

Tsetse and Trypanosomoses in Ghana in the Twentieth Century: a Review

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Key words

Glossina – Livestock –
Trypanosomosis – Distribution –
Control method – Ghana.

Summary

African animal trypanosomosis, transmitted by tsetse flies (*Glossina* spp.) is a major constraint limiting the optimal utilization of land for agricultural production in tsetse-infested areas of Ghana. In the last 50 years various workers have made attempts at mapping the distribution of tsetse flies and the disease they transmit with a view to instituting appropriate control measures. Due to the increasing human population and agricultural expansion, there has been a retreat of the *morsitans* group of tsetse flies into protected areas. From the standpoint of livestock production, therefore, members of the *palpalis* group remain the most important vectors of trypanosomosis as they are able to persist even in areas of intense land use. The optimal exploitation of trypanotolerance as a means of trypanosomosis control is hampered by increased crossbreeding with trypanosusceptible breeds. Although the incidence of sleeping sickness has decreased drastically over the last decades, the current status of the disease has not been investigated. This paper takes a retrospective look at the problem of tsetse and trypanosomosis in Ghana, assesses the current disease situation and highlights some research perspectives that are relevant to the sustainable control of the disease.

INTRODUCTION

The optimal utilization of land for agricultural production in low-input systems, which is the predominant system of production in Ghana, should entail the holistic removal of constraints that impede livestock production. These constraints include poor management practices, inadequate nutrition during the dry season, livestock diseases, and lack of access to farm credit (1). Although epidemic diseases such as anthrax and rinderpest have been controlled through rigorous annual vaccinations, parasitic diseases continue to

cause significant but insidious production losses. The parasitic disease of major economic importance is animal trypanosomosis transmitted by the tsetse fly (*Glossina* spp.). Gyening (9) observed that the density of livestock, especially cattle, is inversely proportional to the trypanosomosis challenge and that in high challenge areas there is the virtual exclusion of the keeping of zebu cattle, horses and donkeys. Early attempts to control tsetse flies were aimed primarily at reducing the prevalence of sleeping sickness (13). In an effort to improve the West African Shorthorn breed of cattle through a breeding program that involved crossbreeding with the zebu, Stewart (25) established a breeding station at Pong Tamale in Northern Ghana. Since trypanosusceptible breeds were involved in the program, it was deemed necessary to reduce the risk of trypanosomosis through the suppression of tsetse populations along the Nabogu river. Over the years, this ad-hoc approach has gradually changed to one in which trypanosomosis control was undertaken as an integral part of agricultural development. The purpose of this paper was to review the problem of trypanosomosis in Ghana with a view to highlighting the importance of the disease with regard to agricultural development.

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It seeks also to propose measures that could be taken, especially in the area of research, to promote sustainable livestock production in tsetse-infested areas of the country using existing options for the control of tsetse and trypanosomoses.

■ TSETSE SPECIES DISTRIBUTION

The first attempt at field research on the distribution of tsetse flies (24) showed the presence of the following economically important species: *Glossina palpalis* s.l., *G. tachinoides*, *G. morsitans* s.l. and *G. longipalpis*. A more comprehensive description of the occurrence of these species according to vegetation types and climate was given by Nash (16). In surveys conducted in the drier parts of the country it was found that where *G. palpalis* s.l. and *G. tachinoides* coexisted, *G. palpalis* formed only a small percentage of the tsetse flies. *G. longipalpis* and *G. morsitans* s.l. were associated with game animals in open woodland savanna. Based on the records of other workers and some investigations of his own, Offori (17) prepared a map that showed *G. longipalpis* as occurring in the transitional forest zone, while *G. fusca*, *G. nigrofusca*, *G. tabaniformis* and *G. medicorum* were shown as occurring in the forest zone. During the period between 1978 and 1983 tsetse surveys were carried out to determine the distribution of tsetse flies in the northern half of the country between latitude 8°N and 11°N (6). At various times between 1983 and 2000 other tsetse surveys were conducted in the coastal and derived savanna zones by the Tsetse and Trypanosomiasis Control Unit (TTCU) of the Veterinary Services of Ghana (27, 29, 30). A composite map (Figure 1) shows the results of tsetse surveys carried out between 1978 and 2000. The map also shows the distribution of the *fusca* group of tsetse flies as reported by Offori (17).

The surveys confirmed the presence of *G. tachinoides* along the fringing vegetation of watercourses between latitudes 8°N and 11°N. The species was only absent in areas where fringing riverine vegetation was completely obliterated. In areas where *G. palpalis* was found to coexist with *G. tachinoides*, the former occurred in much smaller numbers. *G. palpalis gambiensis* was absent at the upper limits of the White Volta (beyond latitude 10° 15'), where the fringing vegetation was abundant but had no closed canopy. In Northern Ghana, *G. morsitans submorsitans* was found only in the Mole, Wabahu and Bui game parks and their immediate vicinity, and in the Brong Ahafo Region, only in the game park of Sene District. The retreat of *G. morsitans submorsitans* into protected areas is associated with the extermination of game animals and agricultural expansion as observed by Reid et al. (20).

■ PREVALENCE OF TRYPANOSOMOSES

Early workers in trypanosomosis surveillance and control (13, 14, 32) focused on developing effective methods for the control of human African trypanosomoses through a better understanding of tsetse ecology. The first British veterinarian in Ghana, W.P.B. Beal, in an unpublished report in 1909, testified to the widespread occurrence of trypanosomoses in cattle, sheep and horses across the country. The occurrence of pathogenic trypanosomes (*Trypanosoma vivax*, *T. congolense* and *T. brucei*) in cattle trekking from Northern Ghana to the Southern markets of Ghana was described by Pomeroy and Morris (19). Infection in cattle was found to vary from 0%, at the point of departure in the tsetse-free area of Pusiga in the North, to 60% at the Yeji and Kumasi cattle markets, the animals having been infected en route by contact with *G. morsitans submorsitans* and *G. palpalis* s.l. This wide variation in the prevalence of trypanosomoses is still a major feature of the epidemiology of the disease in Ghana and is

consistent with the correlation between tsetse apparent density and the risk of trypanosomoses described by Rogers (23). Trypanosomosis surveys, carried out using the buffy coat technique (15) in various parts of the country between 1995 and 2001, showed the prevalence of the disease to range from 5% in the low risk areas, such as the Dangme West and Nanton Districts, to about 50% in the high risk areas, such as the West Mamprusi and Damango Districts (28). The prevalence of the disease in the coastal savanna is higher in Dangme East than in Dangme West. In the latter district, riverine vegetation is virtually non-existent. Figure 2 depicts the mean prevalence of bovine trypanosomoses in Ghana at the district level. It is not possible to make a categorical statement on the evolution of the prevalence of trypanosomoses in the last century because it is not a routine practice of the Veterinary Services Department to perform annual nation-wide

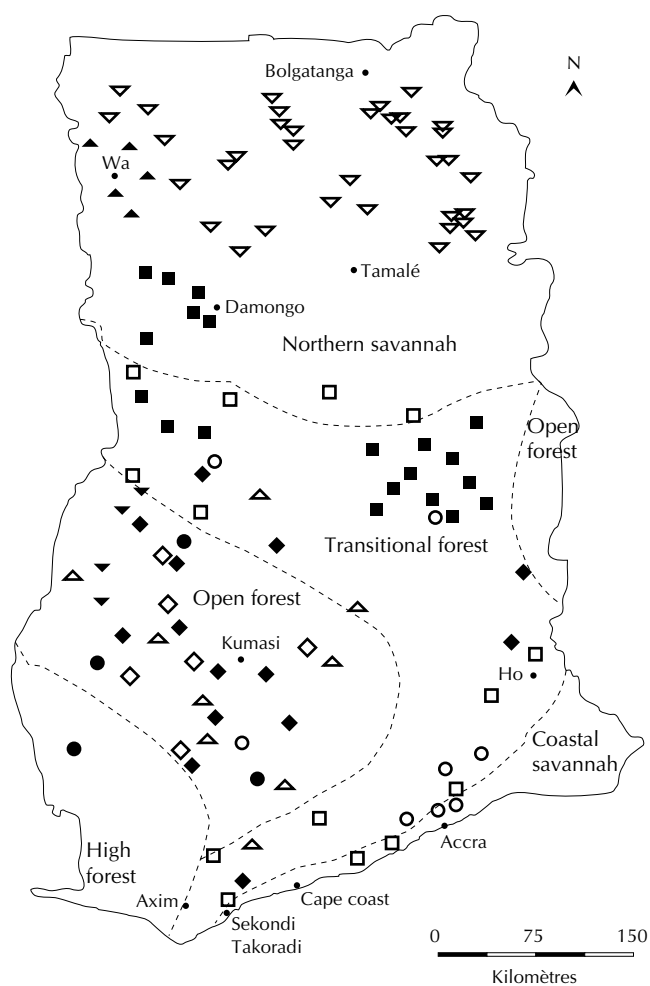


Figure 1: Tsetse distribution in Ghana.

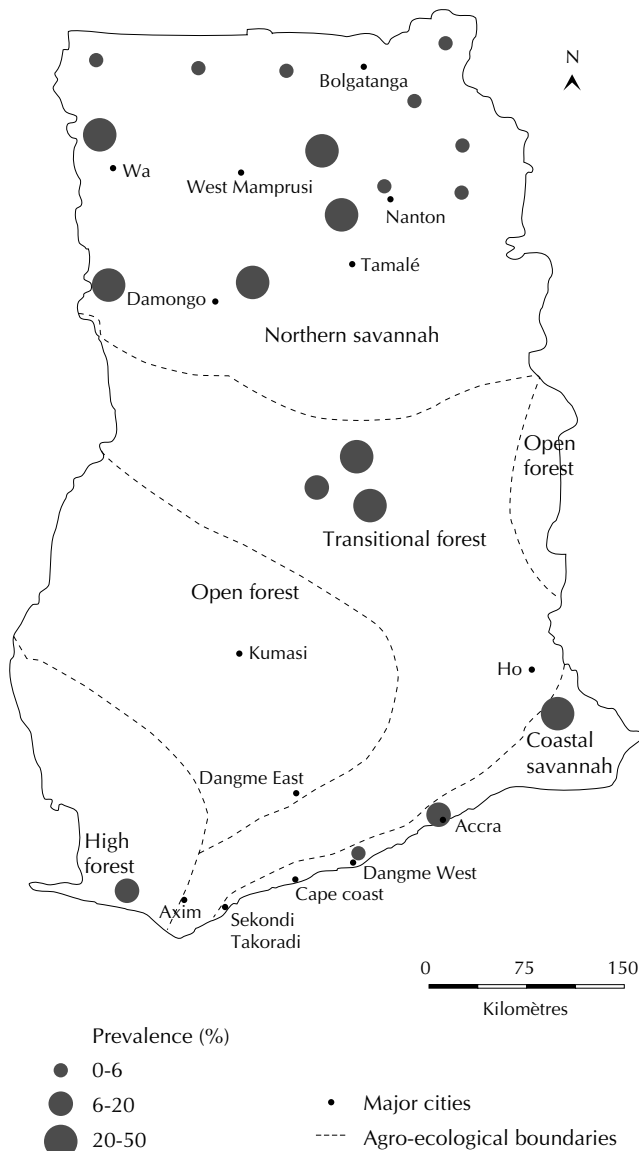


Figure 2: Prevalence of bovine trypanosomoses in Ghana (based on the buffy coat technique).

surveys. Notwithstanding this lapse, some general statements based on field observations can be made. The prevalence of trypanosomoses has declined appreciably in urban and suburban areas where the *morsitans* group of flies has disappeared and the livestock has no contact with riverine tsetse flies. In rural areas, where livestock is highly dependent on rivers for water and where riverine tsetse flies are found, trypanosomoses continue to be a major problem (6). The results of a comparative study using the buffy coat and PCR techniques in the Savelugu and West Mamprusi Districts of Northern Ghana (Mahama, unpubl. results) showed that the prevalence of bovine trypanosomoses was lower in the former (8 vs 16%), where intensive land use in close proximity to riverine vegetation has obliterated tsetse habitat. Outbreaks of bovine trypanosomoses, where entire immigrant herds were decimated in a matter of months (Abavana, pers. commun., 2002), have been reported; the herds had been brought from the tsetse-free areas of Accra plains to the high trypanosome challenge areas of the Brong Ahafo Region (Sene District).

With regard to sleeping sickness, epidemics occurred in the 1940s (13, 14). These were reported in the town of Lawra where the hospital recorded over 1200 cases of sleeping sickness in a population of 40,000 people. Other foci of sleeping sickness,

where an infection rate of about 5% was reported, included Kintampo, in the middle belt of the country, Tumu, Wa, Gambaga and Yendi of the Northern territories. Perhaps because of the slow nature of the sleeping sickness caused by a *T. brucei gambiense* infection, mortality rates were not reported. The prevalence was reduced to less than 10% of the original level following the rigorous application of control methods, which included selective bush clearing and chemotherapy.

Following the successful control of the epidemics that occurred in the 1940s, no systematic surveys have been carried out on a national scale to ascertain the true status of the disease in Ghana. A terminal case of sleeping sickness in a student of Komenda College was reported at the Effia-Nkwanta Hospital, in Takoradi, Western region of Ghana (Director of Medical Services, Takoradi, pers. commun., 1995). The Western region is contiguous with Côte d'Ivoire and there is speculation that cases of sleeping sickness in this region occur in people who have worked in plantations known to be foci of the disease in Côte d'Ivoire.

■ TRYPANOSOMOSIS CONTROL

The ultimate aim of the control of trypanosomoses is to ensure that livestock are viably productive in tsetse-infested areas. Approaches that could be used to achieve this aim include the control of tsetse populations (12), use of drugs (18) and rearing of trypanotolerant livestock (5) or a combination of these (11).

Vector control

Pioneering work in tsetse control mainly involved the drastic alteration of the tsetse habitat, by the selective removal of vegetation types that were associated with tsetse survival. Such clearings were carried out on a massive scale in the Nabogu Valley of the Northern region (25), and in Lawra, along the river Kamba (13). Trials were also carried out in the Upper West region on the possible control of tsetse flies using various trap designs (14). There were unpublished reports of limited game destruction as a means of controlling tsetse flies. In view of the negative environmental impact of these methods, they were abandoned in the early 1950s. It was not until 1996 that a community-based tsetse control project involving the use of deltamethrin-impregnated blue screens was carried out in the coastal savanna. About 600 deltamethrin-impregnated blue screens and 200 deltamethrin-impregnated traps were deployed in the Lower Volta river basin drainage network (27). In the same exercise, about 500 cattle were topically treated with deltamethrin "pour on". Within three months of the application of these methods, the tsetse population was reduced by 98%. The method proved highly effective but could not be sustained because community enthusiasm waned as a result of the false perception that the tsetse fly menace no longer existed.

Large-scale community-based vector control operations, involving the use of insecticide-impregnated traps and screens as well as the use of pour ons, are expected to commence by 2004 in priority areas as part of the activities of the Tsetse and Trypanosomiasis Control Unit.

Chemotherapy

The use of prophylactic and curative drugs has remained the most popular method for the management of animal trypanosomoses from the late 1950s to date (28). It is regrettable that no systematic investigation has ever been conducted in the country to quantify the utilization of trypanocides. A number of problems are encountered when an attempt is made to evaluate the use of

trypanocides. Firstly, because of liberalized trade, it is virtually impossible to monitor the inflow of trypanocides into the country. Secondly, there is no mechanism in place to monitor the movement of drugs from the point of distribution to the end user. Due to the lack of diagnostic services at the rural level, it is estimated that in more than 90% of cases, the use of trypanocides is not based on a parasitological diagnosis; it is thus difficult to estimate how many confirmed cases of trypanosomoses are treated per year. For the purpose of this review, however, it can be stated that there are more than 51 registered pharmacies located in 13 major towns and cities. Several other unregistered pharmacies deal in the trypanocide trade. It is estimated that more than US\$ 300,000 worth of trypanocides (Diminazene and isometamidium compounds) are sold every year (Mohammed Amin, pers. commun., 2003). According to the same source, the commonest diminazene compounds on the market are Berenil[®], Veriben[®], Dophanil[®], Dimaze[®], Nazomil[®], and Diminavet[®]; while the isometamidium compounds found are Samorin[®], and Veridium[®]. Quinapyramine salts, Ehidium[®] and Homidium[®] have been rare on the market for the past two decades (Sakara Yakubu, pers. commun., 2003).

■ TRYPANOTOLERANT LIVESTOCK

Stewart (26) recognized the need to conserve and multiply the trypanotolerant indigenous dwarf cattle breed, which he called the West African Shorthorn, as a means of maintaining viable livestock production in tsetse-infested areas of Ghana. Nash (16) observed that, from a veterinary point of view, tsetse flies were the main constraint limiting the rearing of large humped zebu cattle in tsetse-infested areas of Ghana and that indigenous breeds appeared to be more productive under similar trypanosome challenge. According to the Livestock Census of 1997 carried out by the veterinary services of Ghana, the cattle population of Ghana was 1.5 million. Of this national herd, the West African Shorthorn constituted 70%. The next cattle breed in terms of numbers (25%) was the Sanga, which is a cross between the local West African Shorthorn and the zebu. The large humped zebu breed constituted about 5%. The distribution of trypanotolerant breeds of cattle is related to trypanosome challenge. In the relatively tsetse free areas of the Accra plains and the drier northern areas for example, there is a predominance of zebu cattle, while in the high challenge areas, such as those along the Black Volta and in the *morsitans* zone, there is a predominance of the pure West African Shorthorn breed. There is the general observation that most farmers prefer to use zebu cattle as breeders in their herds. Most sheep and goat breeds are of the trypanotolerant dwarf type. Sahelian breeds are sometimes used to be crossed with local dwarf small ruminants but their crossbreeds account for less than 10% of the small ruminant population (7).

■ SUGGESTIONS FOR FUTURE RESEARCH

Suggestions made on the pursuit of future research in this review are founded on the experiences of fieldwork conducted in the last two decades, in various parts of the country. The proposed research themes are of immediate and long-term relevance to the sustainable control of tsetse and trypanosomoses. The order in which they have been presented does not necessarily represent the sequence in which they have to be conducted.

Remote sensing and vector control

The integrated applications of recently developed non-pollutant methods of tsetse control have proven effective in the suppression

of tsetse populations (11). The cost of these methods is ultimately linked to the area of the tsetse habitat treated. To ensure that minimal costs in vector control are incurred, the use of remote sensing techniques would be essential in the precise identification of potential tsetse habitat (4, 22). The application of remote sensing techniques for the identification of epidemiologically important sites of transmission of trypanosomoses of riverine tsetse flies as described by de La Rocque et al. (3) would be particularly relevant to the control of trypanosomoses in Ghana. Along similar lines, cross-sectional and longitudinal epidemiological surveys, with the support of remote sensing techniques, were initiated in 2000 and will end in 2004. These surveys, conducted under the Concerted Research Program for Livestock Research and Development (PROCORDEL) coordinated by the Centre international de recherche-développement sur l'élevage en zone sub-humide (CIRDES), are expected to generate information that will facilitate the elaboration of a cost-effective approach to vector control.

Selection of priority areas for the control of tsetse and trypanosomoses

Geographic Information Systems (GIS) have become increasingly important as tools for decision making in the selection of priority areas for tsetse control (21). In the low input systems of livestock production, priority areas for tsetse control are those where the removal of trypanosomoses as a constraint would enhance crop/livestock integration (10). A prerequisite for the fruitful application of GIS for decision making in the selection of priority areas is the availability of epidemiological data of sufficient quality and quantity. In this respect there is a need to update existing information on agricultural suitability, crop production, livestock population, human population as well as information on tsetse and trypanosomosis. In view of the costs involved in surveys, consideration should be given to the addition of value to retrospective data.

Drug resistance

The continued use, in the last 40 years, of a limited number of trypanocidal drugs that are closely related has led to the emergence of drug resistant trypanosomes in various parts of Africa (2, 18). A problem that is probably not peculiar to Ghana alone is the lack of an effective mechanism to monitor the use of trypanocides at the farm level. There is therefore a strong suspicion that under-dosage and the use of substandard drugs are common practice. Against this background it is imperative that a systematic investigation be initiated to evaluate the use of trypanocides in the country and to quantify the problem of drug resistance as discussed by Geerts et al. (8).

Conserving indigenous breeds of livestock

Trypanotolerant breeds of cattle have played an invaluable role in maintaining the livestock resource base in tsetse-infested areas. Over the years, however, there has been gradual but sustained crossbreeding of the West African Shorthorn with zebu breeds coming from neighboring countries. Indications are that this trend will go on for a long time. From a biodiversity point of view and from the standpoint of increasing the options available for trypanosomosis control it is crucial that an evaluation of the impact of breeding practices on the population of indigenous breeds be carried out. A temporal and spatial analysis of cattle breed distribution spanning at least 40 years could provide useful information on the development of strategies for the conservation of indigenous breeds.

■ CONCLUSION

The economically important species of *Glossina* are extensively distributed over the different agro-ecological zones of the country. In the last century there has been a retreat of the *morsitans* group of tsetse flies to protected areas as a result of agricultural expansion. The *palpalis* group of tsetse flies have exhibited greater tenacity to their environment and still survive (albeit in smaller numbers) and transmit animal trypanosomoses in areas where the *morsitans* group have disappeared. The prevalence and incidence of animal trypanosomoses across the country is as varied as prevailing tsetse habitat types. Over the last century, a general decline of the prevalence of both animal and

human trypanosomoses appears to have occurred in areas of high demographic pressure (urban and suburban areas).

Available options for the control of trypanosomoses include the exploitation of trypanotolerance, the optimal utilization of existing trypanocidal drugs and the application of non-pollutant vector control methods. The option or combination of options adopted in any given area would depend on prevailing circumstances, with technical and economic feasibility as well environmental consequences being the overriding considerations. In view of the crucial roles that trypanotolerant livestock and trypanocides have played in the control of trypanosomoses, knowledge gaps identified in the utilization of these options should be filled through applied research.

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Résumé

Mahama C.I., Mohammed H.A., Abavana M.A., Sidibé I.B., Koné A., Geerts S.C. Mouches tsé-tsé et trypanosomoses au Ghana au vingtième siècle

La trypanosomose animale africaine, transmise par les mouches tsé-tsé (*Glossina* spp.), est un problème majeur limitant l'utilisation optimale de la terre destinée à l'agriculture dans les régions du Ghana infestées de glossines. Au cours des 50 dernières années plusieurs chercheurs ont analysé la distribution des mouches tsé-tsé et la maladie qu'elles transmettent afin d'adapter les mesures de contrôle appropriées. A cause de la croissance démographique et de l'expansion agricole, l'aire de distribution des glossines du groupe *morsitans* a diminué. Les mouches du groupe *palpalis* restent les vecteurs les plus importants de la trypanosomose animale, parce qu'elles sont capables de persister même dans les régions fortement occupées par l'agriculture. L'exploitation optimale de la trypanotolérance comme moyen de contrôle des trypanosomoses est entravée par l'utilisation croissante d'animaux croisés avec les races locales trypanosensibles. Bien que l'incidence de la maladie du sommeil ait diminué significativement au cours des dernières décennies, l'état actuel de la maladie n'est pas bien connu. Cette revue décrit l'historique du problème de la trypanosomose et de ses vecteurs au Ghana, examine la situation actuelle de la maladie et identifie quelques priorités de recherche dans l'optique d'un contrôle durable de la trypanosomose.

Mots-clés : *Glossina* – Bétail – Trypanosomose – Distribution – Méthode de lutte – Ghana.

Resumen

Mahama C.I., Mohammed H.A., Abavana M.A., Sidibé I.B., Koné A., Geerts S.C. Tsé-tsé y tripanosomosis en Ghana en el siglo veinte: una revisión

La tripanosomosis animal africana, transmitida por las moscas tsé-tsé (*Glossina* spp.) representa un obstáculo mayor, que limita la optimización del uso de la tierra para la producción agrícola en las zonas infestadas de Ghana. Durante los últimos 50 años, diversos trabajadores han tratado de cartografiar la distribución de las moscas tsé-tsé y de la enfermedad que estas transmiten, con el fin de instituir medidas de control apropiadas. Debido al aumento de la población humana y a la expansión agrícola, ha habido un retiro del grupo *morsitans* de las moscas tsé-tsé hacia zonas protegidas. Desde el punto de vista de la producción animal, sin embargo, miembros de los *palpalis* continúan a ser los vectores más importantes de la tripanosomosis, debido a que su capacidad de persistir en áreas de uso intenso de la tierra. La explotación óptima de la tripanotolerancia como medio de control de la tripanosomosis se encuentra bloqueada por el aumento de los cruces entre razas tripano-susceptibles. A pesar de que la incidencia de la enfermedad del sueño ha disminuido drásticamente en las últimas décadas, no se ha investigado el estadio actual de la enfermedad. El presente trabajo realiza un estudio retrospectivo del problema de la tsé-tsé y de la tripanosomosis en Ghana, evalúa la situación presente de la enfermedad y realza varias perspectivas de investigación relevantes para el control sostenido de la enfermedad.

Palabras clave: *Glossina* – Ganado – Tripanosomosis – Distribución – Método de control – Ghana.