Acta Entomology and Zoology

E-ISSN: 2708-0021
P-ISSN: 2708-0013
www.actajournal.com
AEZ 2020; 1(1): 26-30
Received: 05-09-2019
Accepted: 15-10-2019

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Indigenous knowledge of termites control methods in five farming communities in Gadau district Bauchi state Nigeria

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DOI: https://doi.org/10.33545/27080013.2020.v1.i1a.5

Abstract
This study was conducted in five farming communities selected at random in Gadau district, Itas/Gadau Local Government, Bauchi State Nigeria. The research was aimed at identifying suitable and sustainable indigenous methods adopted by the local peasant farmers for termite control in which semi-structured questionnaires were administered to 20 farmers in each of the selected five communities who practice indigenous termite control methods. A total of 100 farmers who had applied various indigenous treatments on their crop fields against termites' infestation were interviewed. 81 termites' species, which varied in presence at each locality, and five termite prevention and control methods were identified in the area: (i) Direct pouring of water on the termite nest (ii) application of wood ash (iii) Application of a mixture of salt and Shea butter residue (iv)Mixture of cow urine and paper and (v) Application of Chemical (DDT). Application of wood ash was found to be the most common method used by the farmers. Despite their well-known role as pest, termites are considered important in the area because they provide necessary ecosystem services.

Keywords: Termite, farmers, wood ash, shea butter, pest control, gadau

Introduction
Termite infestation is prevalent worldwide especially in the tropics where distribution, extent of spread, problems and constraints results in livelihood threats particularly among rural small-scale farmers[1]. The ever-growing interest in sustainable agriculture and food security on the African continent highlights the need for a more balanced approach to termite control that will prevent serious ecological damage and loss of ecosystem services provided by termites whilst using the available resources without exhausting them.
Termites are abundant and diverse throughout the world with about 660 species out of the total of 2600 species found in Africa [2]. In Nigeria, 86 species are found, which belong to 38 genera, comprising of mound building and dry wood termites [3].
In Nigeria, some species (e.g. *Macrotermes, Microtermes* and *Odontoter-mes* species) cause widespread damage to crop seed-lings whilst others (e.g. *Ancistrotermes*, *Allondoter-mes* and *Pseudacanthotermes* species) cause localized da-mage to forest trees, rangelands, food crops and other natural resources [4].
Damage caused by termites is greater during periods of drought than during the periods of regular rainfall [5]. The problem of termite infestation can have several effects such as agronomic, economic, or social constraints. The agronomic influence includes the role of termites as pests and ecosystem engineers; whereas, the economic aspect involves the destructive tendencies of termites due to their foraging activities on plants and wood products which cause economic hardship to individual producers [6].
In some African countries, information on economic losses is available, for example, in Kenya and Tanzania up to 30% damage has been recorded [7], while in Ethiopia 60% damage has been recorded Also, inter-views held with famers in south western Nigeria revealed that up to 100% damage can occur on maize production. Chemical control of termites in plantations and farms is expensive and require skilled labor and may not be effective in all cases [8]. The problem of termite infestation can have several effects such as agronomic, economic, or social constraints.Termites are one of the major agroforestry pests in the tropics causing substantial economic losses; losses ranging from 50% to 100% have been reported. Chemical control of termites in plantations and farms is expensive and require skilled labor and may not be effective in all cases [8].

The excessive application of termiticides causes environmental pollution and may result in the death of non-target organisms, which necessitated the ban of some chemical control measures. Several indigenous methods are used by farmers to prevent and control termites in Nigeria. They include wood ash, sand, toads and shell/scallop of tortoise [9]. Some of these methods are evaluated and documented for the southern belt of the country only. Information generated on the indigenous knowledge of termite management within the zone will be vital for priority setting and development of pest management strategies that meet local needs [9, 10].

As there are several indigenous methods used by farmers to prevent and control termites in this particular area, the purpose of this research is to provide the indigenous and reliable knowledge on controlling termite infestation in five farming communities in Gadau District.

The aim of this study was to identify suitable and sustainable indigenous methods used by local farmers that best fit the biophysical, economic and socio-cultural conditions of termite control.

Materials and Methods

Study area Gadau is situated in Itas Gadau Local Government Area Bauchi State Nigeria, Gadau is located in the West Africa time zone latitude and longitude of 11.8328495, 10.1661239 respectively.

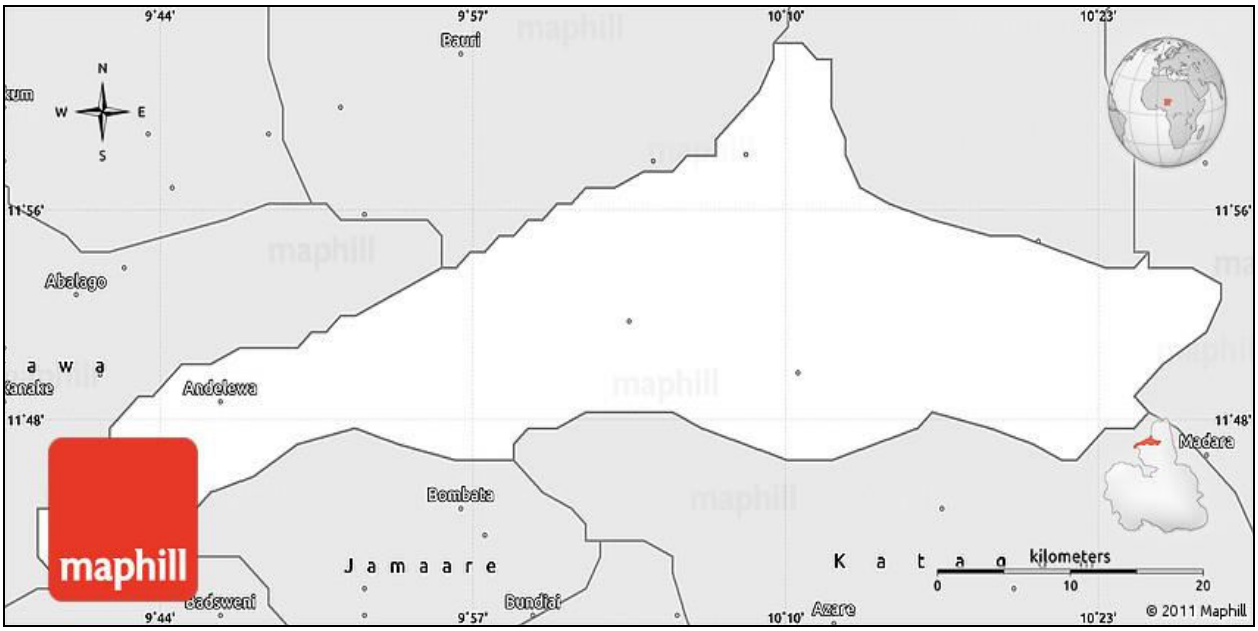

Fig 1: Map of study area, Gadau district, Itas Gadau Local Government Area of Bauchi state.

Sampling methods

During the research, five farming communities in the Gadau district with possible indigenous termite management practices were randomly selected for the study. Therefore, 100 questionnaires were administered to 100 respondent farmers (20 from each community) on the type of indigenous methods applied in termite control, reasons for the particular indigenous method. The farmers were within the ages of 20 to 65 years and had gained 1 to 30 years of experience in farming and the use of indigenous methods. Thus, years of experience was taken into consideration in order to ascertain the efficacy and problems associated with the use of indigenous methods.

Data collection and analysis

The study used semi-structured questionnaires and participatory rural appraisal (PRA) approach (farmers directly involved in identification and assessment of termite in infestation in the field). Field surveys were conducted on the plots where indigenous termite management had been applied and field observations of possible distance of termite nest/activity from the treatment spots were measured to ascertain the efficacy of the indigenous methods. The data collected using questionnaires were analyzed using descriptive statistical analysis.

Results

Personal data of farmers in the study area

The majority of the farmers were within the age of 25 to 39 years (56%) followed by the 40 to 49 years (43%) age groups and the farmers with age group 60 above constitute the lowest proportion of respondents among those interviewed (1%). The majority of the farmers (82%) applied indigenous practice for the management of termite infestations on areas between 1 to 3 acres while 18% were working on farm sizes of four acres and above.

Termite species diversity and distribution

Eighty-one (81) species of termite were identified in the study area (Table 1). The genus Termes, Coptotermes, and Glyptotermes were common throughout the study area comprising 80% of the total. The community of Walai had the highest number of 26 different termite species and the community with the least number was Malumawa with ten species (Table 1). The result affirms that, the number and species of termites vary within a locality.

Table 1: Termite species and spatial distribution in the study area

Genus	Total NO. OF SPP	Specie Distribution in The Community				
		Gadau	Malumawa	Atawari	Walai	Katsinawa
Macrotermes	6	1	2	-	3	-
Glyptotermes	8	3	1	2	1	1
Pericaprotermes	20	5	3	2	10	-
Coptotermes	30	6	4	7	10	3
Termes	17	2	1	2	2	10
Total	81	17	10	13	26	14

Termite damage and indigenous management methods

Crops grown in the study area and most affected by termites infestation included millet, maize, rice, groundnuts and pepper (Table 2). The crops were often observed to be significantly damaged before or after harvest. Though there was no quantitative data on extent of termite damage, the study revealed that the highest crop damage occurred in millet production followed by groundnuts, while other crop damages were minor.

Table 2: Commonly damaged crops by termites in the study area.

Common name of crop	Scientific name
Maize	*Zea mays*
Millet	*Pennisetumglaucum*
Groundnuts	*Arachis hypogeal*
Rice	*Oryza sativa*
Pepper	*Capsicum spp.*
Garden eggs	*Solanum melongena*

The research outcome as indicated in Table 3 revealed five main methods used by farmers in the study area for the control of termite infestations.

Table 3: Indigenous management methods used in the study area

Method used	Cow urine + Pepper application	Direct pouring of water on termite nest	Application of Chemical (DDT)	Wood ash	Salt in shea butter residue
Frequency of application	Once	Once	Anytime	Any time before storage	Once
Area applied	Farm/House	House	Farm/House	Any where	Termite nest and infested field
Time applied	Rainy Season	Rainy Season	Rainy Season	Any season	Any season
Method of application	Mixed cow urine and pepper poured directly on termite nest/field	Water is poured directly on termite nest/field	Chemical eg DDC is spread directly on termite nest/field	Spread on floor and keep harvested produce on top	Spray in nest/on field
% of farmer users (100)	15%	20%	25%	25%	15%

Efficacy of the Treatment methods

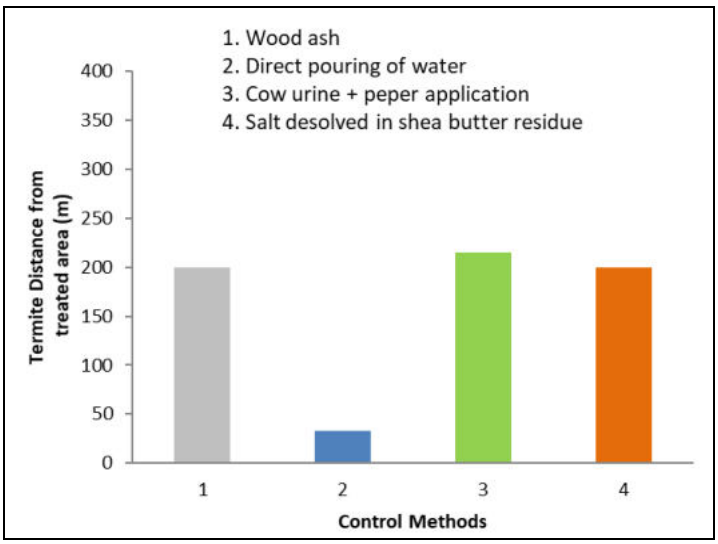

Fig 2: Mean distances of termites/termitaria from fields treated by different indigenous methods.

Discussion

The distribution of termites species identified in Gadau, Malumawa, Walai, Atawari and Katsinawa as shown in Table 1, shows that eighty one species of termites belonging the genus macrotermes, Glyptotermes, Pericaprotermes, Coptotermes and termes were identified. The highest number of termites identified was found in Walai with a total number of 26 termites, followed by the termites in Gadau with a total number of 17 termites, followed by the termites in Katsinawa with a total number of 14 termites, followed by the termites in Atawari with a total number of 13 termites and the least common species was found in

Malumawa with a total number of 10 termites.

Although, there was no quantitative data on extent of termite damage, the study revealed that the highest crop damage occurred in millet production followed by groundnut, while other crop damages were minor. High crop damage in millet confirms that the result obtained by farm interviews held with famers in five farming communities in Gadau district 100% damage by termites can occur in millet production. There was no reported incident of sorghum damage on crop fields during the study thus, confirming the assertion that sorghum is protected from termite damage, perhaps due to its role as a reservoir of termite predatory ants [11, 12].

About 55% of the respondents reported that partial damage occurred in various crops ranging from the seedling to harvest phase but peak damage usually occurred when harvest was delayed with a 100% possibility of damage occurring in storage facilities for every crop. Direct observations revealed that in the study area termite damage was not limited only to crops but to all sorts of resources such as buildings, farm huts, trees, wood and products.

Most pest species, under favorable conditions, have a high reproductive rate and thus may cause habitat destruction when ensuring their own survival [13]. As such, the availability of suitable food and habitats could have enhanced fecundity for any species of termite pests enabling them to reproduce fast enough to cause enormous destruction. The abundance could as well be attributed to the reduction or absence of natural enemies, such as birds, pangolin, aardvark and amphibians, due to habitat destruction or changes in ecological conditions [14].

The research outcome as indicated in Table 3 revealed five main methods used by farmers in the study area for the control of termite infestations. A single application of any of these methods was said to be enough to protect the field for several seasons, except the wood ash method that required annual application. None of the farmers practiced a combined or an integrated treatment method and it was realized that all the methods they used did not kill termites but some acted as repellents. This may have been intentional, as termites are used by farmers as a cheap source of protein feed for chickens during the first four weeks of the chickens' growth in the area. It could also be partially due to the readily available and accessible planting materials in the study area. Dissolved salt (sodium chloride) in Shea residue was the method least used by farmers (4%). This could be attributed to cost of the materials for application as salt is primarily used as a cooking ingredient and it is fairly expensive for farmers to purchase in the quantities needed. The results of the questionnaire indicated that the respondents had no clear indication as to the level of control each particular method exerted on their respective fields. However, measurement of termite locations/termitaries from the treatment spots was used to calculate the average distances that the termites were repelled by the various methods (Figure 1). Fields treated with Cow urine + peper application recorded the highest mean distance of 215 m, while fields treated with direct water pouring recorded the lowest average distance of 33 m.

Conclusion

The existence of 81 species of termites in five localities in Gadau district has serious implication on natural resources especially the presence of the known pest genera such as *Macrotermes* and *Glyptotermes* in the area. Farmers' innovation was evident in the diversity of indigenous termite control methods that were employed in the study area. Five methods of termite control identified in the study area were said to protect the fields for several seasons upon a single application. Reports, direct observations and field measurements gave evidence towards the efficacy of these methods.

Acknowledgment

Our acknowledgment goes the Department of Biological Science of Bauchi State University for supporting the research and using their labs and museum for termite identification purposes as well as the Staff of the Department for their observations.

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