Variation in the rate of infection of cattle by *Trypanosoma spp.* in the sub-humid zone of Mali

ABSTRACT

In sub-Saharan Africa, livestock farming in general, and cattle farming in particular, is a source of income for many people. This activity tends to intensify in urban and peri-urban areas. Like many other livestock-raising countries, Mali faces several constraints, including African Animal Trypanosomiasis (AAT), which affects herd productivity and thus threatens food security. Several factors can influence the transmission of this disease, including the host-parasite-vector relationship, animal phenotypes, and climate. In Mali, the susceptibility of cattle breeds to trypanosome infection has been poorly documented. This study was aimed to determine the factors influencing the transmission of AAT in the sub-humid zone of Mali. Bi-seasonal sampling was carried out in 2011 on 720 cattle taken in a stratified and random fashion. Blood samples were taken from the jugular vein and the WOO diagnostic technique was used. Factors such as phenotype, season, prophylactic treatment, and infection rate were considered. The results showed that among these variance factors, phenotype, prophylactic treatment, and haematocrit level were positively correlated with the infection rate of cattle ($P<0.05\%$). The variation in the infection rate recorded during the different seasons was not significant ($P>0.05\%$).

Keywords: Season, Seroprevalence, Trypanosomiasis, cattle, haematocrit rate

INTRODUCTION

In many tsetse-infested countries, trypanosomiasis is one of the infectious diseases that cause most damage to animals (Houndjeet al., 2024) and is described as one of the main health constraints to livestock farming (Vreysenet al., 2013). These authors estimate that some 20,000 to 25,000 animals are exposed to the risk of the disease every year, with the risk of a persistent epidemic. While in some countries the situation is under control, in others the epidemic is spreading, with prevalence levels often very high (Traoréet al., 2024). The outbreaks of tsetse fly diseases are highly diversified across countries. This diversification is linked to favourable epidemiological conditions such as the presence of tsetse flies, food hosts, and/or trypanosome strains (Bouyer, 2015). In Savannah, due to the behaviour of anthropophilic tsetse flies, the disease overlaps with the network of forest galleries, whereas its distribution is much more diffuse in the forest. Trypanosomiasis is a vector-borne disease whose presence and transmission depend on three main factors: the parasite (trypanosome), the vector (tsetse fly) and the host (vertebrate). In addition to these factors, the risk of transmission can be accentuated by other factors including climate, the phenotype of the animals, access to food and even socio-economic conditions. The rural populations who live in this environment, and on whom they depend for farming, fishing, livestock rearing or hunting, are the most exposed to the bites of the disease.

AAT strikes in areas where health systems are most deficient or non-existent. Socio-economic factors such as political instability, population displacement, war and poverty favor its spread. In Mali, tsetse flies are present in four regions, from the center to the south, at varying densities (Traoréet al., 2024). It is estimated that around 2.7 million cattle and 2.5 million humans are at risk from the disease, resulting in the loss of 500,000 tonnes of meat and 1 million liters of milk (Djiteyeet al., 1997). In 2004, high mortality rates (40%) due to AAT were observed in plough oxen in the south of the country (Sikasso, Bougouni, Kadiolo), resulting in a loss of productivity for the animals and a reduction in agricultural yields. The peri-urban area of Bamako, crossed by the Niger River basin and including the communes of Mandé, Tienfala, and Baguinéda, is recognised as a priority for the fight against AAT because of its great agro-pastoral potential. This part of the area is Bamako's dairy belt, supplying the Bamako district with market garden produce and dairy products. Semi-intensive livestock farming is on the increase in Mali's sub-humid zone, enabling farmers to keep several different breeds. Very little has been documented about the susceptibility of these breeds to trypanosome infections. Increasingly severe food shortages are forcing many farmers to move seasonally, even in tsetse-free areas. According to Bauer et al. (1988), environmental changes and the effects of man on the environment can also increase the transmission of the disease. This study aimed to evaluate the seasonal fluctuation of AAT and its variation according to the main breeds of cattle reared in the sub-humid zone of Mali to contribute to the strategic control of the disease.

MATERIALS AND METHODS

Study area

The study was carried out on cattle in the municipalities of Tienfala, Baguinéda, Mandé (Koulikoro region), and the district of Bamako in 2011. In the Koulikoro region, the invertebrate fauna is very rich in insects of medical, veterinary, and agricultural interest (*Muscidae*, *Culicidae,* and *Simuliidae*). The fodder potential is characterised by a carpet of grasses dominated by *Loudetiatogoensis* on leathery soils, *Andropogonpseudopricus* on hydromorphic plains, and *Schoenefelddiagracilis* on rocky soils. Annual rainfall in the region can reach 990 mm^3 (Traoré, 2024). In general, relative humidity varies between 40 and 60%, with an average humidity of 81% in August (ANMM 2021). There is a wide range of plant formations that favours the proliferation of tsetse flies, the biological vectors of AATs. The district of Bamako has a humid tropical climate, with a total annual rainfall of 878 millimeters, with a marked dry season and rainy season. The vegetation is of the Savannah-Sudan type. The choice of these sites was motivated by the fact that several animals are found in Bamako and the existence of several cattle breeds in the municipalities of Mandé, Tienfala, and Baguinéda (Traoréet al., 2025).

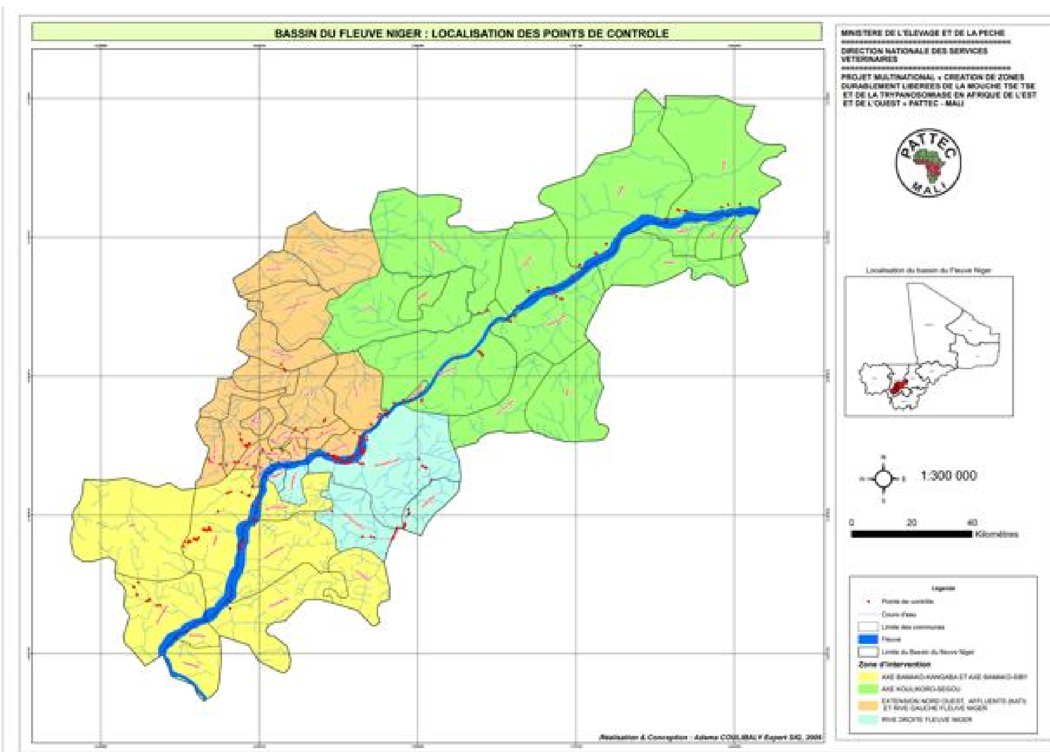

Figure 1: Location of the study area (source, PATTEC-Mali, 2007)

Parasitological survey and analysis

A bi-quarterly cross-sectional survey was carried out from March to December 2011 at the sites. In each site, three parks were selected within a 15 km radius. The choice of pens was a reasoned and stratified (two private pens and one collective pen) for each new visit. However, the choice of cattle was random. On average, around 120 cattle were sampled at the jugular vein per visit, i.e. around thirty cattle per commune. The blood was collected in Vacutainer tubes, each containing an anticoagulant. Information such as sex, age, breed, trypanocidal treatment received or not, transhumant or sedentary was recorded. The method of Murray (1997) was used to examine the Buffy coat after differential centrifugation in capillary tubes for trypanosomes and to determine the haematocrit level. The degree of anaemia was assessed by the haematocrit value.

Data analysis

The data collected were entered into Excel version 2007, which was used to determine parameters such as frequencies, percentages and means of the variables. Statistical analyses were performed using R software (R version 4.4.2, http://www.r-project.org); Bartlett's Chi2 test was used to compare variances at the 5% level of significance.

RESULTS AND DISCUSSION

A total of 720 cattle of different breeds were sampled during the six visits in 2011. The number of cattle sampled, and the breeds encountered varied from one locality to another with a probability of P=0.00 (Table 1).

Table 1: Distribution of samples by breed and by locality

Breed	Sample size by locality				
	Tienfala	Baguinéda	District	Mandé	Total
Zebu	24	91	91	24	230
Metis	66	89	93	70	318
Mere	79	0	0	79	158
Others	7	0	0	7	14
Total	176	180	184	180	720
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Surveys of farmers revealed that less than half (32.8%) of cattle had been treated with a trypanocidal product in the three months preceding the surveys, compared with 67.2% of those who had not been treated. In Bamako, 72.83% had been treated, compared with 38.64% in Tienfala, 27.78% in Baguinéda and 37.78% in the commune of Mandé. The infection rate obtained was higher in untreated subjects (70.68%) than in those who had been treated (29.31%).

Variation in infection rate according to season

A non-significant variation in the infection rate was obtained during the different seasons (P>0.05). It was 8.75% in the cold dry season, 9.16% in the rainy season and 6.36% in the hot dry season (Figure 2).

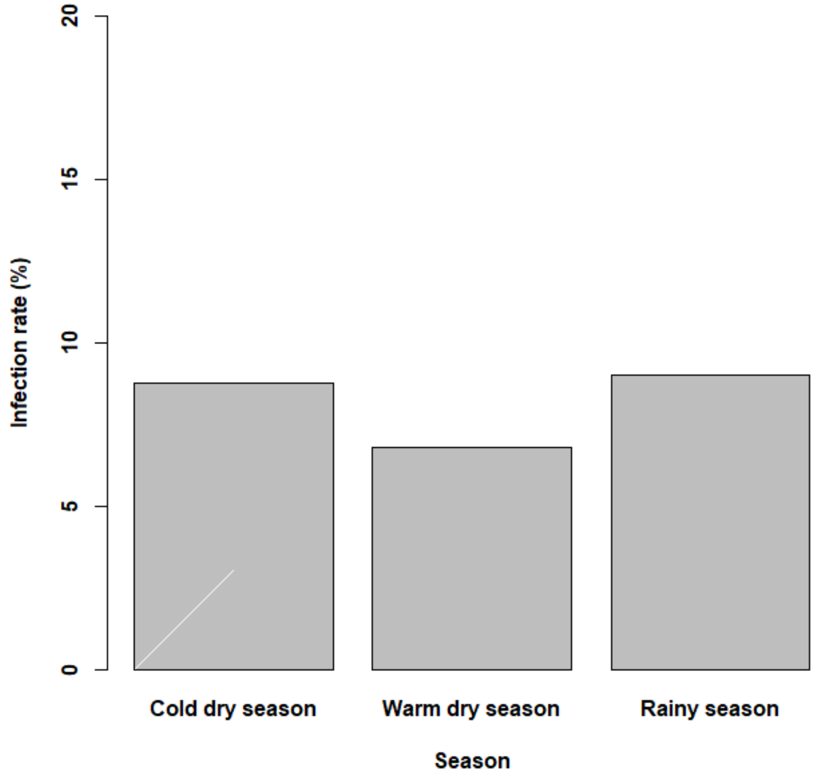

Figure 2: Variation in seroprevalence according to season

This non-significant difference could be explained by the behaviour of the animals, which did not vary according to the season. Host-parasite-vector interaction was infrequent. These results are similar to those of Bengaly et al. (2001) in Burkina Faso, who obtained different but non-significant seroprevalence during three periods of the year, ranging from 33.5% and 41.7% during the rainy season to 71% during the dry season.

Variation in infection rate by cattle breed

The infection rate was highest in Zebu cattle (34.48%). Among Meres and Metis from Zebu x exotic breed crosses, seroprevalences were 31.03%. For the other breeds, the infection rate was 3.44% (Figure 3).

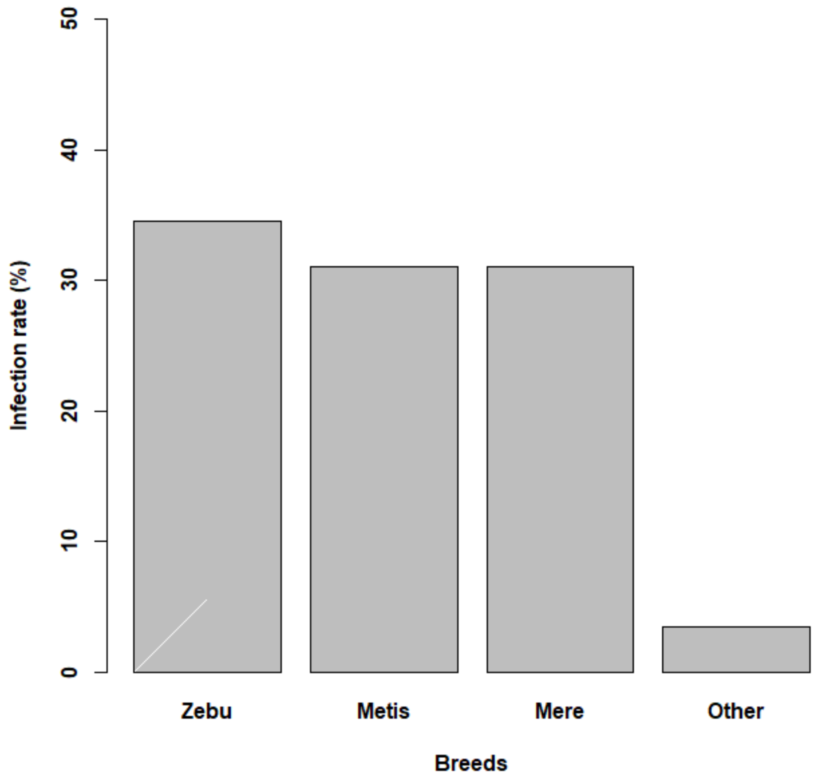

Figure 3: Variation in seroprevalence according to cattle breed

Statistical analysis shows that the difference obtained was not significant (p = 0.12). However, with regard to the intra-phenotypic infection rate, the infection rate was higher for breeds with a mixed phenotype (11.39%). It was 8.69% for zebu and 5.66% for mixed breeds with a probability of P<0.05%. These results suggest that the Mérés were more susceptible than the other phenotypes in this study. These prevalence rates are lower than those obtained by Facourou et al. (2012), who found that cross-bred zebus were more susceptible to trypanosomiasis infections with a prevalence of 15.6%, showing that phenotypes can be a factor in susceptibility. In southern Mali, it is the N'Dama phenotypes that are known to be trypanoresistant. Yao et al. (2009) reported that phenotype may be one of the factors influencing variation in trypanosome infection rates. Diaf (2009), in a study carried out in Senegal, showed that zebus are much more preferred by agro-breeders because 'this breed represents a good compromise between aesthetics, productivity and hardiness', whereas it is rather crossbreds that are preferentially chosen by agro-breeders and dairy farmers for their milk production (Bouyeret al., 2009).

Variation in haematocrit level according to season

Most of the animals diagnosed (512/720), i.e. 71.11%, had a higher haematocrit level (PCV>25) compared with 202 animals with a low haematocrit level. Analysis of the data indicated that the difference observed was highly significant (P=0.00) (Figure 4). The variation in haematocrit level was not only due to the health status of the animals but also to the different diets available during the different seasons and to trypanocidaltreatment. These confirm the results obtained during this study, 168 cattle were anaemic with respectively 78/168 in the dry season against 58/168 in the rainy season and 28/168 in the cold dry season. The animals found sufficient food, especially during the winter and cold dry seasons, when food resources were much more available. It should also be noted that most livestock farmers in the study area practise semi-intensive livestock rearing; they are obliged to feed their herds sufficiently for better productivity. According to Meyer et al. (1999), animal productivity performance depends on compliance with a specific diet. CUQ et al. (1977) showed a decreasing variation in haematocrit levels in cattle over the seasons: 38.0 towards the end of winter, then 37.0 and 36.0 respectively in spring and the rainy season (P>0.5%).

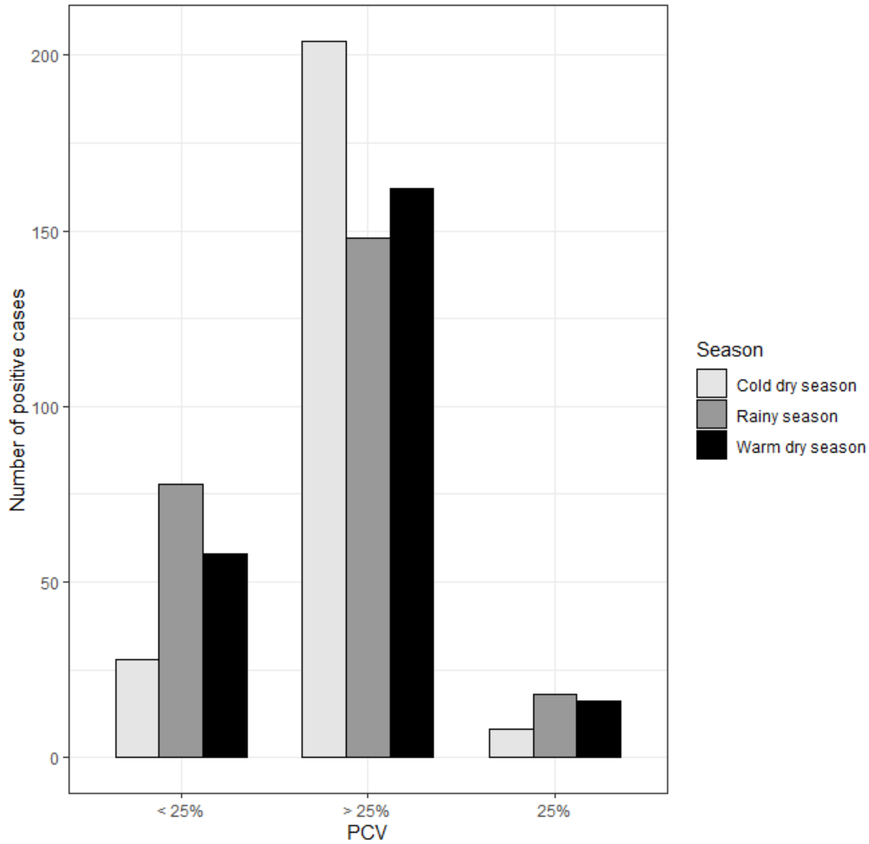

Figure 4: Seasonal variation in haematocrit levels

The haematocrit level varied significantly (P=0.00) according to the different phenotypes, with 44.34% (102/164) of the zebus suffering from anaemia (PCV<25) whereas in the mestizo and mere, it was 5.66% and 27.84% respectively (figure 5). The lowest haematocrit level was 11% and the highest was around 45% (P<0.05%). 22.7% of all animals had a PCV of less than 25% compared with 71.3% of those with a PCV of more than 25%. Of the infected animals, 11.51% had low VCP while 81.03% had VCP > 25% (P=0.24%). This result shows that the health status of the animals and food can be considered acceptable. In cattle, 25% is the optimal average haematocrit level. Below this value, the animal is considered anaemic and suspected for parasitic infections. This confirms our results and those of Tanenbéet al. (2010). Analysis of our results reveals that 94.51% of the animals detected as positive had a PCV < 25, compared with 9.14% of those detected as positive but with a PCV > 25%. Tanenbeand colleagues in 2010, in Cameroon, stated that 12.7% of the animals surveyed had a PCV≤ 25% (n=349) among which 79% were affected by *Trypanosoma Sp*. Analysis of the data showed that treatment and seasons can significantly influence haematocrit levels.

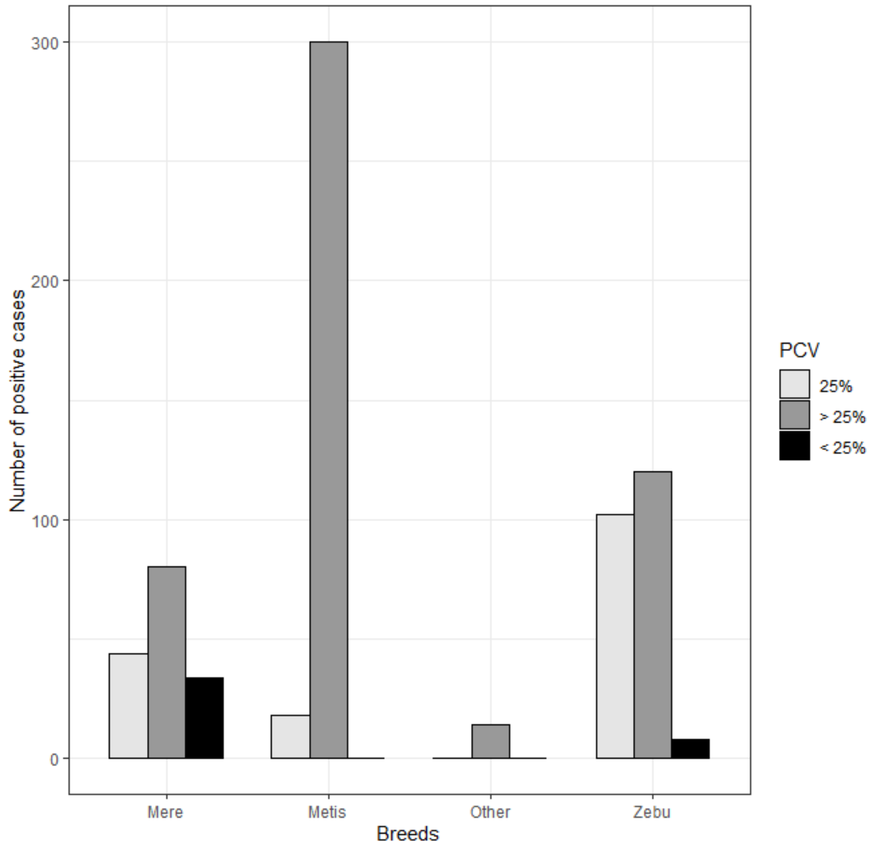

Figure 5: Variation in haematocrit rate as a function of phenotype

Of the variance factors selected, only phenotype and haematocrit rateaffected the variation in the rate of infestation of cattle by trypanosomes. Bengaly et al.(1998), also showed that, in addition to locality and management zone, the phenotype of the animals can have a considerable effect on the prevalence of AAT.

Vegetation cover, climate, temperature, the feeding host, and relative humidity are the factors that have the greatest influence on the dynamics of tsetse flies and consequently on the transmission of the disease (Atrevy, 1978). The relatively high prevalence in the communes of Mandé and Tienfala can be explained by climatic conditions that favour the proliferation of tsetse flies, the biological vectors of AAT (Figure 6). The climate in the commune of Tienfala (Koulikoro region) is fairly humid tropical, with an average annual rainfall of 990 mm^3 (Traoré, 2024). The savannah-Sudan and pre-Guinean vegetation in the commune of Mandé provides a favourable living environment for tsetse flies, with varying densities (Traoréet al*.,* 2024). The zero prevalence in Bamako may because the animals are sedentary, and the vector-parasite-host relationship is very weak. Animals transiting through the area are in most cases directed towards the peripheral zone (Tienfala, Baguinéda).

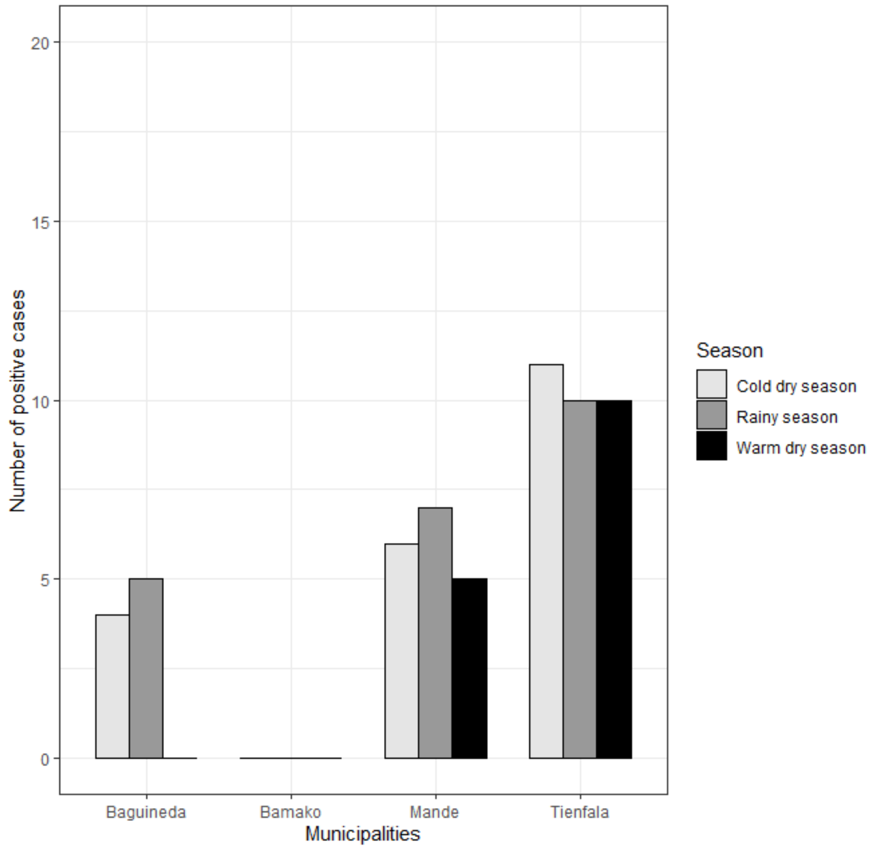

Figure 6: Variation in infection rates according to locality

CONCLUSION

Assessment of the AAT infection rate in cattle showed that transmission of the disease can be influenced by breed and the treatment administered. Despite farmers' preference for zebus and cross-bred zebus x exotic breeds for their stoutness and productivity, they are more susceptible to *Trypanosoma spp.* disease.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

CONSENT AND ETHICAL APPROVAL

The study protocol was approved by the institutional ethics committee of the Faculty of Science and Technology (FST). Informed, voluntary consent was obtained from all owners. All measures were taken to minimize the risks associated with participation in the study.

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