Journal of Agricultural Extension and Rural Development Vol. 2(8), pp. 161-166, October 2010
Available online http:// academicjournals.org/JAERD
ISSN- 2141 -2154 ©2010 Academic Journals

Full Length Research Paper

A stake-holder based approach to tsetse fly control in central Nigeria

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Accepted 21 August, 2010

A 42 week community-based tsetse control project was undertaken in 3 riverine sub-ecosystems located in the Agaie Local Government area of Niger State, Nigeria to assess the effect of suppressing tsetse populations on the prevalence rate of trypanosomiasis in cattle. Baseline information on the vector and the disease was collected during the first 2 weeks of the 42-week period and suppression of the vector populations (traps and screens were used) were conducted during the remaining 40 weeks of the same period. Results of this initiative indicated a 90 fold reduction in the density of tsetse fly by the end of week 40. This density reduction was also observed in the experimental riverine sub-ecosystem where screening of 311 white Fulani zebu cattle showed a 3.4% decrease in prevalence with the presence of 17 recently purchased animals not previously screened for trypanosomes, providing plausible explanation for persistence of the disease. These results demonstrate that it is possible to contain the prevalence of trypanosomiasis in Nigeria by deploying appropriate interventions.

Key words: Tsetse control, local communities, cattle, pastoralists, Nigeria.

INTRODUCTION

It is generally believed that difficulties in raising livestock in Nigeria are substantially induced by the widespread prevalence of tsetse fly that is estimated to cover about 80% of the country's total area. This estimate is supported by dated records that show the extent of infestation from the coast to latitude 12°N during the recent historical past (Onyiah et al., 1983). The only area recorded as tsetse free is the semi-arid sahel savanna zone north of latitude 12°N and the Obudu and Mambilla highlands. At present, the Jos plateau no longer qualifies to be considered a tsetse fly free zone due to the observed expansion and active breeding of *Glossina palpalis palpalis* in Bassa, Bokkos, the Barakin Ladi Local Government Areas and Jos East (NITR/NARP MTR, 1995). The effects of tsetse on human health include increased malnutrition due to shortage of meat, milk and related products. Though the *morsitans* infested areas are said to have reduced in size (Putt et al., 1980), due to the claimed break in sylvatic transmission of animal trypanosomiasis (Bourn et al., 2001), non-sylvatic transmission by the riverine species is still a major problem (Ahmed, 2003, 2007). Recent assessment of the landuse changes across Nigeria over the 17 years before 1995 show a marginal 0.2% decrease in the riparian forest that provided natural habitat to these species (Bourn et al., 2001).

The potential of using traps and screens impregnated with chemical insecticides to control tsetse has been demonstrated in many tsetse infested countries of Africa (Lavessiere et al., 1989; Lancien et al., 1989; Kamara et al., 1993). Despite the immense potentials of these trials, in Nigeria, inadequate attention has not been given to involvement of local communities in the use of traps and screens. During the BICOT campaign for example, local communities were not involved when insecticide impregnated screens and biconical traps were used to suppress tsetse populations (Oladunmade et al., 1985) though the initiative was meant to provide the experimental basis of an integrated pest management technique aimed at controlling tsetse and trypanosomiasis in central Nigeria by involving the local communities and extension agents. This disjunction prompted us to provide baseline data against which the performance of successor control initiatives can be measured.

We did this by undertaking a community-based tsetse control project that was purposefully designed to enhance our understanding of the epidemiology of trypanosomiasis, the species of tsetse involved and their

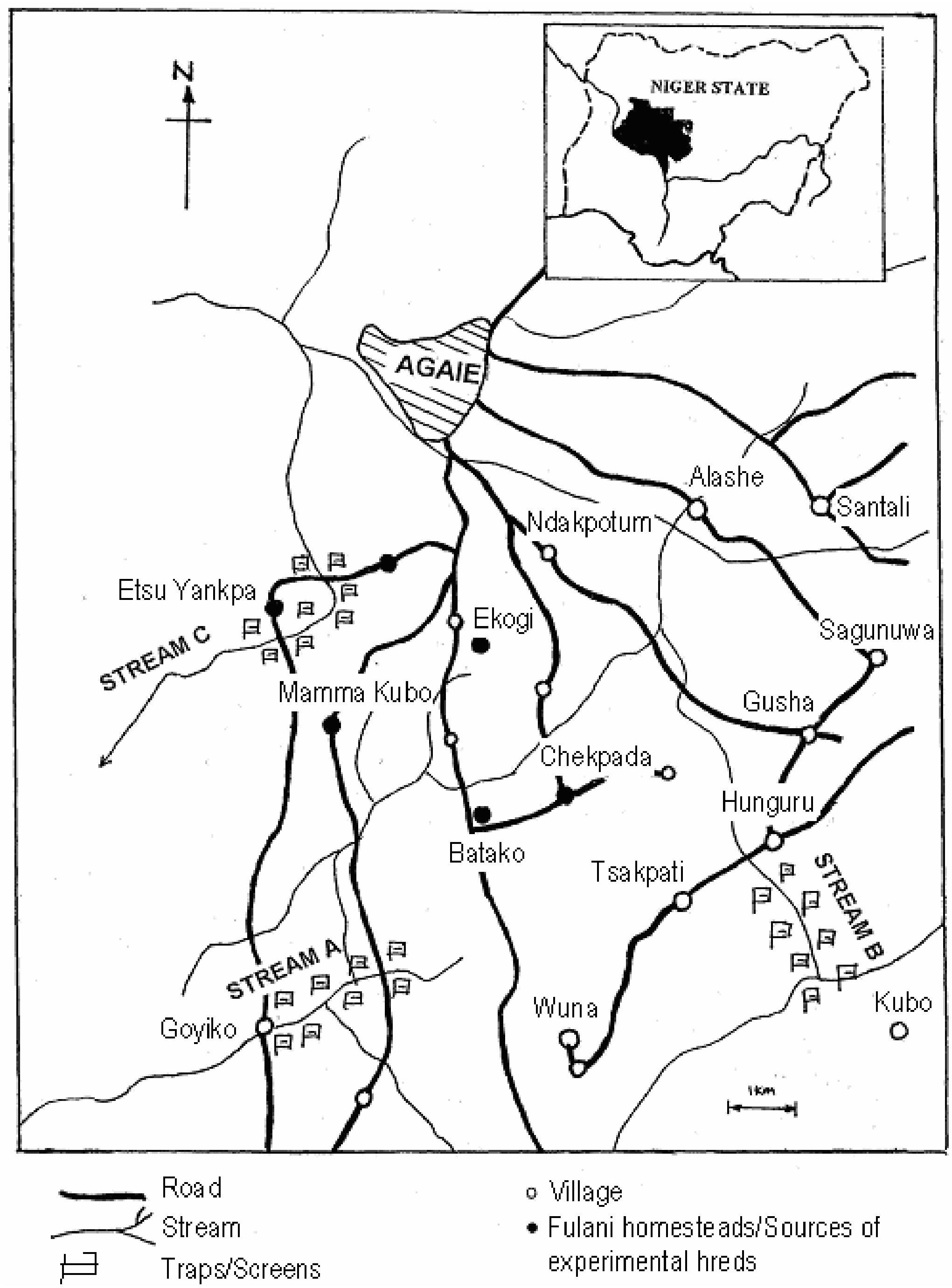

Figure 1. Location of the 3 streams and livestock herds that were included in the sample.

biology and ecology.

Study area

The study area is situated in the Agaie Local Government Area (LGA) of Niger State, Nigeria, approximately 130 km south of Minna. Mean annual temperatures range between 24.5 and 30°C, while the altitude ranges between 0 – 200 m above sea level. Rainfall is seasonal and confined to the period between April and October (ODNRI, 1989). The area has a good drainage network and high potential for both arable and livestock farming. There is no prior record of tsetse control programmes in the area. Figure 1 shows the three streams (Streams A, B and C) that were selected for investigation in this study.

MATERIALS AND METHODS

Livestock

Twelve herds of zebu breeds belonging to the Fulanis were registered for the study. The criterion for registration was strict utilization of one or more of the designated streams and adjoining gallery forests for grazing and watering.

Study design

The study was carried out for 42 weeks with the first 2 weeks being used to collect baseline data on the vector and disease. This was accomplished by screening all the 12 herds for trypanosomes. The screening procedure that was used involved:

(i) Bleeding each herd and collecting the blood in labeled Ethylenediaminetetraacetic acid EDTA bottles.
(ii) Transporting the blood samples to the field laboratory in cold boxes kept at freezing temperatures by use of ice blocks.
(iii) Examination within 2 hrs for trypanosomes using the 'buffy coat' method (BCM) and 'haematocrit' centrifugation technique (HCT).

During the examination (stage iii above), thin films were made of all positive slides for subsequent morphological identification. Parked cell volume (PCV) was determined by the HCT method. All positive cases and those with a PCV below 25% were treated using *berenil* at 3.5 mg/kg body weight. Antibiotics (*albendazole* and *hantanide*) were used to treat bacterial and worm infestations.
The remaining 40 weeks were used to:

(i) Suppress the fly population by systematic use of traps and screens (weeks 3 - 39).
(ii) Screen the target herds for trypanosomes after the suppression campaign (week 40).

Throughout this period, herds were allowed into experimental streams for grazing and watering in order to minimize biasing the observations by excluding animals exposed to suppression treatments, that is, animals were still exposed to their host environment after suppression. This arrangement was preferred because it provided a dependable basis for detecting persistence of the disease after the suppression campaign.

Tsetse sampling

The removal trapping technique (Zippin, 1958) was employed to determine tsetse densities in the 3 streams selected. For 2 weeks, after commencement of the study, flies were caught (biconical traps spaced at distances of 100 m from each other were used) in the study area's riverine vegetation and forest galleries.

Bioassay

The method adopted was similar to that proposed by Makumi et al. (1993). Wild female *G. p. palpalis* were obtained from a different forest area not covered by this study and exposed for 2 min to small strips of treated cloth material in sealable tubes. Thereafter, the cloth was removed from the tubes knockdown effects and mortality recorded after 1 and 24 h, respectively. The control group was exposed to untreated cloth material under similar treatment conditions. Flies from both groups (the experimental and control group) were confined to the forest by keeping them in field insectary that was assembled from thatch leaves and sticks.

Public enlightenment campaign

Though local people were familiar with sleeping sickness (human trypanosomiasis) because of its endemism to the area, they lacked detailed information on the relationship between the disease and tsetse fly. However, their knowledge of the disease aided the awareness campaign by facilitating meaningful explanation of the vector's role in the transmission of human sleeping sickness and places and times at which transmission occurs. Specimens of tsetse fly were shown to villagers in meetings that were organised for the same purpose and to ensure that all participants could confidently identify the vector. Each of the 3 villages were requested to nominate 1 representative each who were subsequently charged with the responsibility to take care of all traps and screens that were deployed along their streams. The nominated representatives received 2 weeks training on how to: handle traps and screens, identify tsetse fly, harvest the trapped flies and compile and keep records of their trap catches. Three senior extension officers from the Department of Agriculture in the LGA were also trained alongside the village representatives and assigned one to each stream as supervisors and were provided with extension materials that were prepared in simple English. To capture interest and to elicit meaningful participation, every representative was given a T-shirt bearing pictures of tsetse fly, a rain boot and a field note book. The involvement of local communities was facilitated by a sense of ownership which they were easily made to appreciate by reminding them of their traditional rights to the affected streams and other resources associated with these ecosystems. This sense of ownership proved to be vital for the project's success because the villagers willingly protected and maintained these installations.

Suppression of tsetse population

The fly populations were suppressed using blue screens (1 x 1 m) impregnated with a short contact time emulsifiable concentrate (NUVAN) (dichlorvos [O-(2.2-dichlorovinyl) O, O-dimethyl-phosphate]) at a dose of 200 mg/m^2 (active ingredient) that was hung on tree branches with rope.

Statistical analyses

Results obtained were analysed using SPSS and Minitab statistical packages. T-test was used to compare the means, while Regression analysis was used to determine the population trend.

RESULTS

Tsetse species

The 3 streams were inhibited by 2 tsetse species, namely *G. p. palpalis* and *G. tachinoides*. Streams A and B were inhibited by *G. p. palpalis*, while stream C was occupied by *G. tachinoides.* A total of 741 flies were caught in the 3 streams during the period of baseline data collection. An estimate of the population size was 118 ± 25.3 for stream A, 453 ± 49.89 for stream B and 138 ± 14.13 for stream C equivalent to a density of 1.4, 3.6 and 1.8 flies/trap/day, respectively (Table 1). After collection of the baseline data, entomological activities ceased in streams A and C due to abandoning of sites by the local representatives.

Table 1. Tsetse density before and after-suppression interventions.

Site name	Number of flies caught per density: Pre-control	Number of flies per density: Control			
		2 weeks	3 months	6 months	10 months
Stream A	114 / 1.4	-	-	-	-
Stream B	498 / 3.6	211 / 1.5	109 / 0.8	88 / 0.6	5 / 0.04
Stream C	129 / 1.8	-	-	-	-

Table 2. Mean of trypanosome prevalence in cattle before and after vector control.

Stream	Herd no.	Herd size		Prevalence rate (%)		
		Pre-suppression	Post-suppression	Pre-suppression	Post-suppression	Percentage change
A	III	62	0	3.2	ND	-
	V	110	0	3.6	ND	-
	VII	134	0	3.7	ND	-
	VIII	96	0	3.1	ND	-
B	I*	40	80	5.0	3.6	1.4
	II	98	115	2.1	1.0	1.1
	IV	104	110	6.7	1.8	4.9
	XI	109	100	6.4	2.3	4.1
C	VI	83	84	13.3	9.9	3.4
	IX	73	88	15.1	10.7	4.4
	X	64	80	9.4	6.7	2.7
	XII	120	76	21.7	7.9	13.8

ND = no data, *Herd not considered.

Bioassay

Results for the bioassay showed that rainfall affects the potency of the insecticide on the screens, with mortality declining to less than 30% ($p < 0.05$) after 3 months in rainy season.

Prevalence of trypanosomiasis in cattle

Out of the 1093 animals from 12 herds that were screened, 88 (8.1%) were infected with various species of trypanosomes. However, by the 40th week when the animals were re-screened to measure the effect of vector suppression on the disease prevalence rate, only 311 animals from herds II, IV and XI fulfilled the criteria for diagnosis.

The prevalence rate of trypanosomes in these animals had declined by 3.4% from 5.1 to 1.7%. Infection rates were higher in herds VI, IX and XII (Table 2). However, these herds utilized stream C (River Dumi), which was infested by *G. tachinoides*. No information was available for herds III, V, VII and VIII because they migrated out of the study area after the collection of baseline data. Herds I, X and XII belonged to non-sedentary families who believe in sharing their animals and sending them to different parts of the country to avoid catastrophe, hence the wide variation in number of animals before and after the suppression campaign (Table 2). Although the prevalence rates of post vector suppression were lower than the pre-suppression rates, the differences were not significant ($p>0.05$) (Table 3).

Table 3. Comparison of disease prevalence rate before and after vector control.

Herd	Prevalence rate (%)		P-value	Sig*
	Pre	Post		
I	5.0	3.6	0.103	NS
II	2.1	1.0	0.217	NS
IV	6.7	1.8	0.333	NS
XI	6.4	2.3	0.280	NS

*NS = Not significant.

Suppression of tsetse population

After collection of the baseline data, entomological activities ceased in streams A and C due to abandonment of the sites by the local representatives. For stream B, where data are available, there was a steady decline

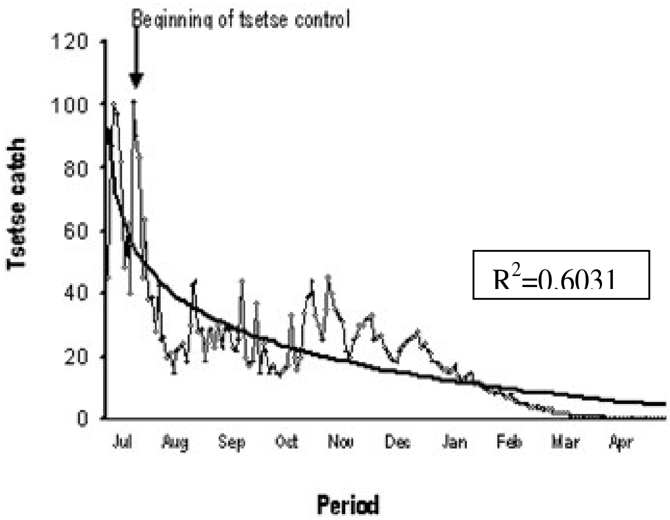

Figure 2. Reduction in the number of *Glossina p. palpalis* at stream B.

in the number of tsetse caught per month (R^2 = 60.3%) (Figure 2).

DISCUSSION AND CONCLUSIONS

The results of this study demonstrate that with proper enlightenment, motivation and training of local communities can contribute significantly to the control of tsetse and trypanosomiasis in Nigeria.

An interesting observation worth mentioning is that the villagers who supported the suppression campaign (crop farmers in this specific instance) do not own the cattle herds that were used in the experiment. The animals are owned by Fulani pastoralists who usually camp outside the villages. Being predominantly arable farmers who spent several hours attending to their farms, the villagers were hosts to the flies and were therefore eager and willing to assist. Besides, cattle provide manure which is equally important in sustaining their livelihoods. Though simple in nature, the methodology used is immensely capable of delivering numerous dividends such as: reduced prevalence of sleeping sicknesses for the crop farmers, securitized access to manure from the Fulani's cattle, increased food production from routinely manured arable land holdings, reduced prevalence of trypanosomiasis for cattle in this environment and a lot of other benefits normally accruing from a viable pastoral economy, that is, more milk, beef and draught power for ploughing.

The sense of ownership alluded to the preceding sections is demonstrated by the fact that, by week 40 after commencement of vector suppression, all the 10 traps and 20 screens deployed in stream B were accounted for and were in usable condition because of dedicated maintenance. We were however unable to adequately explain why village participants in charge of streams A and C abandoned their engagements, though termination of services by one of the supervisors and the concomitant severance of supervision and guidance can be invoked to provide part of the explanation.

Results of the entomological studies for stream B show a 6-fold decrease in density after 6 months of continuous suppression with only 5 flies being caught 10 months after commencement of the suppression campaign. These results are in agreement with the findings of Gourtex et al. (1986), who observed effective use of few traps by local communities in Congo Brazaville in controlling the prevalence of *G. palpalis* that tends to exhibit restricted distribution compared to *morsitans spp*.

Though a substantial reduction in tsetse density was achieved (herds IV, VI, IX, XI and XII), there was no corresponding decrease in prevalence rate in herds I, II and X (Table 2). Overall, herds I, II and X exhibited a marginal (average = 1.7%) reduction in disease prevalence after 10 months compared to the more successful cases (herds IV, VI, IX, XI and XII) that exhibited a larger decrease averaging 6.12%. This anomaly can be explained by the 17 animals that provided a possible reservoir of the disease because they were not screened for trypanosomiasis before they were mixed with experimental herds.

The results of this study point to a missing link that could have contributed to repeated failures of past tsetse control efforts in Nigeria, that is, trivialization and in most cases outright exclusion of local communities in tsetse-control initiatives. In this respect, it is important to note that the formulation of future tsetse control and trypanosomiasis interventions stands to benefit if community involvement is given the proper consideration it deserves.

As demonstrated by results of this study, interdependencies between pastoralists and crop farmers can be effectively exploited to support the formulation of sustainable tsetse control initiatives. This proposition is supported by success stories from different parts of Africa as observed by Gourtex et al. (1986) in Congo Brazaville, Dransfield et al. (1990) at Nguruman in Kenya and Laveissière et al. (1985, 1990) in Cote d'Ivoire where the success of tsetse control initiatives has been largely ascribed to planned involvement of local communities. Nigeria needs to seriously consider this approach not only because of its demonstrated potentials to alleviate the problem, but also because it offers an effective and affordable means to address constraints associated with the country's lack of trained extension officers. Nigeria can champion adoption of this approach by urging for example, the Nigerian Institute for Trypanosomiasis Research (NITR), the Federal Department of Livestock and Pest Control Services and the ongoing initiatives like the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) to embrace the philosophy of community involvement.

ACKNOWLEDGEMENTS

This work was part of the World Bank Assisted NARP projects under the Nigerian Institute for Trypanosomiasis Research and was carried out in collaboration with the staff of the Agricultural Department of Agaie Local Government Area (LGA) and extension workers from the Agaie unit of the Agricultural Development Project (ADP). We thank the Chairman of the LGA and all extension personnel for their cooperation and support and Mr Jerome Anere for the statistical analyses.

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