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ScienceDirect
The Veterinary Journal 173 (2007) 384–390
The Veterinary Journal
www.elsevier.com/locate/tvjl

Epidemiological aspects and economic impact of bovine theileriosis (East Coast fever) and its control: A preliminary assessment with special reference to Kibaha district, Tanzania

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Abstract

A cross-sectional study based on clinical examination, inspection of herd health records and a questionnaire was designed to determine the epidemiology, economics and potential impact of immunisation against theileriosis in Tanzania. The results showed annual theileriosis costs to be US$ 205.40 per head, whereas the introduction of immunisation reduced this by 40–68% depending on the post immunisation dipping strategy adopted. Morbidity risk due to theileriosis was 0.048 in immunised and 0.235 in non-immunised cattle, and the difference was significant ($\chi^2 = 66.7$; $P = 0.000$). The questionnaire results indicated that immunised cattle had a significantly ($\chi^2 = 6$; $P = 0.015$) higher risk of anaplasmosis compared with non-immunised cattle, whereas the risk of bovine babesiosis did not differ significantly ($\chi^2 = 0.06$; $P = 0.807$) between the two groups. Mortality risk due to anaplasmosis was 0.046 in immunised and 0.018 in non-immunised cattle and this difference was statistically significant ($\chi^2 = 4.48$; $P = 0.043$). The theileriosis mortality risk was 0.203 in the non-immunised cattle, while the risk was 0.009 in the immunised cattle and these differences were also significant ($\chi^2 = 103$; $P = 0.000$). It was concluded that farmers who have immunised their cattle may cautiously cut down acaricide application by 50% for extensively grazed herds and by 75% for zero grazed animals depending on the level of tick challenge at the herd level.

Keywords: Anaplasmosis; Babesiosis; Cost benefit ratio; Infection and treatment method; Net present value; Tick-borne disease; Theileriosis; Tanzania

1. Introduction

Theileriosis caused by *Theileria parva* (also known as East Coast fever or ECF) is the greatest economic limitation to improved dairy production in the coastal regions of Tanzania and causes mortality and performance losses particularly in highly susceptible taurine breeds and their crosses. Farmers are discouraged from upgrading their indigenous cattle owing to the perceived high risk of theileriosis and existing grade cattle are largely raised by heavy reliance on frequent acaricide application. However, this approach has failed to have a major impact on tick control as it is not considered possible to eradicate ticks and tick-borne diseases (Norval, 1983; Young et al., 1988). The selection of acaricide resistant ticks and alternative tick hosts has also provided significant setbacks to the sustainability of this control method (Mukhebi et al., 1992).

The immunisation of cattle against theileriosis by the infection and treatment method (ITM) (Radley, 1978, 1981), offers the prospect of a less costly and more effective control of the disease without continued reliance on expensive acaricides. The resulting immune response (following ITM) coupled with low levels and continuous

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doi:10.1016/j.tvjl.2005.08.013

natural challenge protects the animal for the rest of its life (Mutugi et al., 1989). However, the risk from other tick-borne disease (TBD) such as anaplasmosis and babesiosis limits adoption of reduced tick control practices (TCP) following ITM. The current study was designed to investigate the magnitude of economic damage caused by theileriosis and the epidemiology of the disease after immunisation, and also to assess the potential impact of immunisation as a basis for planning a more widespread application of the technology to smallholder dairy enterprises in Tanzania.

2. Materials and methods

2.1. Study area

The study was carried out in the Kibaha district of the Coast region of Tanzania about 33 km West of Dar es Salaam. The area has a bimodal rainfall pattern; the long rain season is between March and June and short rain between October and December, with an annual average precipitation of 1000 mm. The district has an average temperature of 28 °C. The district has an estimated 20,000 head of cattle (MOA, 2001); improved dairy cattle (predominantly Friesian and Jersey crosses with Tanzanian shorthorn zebu cattle) constitute 3% of the district population (MOA, 2001) and 46.7% and 53.3% of the improved dairy cattle are zero and extensively grazed, respectively.

The close vicinity to Dar es Salaam city provides the district with a growing and reliable demand for milk. However, the district's efforts to improve dairy production are hindered by the persistent tick-borne diseases. Unpublished survey data indicate that, of the overall estimated mortality rate of 22% in grade cattle in the district, theileriosis accounts for 70%. Because of their high susceptibility to TBD, grade cattle are raised with the intensive use of acaricides being treated as often as twice weekly. Although some livestock keepers immunise their cattle against theileriosis using trivalent (*T. parva* Muguga, *T. parva* Kiambu and *T. parva* Serengeti-transformed) stabilate FAO-1 and FAO-2 batches of the vaccine, most continue with intensive dipping, after immunisation.

2.2. Study design

This cross-sectional study was designed to investigate animals on urban/peri-urban based smallholder dairy herds. All such dairy herds in the district formed the population from which study herds were randomly selected. To qualify for inclusion, there had to be an average herd size of $1 \geqslant n \leqslant 15$; availability of TBD morbidity and mortality herd records, and the herd must have had at least one immunized animal.

The following information was used in computing the sample size required. Since we had no prior estimates of the prevalence of clinical theileriosis, an a priori prevalence (P) of clinical theileriosis of 50% was assumed. There was a total (n) of 498 herds listed in the proposed study area; of these, 318 were eligible and the average herd size was estimated to be four animals. A total of 839 animals were investigated. One hundred herds had more than 15 cattle, 50 did not keep records and 30 herds had no immunized animals; these herds were therefore excluded from the study.

The sample size needed was determined as

$n = (Z^2_{\alpha(2)} * PQ)/L^2$ (Thrusfield, 1995),

where $Z_{\alpha(2)} = 1.96$; $P =$ the disease risk; and $Q = 1 - P =$ disease free risk; $L =$ the desired absolute precision level, which was set at 5%.

Thus,

$n = 1.96^2 * 0.50 * 0.50/0.05^2 = 384.16$ animals,

and the number of herds to be sampled was 384.16/4 = 96.04.

Ninety-six dairy cattle clusters were therefore randomly selected; the ultimate sample size depended on the number of eligible animals in the selected herds. The final data set available for analyses included 102 herds with 839 dairy cattle. Eighty-seven percent of the investigated dairy cattle were crossbreds whereas 13% were Tanzanian shorthorn zebu. Of the investigated cattle, 67.10% were immunised. Some 47%, 40% and 13% of the investigated herds practised zero, extensive and semi-intensive grazing, respectively.

Field work was conducted between April and July 2001. Two field procedures were followed in this cross-sectional study providing clinical and data inspection during one herd visit. During the clinical inspection, individual animals were screened to estimate the prevalence of clinical theileriosis. Individual rectal temperature was recorded; a temperature of $\geqslant$39.5 °C in adults ($\geqslant$12 months), and $\geqslant$40 °C in calves ($\leqslant$12 months) were considered as a febrile reaction. Palpation of the pre-scapula lymph nodes (for convenience and logistical reasons, only the right hand pre-scapula lymph nodes were inspected), the sizes were scored as + (normal); ++ (slightly enlarged) and +++ (grossly enlarged). In this study, lymph node enlargement of (+) were defined as having originated from cows free of theileriosis while palpation results of $\geqslant$++ were classified as evidence of theileriosis.

Blood smears and lymph node biopsies were taken only from those animals that were judged as having enlarged lymph nodes to demonstrate the presence of the causing organism. Smears were Giemsa stained and microscopically examined under 40× and 100× oil immersion objectives.

Whole body tick counts of the adult stage of all tick species were carried out. Tick identification was done