P., Ngowi, H., Sumbu, J. W. , Masiga, C. & Mugoya, C. (2010). Training manual on *Taenia solium* cysticercosis (See Annex 1)

2. Maingi, N. and Obonyo F O. (2010). English, Dholuo and Kiswahili poster and leaflet of Taenia solium cysticercosis (See Annex 2)

5.0 Annexes

Annex 1: Training manual on Taenia solium cysticercosis

TRAINING MANUAL

ON

TAENIA SOLIUM CYSTICERCOSIS/TAENIOSIS

Prepared by

Maingi, N.[a], Saimo, M.[b], Lubega , G.[b], Lekule F.P.[c], Sumbu, J. W.[d], J.M.MASUMU[a]

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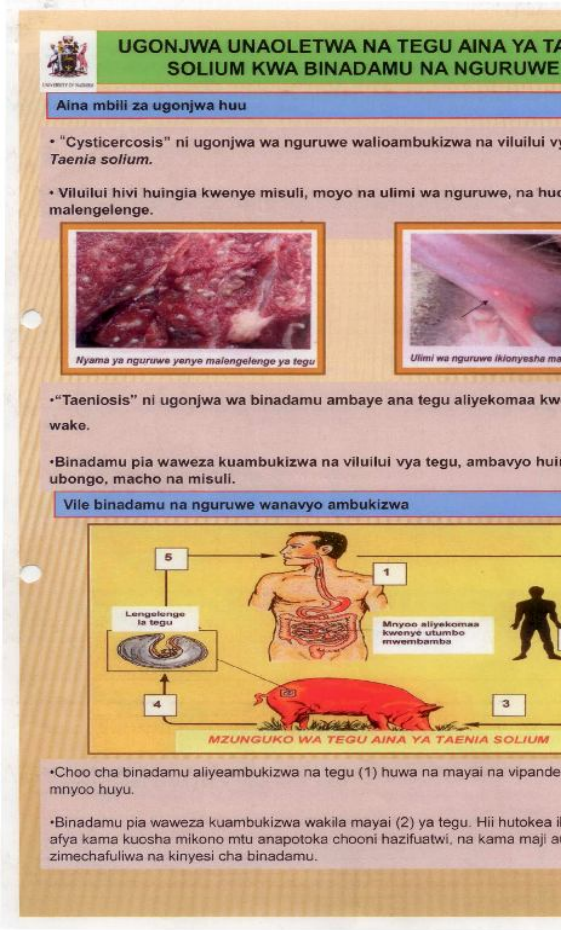
University of Nairobi Makerere University Sokoine University DR Congo

Annex 2: Poster/pamphlet on *Taenia solium* cysticercosis (Kiswahili and Dholuo versions



UGONJWA UNAOLETWA NA TEGU AINA YA TA
SOLIUM KWA BINADAMU NA NGURUWE

Aina mbili za ugonjwa huu

• "Cysticercosis" ni ugonjwa wa nguruwe walioambukizwa na viluilui v
Taenia solium.

• Viluilui hivi huingia kwenye misuli, moyo na ulimi wa nguruwe, na hu
malengelenge.

Nyama ya nguruwe yenye malengelenge ya tegu

Ulimi wa nguruwe ikionyesha ma

•"Taeniosis" ni ugonjwa wa binadamu ambaye ana tegu aliyekomaa kw
wake.

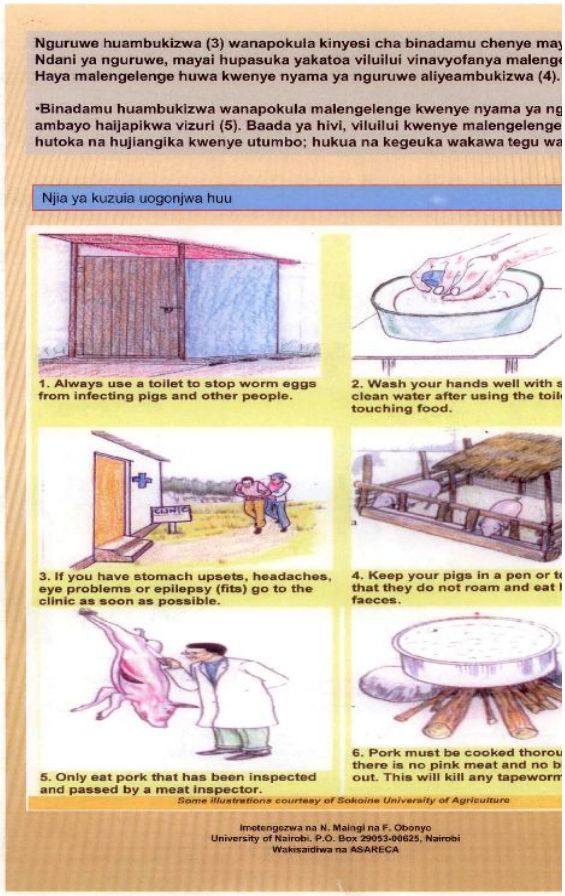
•Binadamu pia waweza kuambukizwa na viluilui vya tegu, ambavyo hui
ubongo, macho na misuli.

Vile binadamu na nguruwe wanavyo ambukizwa

5
1
Lengelenge la tegu
Mnyoo aliyekomaa kwenye utumbo mwembamba
4
3
MZUNGUKO WA TEGU AINA YA TAENIA SOLIUM

•Choo cha binadamu aliyeambukizwa na tegu (1) huwa na mayai na vipande
mnyoo huyu.

•Binadamu pia waweza kuambukizwa wakila mayai (2) ya tegu. Hii hutokea i
afya kama kuosha mikono mtu anapotoka chooni hazifuatwi, na kama maji a
zimechafuliwa na kinyesi cha binadamu.



Nguruwe huambukizwa (3) wanapokula kinyesi cha binadamu chenye may
Ndani ya nguruwe, mayai hupasuka yakatoa viluilui vinavyofanya malenge
Haya malengelenge huwa kwenye nyama ya nguruwe aliyeambukizwa (4).

•Binadamu huambukizwa wanapokula malengelenge kwenye nyama ya ng
ambayo haijapikwa vizuri (5). Baada ya hivi, viluilui kwenye malengelenge
hutoka na hujiangika kwenye utumbo; hukua na kegeuka wakawa tegu wa

Njia ya kuzuia uogonjwa huu

1. Always use a toilet to stop worm eggs from infecting pigs and other people.

2. Wash your hands well with s clean water after using the toil touching food.

3. If you have stomach upsets, headaches, eye problems or epilepsy (fits) go to the clinic as soon as possible.

4. Keep your pigs in a pen or t that they do not roam and eat faeces.

5. Only eat pork that has been inspected and passed by a meat inspector.

6. Pork must be cooked thorou there is no pink meat and no b out. This will kill any tapeworm

Some illustrations courtesy of Sokoine University of Agriculture

Imetengezwa na N. Maingi na F. Obonyo
University of Nairobi. P.O. Box 29053-00625, Nairobi
Wakisaidiwa na ASARECA

TUOCHE MIKELO GI KUTE MILINY TO KOD MI MADONGO E I DHANO TO KOD ANGURO

Gin touché mage mikelo kod miliny?

•Tuo miliny e i anguro en tuo mikelo gi kute miliny.

•Kute miliny pondo e i ring'o,e i adundo kata e ilep toginyalo nenre kak matindo tindo.

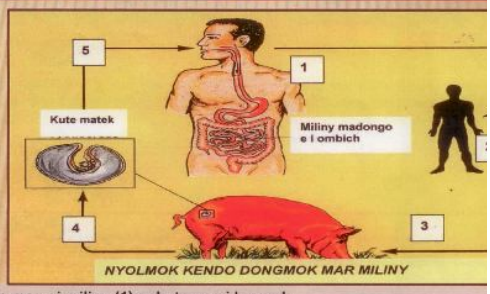
Ring anguro man gi kute matek

Le mar anguro man gi k

•Tuo miliny e i dhano en tuo mikelo gi miliny madongo e i ombich.

•Dhano bende nyalo yudo tuo ni ka kute miliny pondo e i obuongo, wan

Anguro kata dhano yudo tuo ni e i yoo mane?



NYOLMOK KENDO DONGMOK MAR MILINY

•Dhano man gi miliny (1) golo tong e i losruok.

•Dhano bende nyalo yudo tuo kagichamo tong' miliny (2). Mano timore ka tamruok luoko kata lao luedo bang ae e i choo kata kopo ni pi kata alot kuom losruok mar dhano.

•Anguro yudo tuo (3) kochamo losruok mar dhanoo moting'o tonge mag anguro tong dongo tobedo kute matek to inyalo yude e i ring'o.

•Dhano yudo miliny kagichamo kute matek e i ring'o mokotedi maber mooko e i ombich togidongo magibedi miliny madongo.

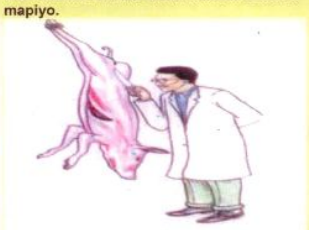
Tuoche gi inyalo geng' e i yoo mane e i anguro kata dhan

1. Ti gi choo saache duto mag losruok mondo wageng' tong njofni mondo kikomak anguro gi jomamoko.

2. Luok lueti maber gi sa bang' losruok kendo kap

3. Kopo ni iwinjo ich kach,wich bar kata tuo mar ndulme dhi kar thieth mondo othiethi mapiyo.

4. Geng' ne anguro e i mondo kikagicham losr



5. Onego icham ring anguro mosepim kendo oyudore ni oongo tuo.

6. Chwak ring'o mar a mondo kikibedie ring'o r mapodi kwar kwar.Manc matek mag njofni tee.

Some illustrations courtesy of Sokoine University of Agriculture

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