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Full Length Research Paper

Indigenous knowledge of termite control: A case study of five farming communities in Gushegu District of Northern Ghana

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The study was conducted in five communities selected at random in the Gushegu-Karaga district of northern region of Ghana. The objective was to identify suitable and sustainable indigenous methods adopted by resource poor farmers for termite control. Semi-structured questionnaires were administered to 20 farmers in each of the selected communities who practiced indigenous termite control methods. A total of 100 farmers were interviewed. There was one female and the remaining 99 were males who had applied various indigenous treatments on their crop fields against termite infestation. The study recorded a total of 24 termite species, which varied in presence at each locality, with a few serious pest species damaging agricultural products such as maize, yam, millet, and other natural resources in the area. Five termite prevention and control methods were identified: (i) burial of plant and animal materials, (ii) application of wood ash, (iii) application of a mixture of salt and Shea butter residue, (iv) planting of elephant grass and (v) 'banchi' methods. Planting of elephant grass was found to be the most common method used by the farmers, while burial of plant and animal materials was found to be the most effective method of termite control in the area. Despite their well known role as pests, termites are considered important in the area because they provide necessary ecosystem services.

Key words: Infestation, pest species, damage, banchi' methods, elephant grass, wood ash.

INTRODUCTION

Termite infestation is prevalent worldwide especially in the tropics where distribution, extent of spread, problems and constraints results in livelihood threats (Dennis, 1987; Fenemore and Prakash, 2006), particularly among rural small scale farmers (Sileshi et al., 2008). 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 (Sileshi et al., 2008) that will prevent serious ecological damage and loss of ecosystem services provided by termites whilst using the available resources without exhausting them (Logan et al., 1990).

Termites are abundant and diverse throughout the world (Donald and Dweight, 1970); with about 660 species out of the total of 2600 species found in Africa (Eggleton, 2000). In Ghana, 86 species are found, which belong to 38 genera, comprising of mound building and dry wood termites (Forsyth, 1966). In Ghana, some species (e.g. *Macrotermes*, *Microtermes* and *Odontotermes* species) cause widespread damage to crop seedlings whilst others (e.g. *Ancistrotermes*, *Allondoter-mes* and *Pseudacanthotermes* species) cause localized damage to forest trees, rangelands, food crops and other natural resources (UNESCO, 1997). Damage caused by termites is greater during periods of drought than during

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the periods of regular rainfall (Logan et al., 1990; Nyeko and Olubayo, 2005).

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 (Fenemore and Prakash, 2006).

Reliable information on economic losses may not be available in Ghana but the threats imposed by termites on the production of food and industrial crops are quite evident. Information on population dynamics, outbreaks, damage incidences as well as available management efforts for termite infestation is essential to educate producers in termite-prone zones. In some African countries, information on economic losses is available, for example, in Kenya and Tanzania up to 30% damage has been recorded (Gitonga et al., 1995) while in Ethiopia 60% damage has been recorded (Wood, 1986). Also, interviews held with famers in south western Nigeria revealed that up to 100% damage can occur on maize production (Umeh and Ivbijara, 1997).

Chemical control of termites in plantations and farms is expensive and require skilled labour (Logan et al., 1990) and may not be effective in all cases (Nair, 2007). The excessive application of termiticides causes environmental pollution and may result in the death of non-target organisms as reported by Dennis (1981), which necessitated the ban of some chemical control measures.

Several indigenous methods are used by farmers to prevent and control termites in Ghana. They include wood ash, sand, toads and shell/scallop of tortoise (Akutse et al., 2012). 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 (Nyeko et al., 2002). The objective of this study was to identify suitable and sustainable indigenous methods to be adopted by resource poor farmers that best fit the biophysical, economic and socio-cultural conditions of termite control.

MATERIALS AND METHODS

Study area

The study was conducted in Gushegu-Karaga district in the northern region of Ghana located between latitude 9°30′ and 10°30′ north longitude 0° and 45° west. The district capital Gushegu is about 105 km away from the regional capital, Tamale.

The district is bordered to the north by East Mamprusi district, to the West by Karaga district, to the South by Yendi district and to the East by Saboba-Chereponi district (Figure 1). There are two main seasons in the district, that is, rainy and dry seasons. The district has a total rainfall of 900 mm–1000 mm per annum, the majority falls in the rainy season, which lasts from May to October and peaks in August and September with the rest of the year being virtually dry. The temperature during the dry season and throughout the year remains high with 38°C or more recorded in March and April.

The vegetation is typically of guinea savannah type characterized by grasses interspersed with drought resistant trees such as Dawadawa, Shea, *Combretum*, Baobab, and Neem amongst others with an overlying shrub layer. Sedimentary rocks are dominant with substantial amounts of concretionary gravel layers near the top horizons and are suitable for road and other constructional works. The soils are mainly savannah ochrosols, groundwater laterites formed over granite and voltaian shale.

The dominant occupation of the people in the area is farming, which occurs in mainly the rainy season. The major crops grown include maize, millet, rice, yam, and groundnuts.

Sampling technique

Five communities in the Gushegu district with possible indigenous termite management practices were randomly selected for the study. Snow-ball sampling technique (Lindlof, 1995) was used to identify farmers who practice indigenous methods of termite control in the area. Questionnaires were administered to 100 respondents (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 made use of semi-structured questionnaires and participatory rural appraisal (PRA) approach (farmers directly involved in identification and assessment of termite in infestation in the field) in achieving the objectives. Field surveys were conducted on the plots where indigenous termite management had been applied. Field observations of possible distance of termite nest/activity from the treatment spots were measured to ascertain the efficacy of indigenous methods.

The data collected using questionnaires were summarized using descriptive statistical packages.

RESULTS AND DISCUSSION

Characteristics of farmers in the study area

Out of a total of 100 farmers/respondents interviewed, one was female and the remaining 99 were males who had all utilized various indigenous treatments on their crop fields against termite infestation. The majority of the farmers were within the 30 to 39 year (42%) followed by the 40 to 49 year (26%) age groups and they were primarily considered the bread winners of their families with farming as their main occupation. They constituted the economically active population age cohort (Ghana Statistical Service, 2000). The farmers belonging to the 60+ year (1%) age group formed the lowest proportion of respondents among those interviewed.

The majority of the farmers (82%) utilized indigenous knowledge for the management of termite infestations on

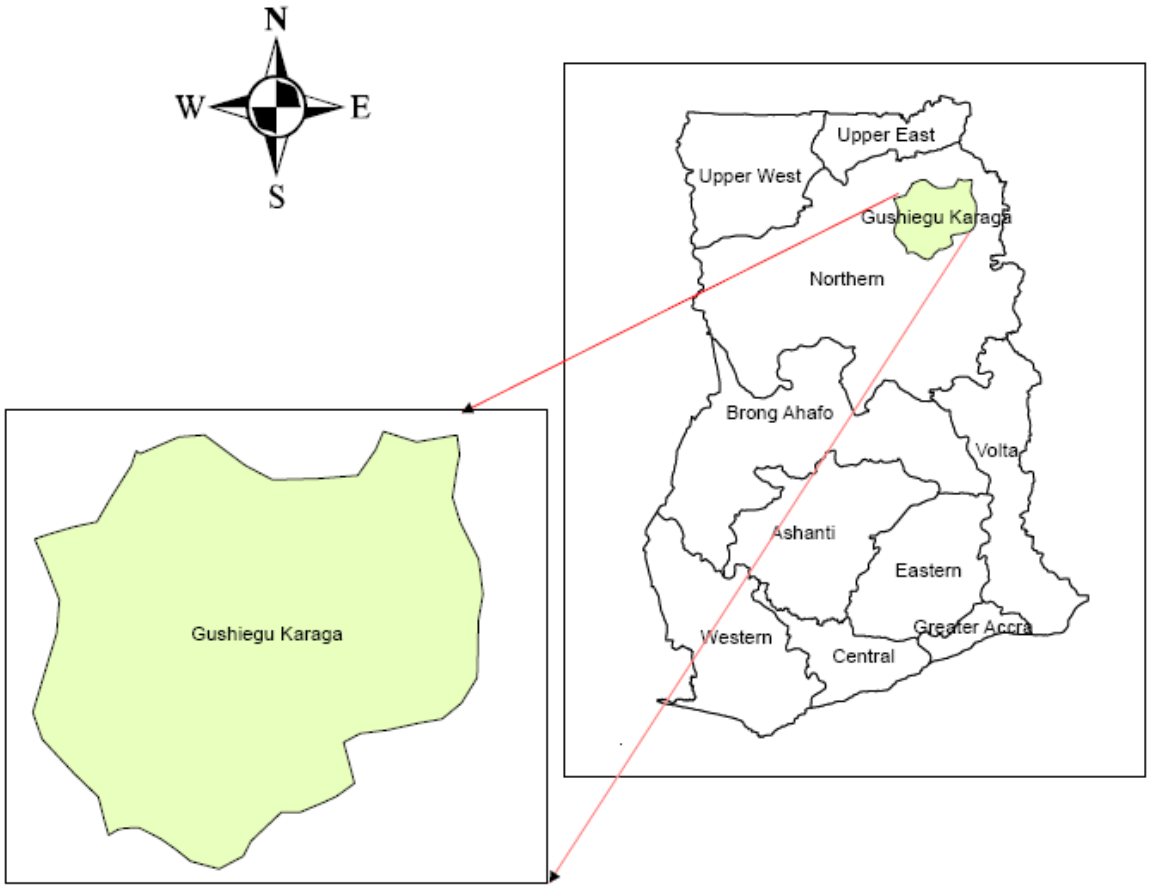

Figure 1. Map of Ghana showing study area, Gushegu-Karaga.

areas between 1 to 3 acres while 18% were working on farm sizes of four acres and above. Banchi is a plant that resembles cassava, *Manihot ultissima* Phol, farmers propagate by cuttings as it is claimed to have the ability to control termites Those farmers that used "banchi" were mostly working on a farm of one acre while those who practiced the burial of plant and animal materials (that is, pounded plant parts together with animals intestines or whole animal buried in the field) mentioned that their method could control termites on a farm size of four acres or more.

Termite species diversity and distribution

Twenty four (24) species of termite were identified in the study area. Out of this number, not all were common in the selected communities (Table 1). The genus *Macrotermes, Odontotermes, and Microtermes* were common throughout the study area comprising 20% of the total. The community of Kanimo had the highest number of 13 different termite species and the community with the least number was Bilsing with nine species (Table 1). The result affirms the findings of Harris (1971) that, the number and species of termites vary within a locality. Few species were recorded as serious pests of agriculture and other natural resources in the study area as was reported elsewhere by Logan et al. (1990) and Wardell (1990). Though the spatial distribution of the species in the study area varied, the majority of the famers indicated that the pest species present were abundant in number. According to Thacker (2002), most pest species, under favourable conditions, have a high reproductive rate and thus may cause habitat destruction when ensuring their own survival. 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 (Jiru, 2006).

Termite damage and indigenous management methods

Crops that were grown in the study area and more importantly were affected by termites included yam, maize, cassava and pepper (Table 2). The crops were

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

Genus	Total number of specie	Specie distribution in the community				
		Kanimo	***Dayoudigli***	***Bilsing***	***Dam***	***Zebihikura***
Termitidae	-	-	-	-	-	-
Macrotermes	4	4	4	1	3	3
Ancistrotermes	3	1	-	2	-	1
Anoplotermes	1	1	1	-	1	-
Acanthotermes	1	-	-	-	1	-
Allondotermes	1	-	-	-	-	1
Odontotermes	3	3	2	2	2	1
Pseudacanthotermes	1	1	-	-	-	-
Pericapritermes	2	1	2	-	2	-
Termes	1	1	-	-	-	-
Basidentitermes	1	-	-	1	-	-
Allognathotermes	1	-	1	-	-	-
Anenteotermes	1	-	-	-	-	1
Microtermes	1	1	1	1	1	1
Rhinotermitidae	-	-	-	-	-	-
Coptotermes	1	-	-	-	-	1
Schedorhinotermes	2	-	-	2	-	1
TOTAL	**24**	**13**	**11**	**9**	**10**	**10**

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

Common name of crop	Scientific name
Maize	*Zea mays*
Yam	*Dioscorea spp.*
Cassava	*Manihot esculenta*
Sweet potato	*Ipomea batata*
Millet	*Pennisetum glaucum*
Groundnuts	*Arachis hypogea*
Rice	*Oryza sativa*
Soya beans	*Glycine max*
Cowpea	*Vigna unguiculata*
Pepper	*Capsicum spp.*
Okra	*Albemulchus esculentus*
Garden eggs	*Solanum melongena*

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 maize production followed by yam, while other crop damages were minor. High crop damage in maize confirms the findings of Umeh and Ivbijara (1997), obtained by farm interviews held with famers in south western Nigeria, that 100% damage by termites can occur in maize 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 (Sekamatte et al., 2003). 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.

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. Some of the methods are commonly used in the southern belt of the country as reported by Akutse et al., (2012). 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.

It was realized that all the methods they used did not kill termites but some acted as repellents. This may have

Table 3. Indigenous management methods used in the study area.

Method used	Planting of elephant grass	Planting of "banchi/ yoobkarugu"	Burial of plant and animal materials	Wood ash	Salt in shea butter residue
Frequency of application	Once	Once	Once	Any time before storage	Once
Area applied	Farm	Home	Any where	Any where	Termite nest and infested field
Time applied	Rainy season	Rainy season	Any season	Any season	Any season
Method of application	Planting of cuttings in underground tunnel	Planting of cuttings on infested field	Pound plant parts and bury with intestines or whole animal	Spread on floor and keep harvested produce on top	Spray in nest/on field
% of farmer users (100)	46	22	18	10	4

Banchi is a plant that resembles cassava (*Manihot ultissima* Phol) in morphology.

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. Apart from the provision of chicken feed, termites as reported by Nyavor and Seddoh (1991) provide quite a number of ecosystem services such as soil enrichment through nutrient cycling and the minimization of wildfire hazards through the removal of fuel litter (Lepage et al., 1993).

The method of usage by farmers as outlined in Table 3, planting of elephant grass was the method most commonly used by the people (46%). This could be due to the fact that, planting of elephant grass has a higher efficacy then the rest. 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 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 ter-mite locations/termitaria from the treatment spots was used to calculate the average distances that the termites were repelled by the various Methods (Figure 2).Fields treated with plant and animal materials recorded the highest mean distance of 374 m, while fields treated with salt dissolved in Shea butter residue recorded the lowest average distance of 33 m. During the entomological survey, it was observed that termites had returned to certain fields where "banchi" was used as a termite management tool. Therefore, this sup-ported the claims made by farmers (21%) during the interview that the method had lost its efficacy in the control of termites. For instance, out of the 22 fields that were treated with "banchi", only one showed good control results while the other 21 were invaded by termites. The efficacy loss of this method could be attributed to a reduction in the number of red ants introduced as a biological control mechanism against termite pests when the "banchi" roots decay. Thus, when the "banchi" roots decay, they attract the red ants to the area which are predators to the termites. The presence of these ants on farmsteads could have been prevented by the massive indoor, farm and farm huts residual spraying intended to control weeds and pests in the study area. This agrees with the findings of Sekamatte and Okwako (2007) that, Ugandan elders linked the increasing termite problem and low abundance of predatory ant species to aerial sprays intended to control tsetse flies (*Glossina sp*) during the 1960s and 1970s.

The control of termites by elephant grass could be due to the presence of antixenose mechanisms in the plant, properties that deter or prevent

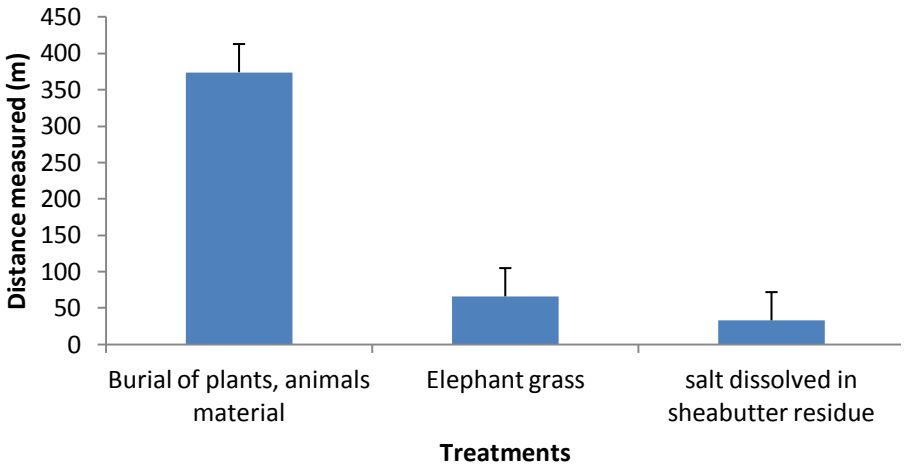

Figure 2. Mean distances of termites/termitaria from fields treated by different indigenous methods.

colonization of plants with termites. Based on the results, the burial of plant and animal materials proved to be the best method for termite control. The reason for this was the method induced the invasion of large numbers of ants on the field to act as biological enemies of termites. This finding supports Logan et al. (1990) that protein-based bait results in greater ants nesting near maize plants and hence reducing termite damage. It also affirms Seka-matte et al. (2001) who reported that reduction in termite damage in plots that received a fish meal treatment was due to the increased number of predatory ants.

Conclusion

The existence of 24 species of termites in five localities in Gushegu-Karaga District has serious implication on natural resources especially the presence of the known pest genera such as *Odontotermes, Macrotermes* and *Microtermes* 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. These methods included: planting of elephant grass, "banchi/yoobkarugu", burial of plant and animal materials, wood ash and salt in shea butter residue. Reports, direct observations and field measurements gave evidence towards the efficacy of these methods.

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