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# EFFECT OF STRATEGIC GASTROINTESTINAL NEMATODE CONTROL ON PRODUCTIVITY OF N'DAMA CATTLE IN THE GAMBIA

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*Une étude longitudinale a été entreprise pour mesurer l'effet d'une lutte ciblée contre les nématodoses digestives sur la productivité des bovins N'Dama en élevage villageois. Initialement 1046 animaux dans 26 troupeaux villageois privés ont été observés pendant cinq ans (1990-1994). Chaque troupeau a été stratifié par âge et sexe et les animaux ont été attribués par hasard à deux groupes de traitement. Les troupeaux ont été subdivisés en deux régimes de traitements. Dans les troupeaux du premier régime, les animaux traités (Groupe 1) ont reçu un seul traitement (Panacur™ 7.5 mg/kg BW, Hoechst Veterinär GmbH) en août de chaque année. Dans les troupeaux du second régime, les animaux traités (Groupe 2) ont reçu deux traitements annuels (juillet et septembre). Un groupe dans chaque troupeau servait de contrôle (Groupe 0) et ne recevait aucun traitement. La mortalité moyenne (incidence cumulative) de 0-1 an était plus que deux fois plus élevée chez les animaux deux fois traités (Group 2) comparée à leur contrôle (21 % contre 7.5 %) mais la différence n'était pas significative dans des modèles utilisant la régression du hasard proportionel (proportional hazard regression). Dans les catégories d'animaux plus agées, aucune différence de mortalité n'a été découverte. Le quantile de 25% de l'âge au premier vêlage diminue de 58 mois dans le Groupe 0 contre 50 mois dans le Groupe 2 et les taux annuels de vêlage augmentent de 43.6% dans le Groupe 0 contre 52.2 % dans le Groupe 2. La croissance pondérale est de 8 à 17 % plus élevée dans les animaux de 2 - 4 ans du Groupe 2 en comparaison au Groupe 0. Un seul traitement de fenbendazole n'a pas d'effet sur la croissance et le taux de vêlage.*

## INTRODUCTION

The effects of gastrointestinal helminths on cattle productivity are well known and estimated to be £45 million annually for the UK only (Bain & Urquhart 1986). In Africa such estimations are not available, but losses are expected to be even higher due to poor nutrition, which substantially enhances the pathogenic effect of parasites (Holmes and Coop, 1994). The ultimate goal of parasite control is to improve rural income through better livestock productivity therefore such a scheme needs to be economically beneficial and must meet farmers priorities for scarce input allocation. Therefore, quantitative data on the economic impact of chronic and subclinical helminthosis, with particular reference to parasite gastroenteritis (PGE) in traditionally reared stock is on the top of the agenda for research needs in this field (Chiejina, 1995). The precise knowledge of the biology and seasonality of the parasites and the groups at risk in the various agro-ecological zones are a prerequisite for any economically and epidemiologically sound approach to the control of gastrointestinal parasites. Kaufmann and Pfister (1990) demonstrated, in a post-mortem survey of Gambian N'Dama cattle, that almost all animals carry gastrointestinal nematodes. The worm burdens follow a distinct seasonal pattern with over 80 % of the adult worm burden occurring during the rainy season (June to October). The main species are *Haemonchus contortus, Cooperia spp., Oesophagostomum radiatum* and *Bunostomum phlebotomum.* None, or only very little reinfections occur during the dry season (Ankers et al., 1994). A large scale study was designed to investigate the effects of a strategic treatment of gastrointestinal nematodes on the productivity of N'Dama cattle under village conditions and thereby to evaluate its economic impact. In this paper we present a summary on the productivity results which are used for the profitability analysis of the intervention.

## MATERIAL AND METHODS

The study was conducted in the Central River Division in The Gambia with a savannah woodland type vegetation (Zinsstag et al., 1997). The rainy season extends from June to October with a mean annual rainfall of 600-1200 mm. This is followed by a dry season from mid-October to mid-May. Initially 1046 animals from 26 private N'Dama cattle herds, were monitored in a longitudinal study from October 1989 to December 1994. Each herd was stratified by age and the animals were randomly (sequentially) allocated to two groups with a similar age distribution. One group received a single anthelmintic treatment of fenbendazole (Panacur™ 7.5 mg/kg BW, Hoechst Veterinär GmbH) in October 1989, whereas the other group remained untreated. In July 1990, the herds were subdivided into two different treatment schemes. In the herds of scheme 1, the treated animals (Treatment group I) were treated once (in August), whereas in the herds of scheme 2, the treated animals (Treatment group II) were treated twice (in July and September). The same treatment schedule was used in the subsequent rainy seasons until December 1994, to measure effects of repeated annual treatments on the same animals. One group in every herd of both schemes served as control (Treatment group 0) and received no anthelmintic treatment throughout the study. Every three months all animals were weighed using an electronic weighing scale and checked for gastrointestinal helminth egg excretion. The annual cumulative incidence of mortality rates were computed for the age classes 0-1 year, 1-2 years and >2 years. Product limit estimation and proportional hazard

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regression (Cox's model) were used as another approach to measure survival time (Cox 1972; SAS Institute Inc., 1996). For all animals born during the observation period, non parametric estimates of survival density were obtained ( SAS™ lifetest procedure). Herd and year stratified proportional hazard model included two levels of treatment group (treated, control) two levels of sex (male, female) and two levels of season (Jan to May, June to December) ( SAS™ phreg procedure). Herd stratification was used to account for cluster effects (McDermott et al., 1994) since Cox's model allows only for continuous covariables. Calving rates were devised from a cumulative incidence formula accounting for immigrating and emigrating animals in the denominator. Annual calving rates were subjected to logistic regression (SAS™ logistic procedure) using five levels of year (1990 - 1994), two levels of treatment (control, 2 annual treatments) and 10 levels of herd (1-10). The treatment effect (Treatment group II versus Treatment group 0) was estimated using a likelihood ratio chi-square statistic. The age at first calving was computed for animals born in 1990 and 1991 since none of the animals born in 1992 had calved by the end of the observation period. Age at first calving in days was estimated by the product limit method and proportional hazard regression in the same way as survival data. The following liveweights were used in a general linear model analysis : birth weigths, weights in the age categories 30 to 365 days, 365 to 730 days, and 730 to 1095 days, and at three, four, five and six-and-more years. To determine the effect of the treatments (once treated minus control ; twice treated minus control) linear contrasts (based on type III sum of squares in the SAS™-GLM procedure) were used. By this procedure the difference between the treatments are estimated taking into account all other effects of the model.

## RESULTS

Abortion rates between treatment groups ranged from 1.5 to 6.7 % and differences were statistically not significant. The average annual cumulative incidence mortality between 0-1 year was more than 2 times higher in treated animals compared to their controls (21 % against 7.5 %). No differences were found in older age categories. Survival analysis confirmed differences in mortality from 0-1 year, but were not significant in proportional hazard models. From 39 animals born in the twice treated group (Treatment group II), 14 calved until the end of the observation period, whereas of 44 animals born in the control group (Treatment group 0) only 5 calved. Product limit and proportional hazard estimates of age at first calving were significantly different between these groups (likelihood Chi2 $p<0.05$). Since median values for the control group where not estimable, the 25% quantiles of age at first calving was used to quantify differences between twice treated animals (50.2 month) and its controls (58.3 month). This represents a decrease of age at first calving in twice dewormed animals of approximately 8 months. No difference of age at first calving was found between one annual treatment and its controls. Predicted annual calving rates of twice treated animals were 52.2 % compared to 43.6 % in the control group ($p < 0.001$), which is an increase of 8.6 % to the rate of the control group. One annual fenbendazole treatment had no significant effect on liveweights, whereas two annual treatments significantly increase liveweights of the age group 12-24/24-36 months by 9.4 %, and 17.5 % respectively. Average weights of three and four year old, twice treated animals are 13.1 % and 8.2 % higher compared to their controls. No effect of anthelminthic treatment on liveweights was found in five years and older animals.

## DISCUSSION

The increase in mortality rates of dewormed calves (0-1 year) compared to their untreated controls, is in contrast to the existing literature (Hörchner et al., 1987; Srikitijakarn et al., 1987. Chartier et al., 1991). Fenbendazole at therapeutic dose has a very low acute toxicity and is not known to cause mortalities (Wiesner, 1993; Stammberger et al., 1993). However Ungemach in (Wiesner, 1993) reports that the whole class of benzimidazoles has embryotoxic properties. Embryotoxicity is reported for fenbendazole in cattle at 22.5 mg/kg body weight which is three times higher than the dose used in this study (Stammberger et al., 1993). Differences in mortality in this age period have serious consequences on cattle production because it leads also to loss in herd lactation yield, as the presence of the calf is required for the milk let down. From a parasitological perspective it is not assumed that gastrointestinal nematodes are a direct or indirect cause of the mortality difference between the treatment groups in this study. In the present experiment a strategic control of gastrointestinal nematode infections did not decrease mortality of cattle from 0-4 years of age. The results suggest a positive effect of strategic gastrointestinal parasite control on the age at first calving and the calving rate. However, more data is needed to confirm the effect on age at first calving. Growth curves of treated young male and female cattle diverted earlier compared to their untreated controls. This indicates an earlier age at puberty in dewormed heifers, which is confirmed by the present results on age at first calving. In this study the parameter 'liveweight' was chosen instead of the 'weight gain' to emphasize the effect of deworming on a whole, traditionally managed, cattle herd in view of an economic analysis. A main result is the demonstration of a ' carry over' effect which reflects the cumulation of weight gains in repeatedly treated animals. The liveweight improvements between one and four years reported here, tally with parasitological data by Kaufmann and Pfister (1990). The study design, dividing herds in treated and untreated animals certainly influenced recontamination. A cluster design, though more difficult to interpret, would probably have shown even better results on liveweights. Graber et al. (1968) recommend treatments at the beginning and end of the dry season. A treatment at the end of the dry season is however unnecessary in the study area after a larvicidal treatment at the beginning of the dry season. Gastrointestinal helminthosis harms mainly growing cattle. It is, together with trypanosomosis and malnutrition a main factor affecting cattle production in this climatic zone. Strategic metaphylaxis prevents a slowdown of growth in infected animals up to 4 years. For traditionally managed cattle in the savana with a unimodal rainfall pattern (600-1200 mm/year) we therefore recommend two treatments of one to four year old animals during the rainy season, at the end of July and mid of September, provided that the financial analysis demonstrates the profitability of this intervention. On the village level, metaphylactic treatment is often impeded by lack of drugs. Moreover, during the rainy season farmers are unable to spend much on farm inputs. Under these circumstances it is very important to assess precisely the target group and to disseminate the appropriate treatment scheme through extension services and training of young farmers.


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