Agricultural Land Denudation Due to Termites Infestations in the Northern Guinea Savanna Crop Fields of Taraba State, Nigeria

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ABSTRACT
Termite mounds were surveyed in the northern Guinea Savanna region of Jalingo and its environs. Parameters like mounds population, sizes, distribution and proximity to one another and the nearest trees were studied. It was observed that there was no statistically significant difference (P<0.05) in the number of mounds per hectare in most farms surveyed except for Kwanti Kirim; more too, nest sizes were statistically bigger in Lankaviri farms, while maximum disturbance accounts for limiting nest sizes and proliferations in the Custom House Farms. Thus the larger the mound size, the more land areas it denudes, thus reducing arable land areas. Also it was observed that most mounds are at close proximity to trees, this shade effects allow for mounds development and termite population longevity. Most mounds are specifically connected, within an agro ecological zone, hence the closer link or none statistical significance (P<0.05) in distances between moulds: In all, most moulds could have arisen from population dispersal of the species prevalent in that Agro ecological zone. In conclusion, termites activities within the Northern Guinea Savanna advertently limit agricultural land availability since management technologies of these nests are lacking, to exploit land area deficit and budgeting, farmers resort to cropping near termite mounds as the soil here are highly fertile.

Keywords: Termite mounds, Soil fertility, Agricultural Lands, Denudations

INTRODUCTION
Much work on termite activities in agricultural crop fields had concentrated on physical damage on field crops. However, no efforts were directed at land denudations. Termites caused physical damage to agricultural land, by reducing physical availabilities through hundreds of galleries (mounds) establishment which physically reduce cultivable land areas. These impacts severely on economies of agricultural production through yield losses per hectare of land area of the crop fields. These termite activities influence the minor topographic features of the land form region, the soil properties and off course the use of such lands (Ukaegbu and Akamigbo, 2004). These affects the basic and organic matter contents of the soil, their relative importance as degraders’ increases significantly with crop types farmed in the crop fields (Bignell and Eggleton, 2000).
It is further observed that factors as soil type, texture and rain fall pattern correlated positively to termites activities in any agro-ecological zone. Thereby a well drained soil with even distribution of rain fall was more susceptible to activities of termites in crop attacks, foraging and mounds establishment, as the surface soil dries up, termites usually carried on their foraging activities underneath. In all, the mounds or
termitaria building termites in crop fields of the savanna region include *Odontotermes* spp, *Macrotermes* spp, *Microtermes lepidus* sjostedt, *Coptotermes* sp, *Nasutitermes* sp. Most obvious mounds are built by grass-eating termites, many subterranean termites build mounds only when their original nests (trees/stumps/logs) are lost or outgrown. Mounds may persist for decades and are continuously occupied; a big mound may house a million or more of individuals in a relative comfort. *Coptotermes lecteus* maintains the mounds temperature at +13°C over a year, where the queen and eggs resides, through evaporative cooling, solar collection, loss of thermal mass, but in cold seasons huddles to share metabolic heat, hence allowing gradual changes between seasons, also gas exchange and moisture content are constantly managed within the mounds. Termite mounds are made of clay and their own frass, and partly of structural stuff that can be re-used as food, hence are significant larder as well as the groups’ habitation.

Mounds are a huge investment of energy and resources, to build a mound a colony must have a long term supply of good food nearby. It must also be large, since termites spend most of their time maintaining the mounds than feeding. Not all termite mounds are large and tall; others are wide and flat designated as “platforms” often slightly-doomed patches of bare earth (Myles, 2002).

In the tropics, *Microtermes* spp., and *Odontotermes* spp., grows big obvious “fungus” gardens in their mounds. Nevertheless, fungi and bacteria are present in all mounds. (Jouquet *et al*, 2005). Mounds commonly have good excess rain water shedding capabilities, moderating flow of gases into and out of the mounds, also act to exclude predators, mounds are constantly being rebuilt and enlarged, hence the classification as active and dead termite mounds (Jouquet, *et. al*, 2004). Traditional crop fertilization practices using termite mound soil is a feature of poor resource and low input agriculture. The chemical and physical properties of termite soil improves crop growth significantly, with a maize yield increases of over 33% better than inorganic fertilizers, and these positive effects were long lasting (Siame, 2005). He further reported that farmers often select suitable termite mounds, cut and transport the soil for broadcast in crop fields and admixed or ploughed into the top soil before the rains at 3 years interval, also planting around the mounds (2 – 4m) distance. Most termites mound soils generally have high clay content, enhancing good water retention capacity, especially in drier soils, hence improves crop growth significantly. Furthermore termite mound soils, have high levels of calcium, phosphorus and organic matter, which contribute significantly to improve crop development, plants also take up nutrients very easily from termite mound soils. Tropical termites account for 20% carbon mineralization, and make significant contribution to over all soil improvements (Bignell and Eggleton, 2000, Holt and Lepage, 2000).

In the physical environment, emphasis is on the abiotic parameters because they significantly affect survival and activities of termites micro-climate (ambient temperature, RH and light) for instance are of overriding importance in nest building, hence the proximity of most nests to the nearest trees for shade effect. Internal microclimates within the nests are kept stable by termite population hence a likely dichotomy (Postava-Davignon, 2010; Fuller *et al*, 2011). Gathorne-Hardy *et al* (2001) suggested that geographical variation and other microclimate studies are key-factors determining colony survival and longevity.

Furthermore, termites in different environments may differ with respect to genetics, which influences selection of particular environment by colony founders, thus colony origin is a significant and independent predictor of termites survival, fertility and fecundity. Thus termites in warmer environment may be able to forage longer, attain and exploit higher and more nutritious resources, thus a better overall physical condition.

Obi *et al* (2008) recorded 75% termiteria in most Guinea Savanna farms in Nigeria with peak infestation during the cropping season and increases with crop-types. He further reported that all the farmers operate low-input grain-based and rain-fed farming system, and termite infestation being a major production constrains, since they are a dominant soil macro fauna in the Savanna region. This study aimed at evaluating the effect of termite distribution as a constrain on land availability in agricultural production.
MATERIALS AND METHOD

Giant termite mounds are common features of rural landscape of Taraba state. They abound in most crop fields. Incidence of termiteria proliferation in agricultural lands, fragmentations and lack of indigenous management techniques are major constrains to crop production in the Guinea Savanna region of Nigeria. The quantity of land cultivated and area of each plots were relatively low, leading to reduced area of arable land and number of farms cultivated per hectare (Obi et. al., 2008).

This study was carried out from October through November to December, 2015 in the Northern Guinea Savanna region around Jalingo Taraba state, farm settlements latitude 08° 53N and longitude 11° 50 E. Jalingo and environs has a wet and dry tropical climate, with rainy season between 146-160 days, an average rain fall of about 700mm-1000mm. Mean annual temperature of the study area is about 28°C, with maximum temperature range between 30°C and 39.4°C, the minimum temperatures range between 15°C to 23°C.

Rainy season commences by May through October, while dry season is from November to April. The soil is typical of a Savanna derived from calcareous rocks in Ferro-magnesium mineral lithomorphic vertisols.

Materials used in the study are measuring tape (100m) and meter rule, while \( \pi r^2 \) was used to calculate the area of individual mounds. estimated five (5) hectares of previously cultivated farm lands infested with termite mounds were randomly sampled in six (6) agro ecological sites near Jalingo i.e. Custom House farm(CHFM) settlement, College of Agriculture Farms(COAFM) Jauro Yinu farms(JYFM), Lankaviri farms (LKFM), Kona Garu farms (KG), Kwanti kirim farms (KKM). In each hectare, total numbers of termite mounds were recorded; areas of five (5) mounds sampled per hectare were computed. While distribution accounted for distance between mounds and to the nearest trees.

RESULTS

Average number of mounds per hectare was 36.5, with the maximum number of 61.75 mounds in Kwanti Kirim farm settlement, however, there was a significant difference (P>0.05) in number of mounds recorded in the other farm settlements except for Lankaviri and Kwanti Kirim farms which were significantly different (P>0.05). Least number of termite mounds was recorded in the Custom House farm settlements with coefficient of variation of 38.7 recorded.

An average land area denuded per hectare in the surveyed area was 144m\(^2\) with the maximum of 261.0m\(^2\) in Lankaviri Farms and minimum of 66.5m\(^2\) in Custom House farms. However, there was a high significant difference (P>0.01) in the total land area denuded across the different farm settlements except for Jauro Yinu farms and Lankaviri farm that are not significantly different (P<0.05).Coefficient of variation of 45.9% was recorded.

Distance of termite mounds to the nearest tree in metres shows an average of 8.8 metres with the farthest being 16.25m in College of Agriculture Farms, and the shortest 1.50m in Jauro Yinu farms. Thus there was a significant difference (P>0.05) in the proximity of active termiteria to the nearest trees across the different farms. Kwanti kirim and College of Agriculture Farms show no significant difference (P<0.05), however, they are significantly different (P>0.05) compared to the other farms surveyed.

Distribution in the mounds are uniform within a hectare in the study sites, however, there was no significant difference (P<0.05) in the distances between mounds. Jauro Yinu and Lankaviri farms had 46.25m and 47.50m respectively with the least mean distance records at Kona Garu Farms (36.50m). The Coefficient of variation 21.7 being valid accounting for dependence of the distribution being uniform and termite population within the mounds are in constant link through underground tunnels.
DISCUSSION

Availability of arable land dwindles due to many physical and political considerations within a settlement. This in conjunction to termiterias, impacts severely on tonnage of agricultural productions by influencing the topographical features of soils organic matter content and drainage conditions. Also soil types, texture, rain falls and micro climate changes, positively correlates to termite activities within a farm settlement. These are further complexed by anthropogenic activities, thereby increasing land area losses, limiting agricultural production (Fuller et.al, 2011, Bong et.al, 2012).

Availability of abundant resources i.e. haulms, crop residues and other vegetative wastes, logs, stumps and weed heaps provide nuclear activity site for termite mounds establishment. Since in the Savanna region, most threshing, depodding and winnowing activities allow for agricultural waste accumulations, these sites are active areas for mounds establishment, hence the proximity to most bigger trees used as shades by the farmers at harvest and processing. Jouquet et al (2005) and Pringle et.al,(2010) reported that area of termite activities form an active niche, where both chemical and physical activities improves soil fertility significantly, hence the cultivation of crops around most mounds (fig. 3.0) to exploit the fertility regime prevalent around this mounds by the Northern Guinea Savanna farmers.

Holt and Lepage (2000), draws a logical conclusion that density, sociality and ambient climate fosters linkage or connectivity between termitaria, hence despite the wide distances between mounds, population links are seen to exist between mounds (Table 1.0). Furthermore, selection of particular environment by a colony founder follows certain independent predictors, hence the abundance of termite, within the surveyed farm settlements.

In contrast, Eggleton (2000) and Bong et al (2012) showed that Agricultural practices may have some negative impacts on the termites assemblages i.e. when tropical soils are cultivated continuously, they become substantially compacted and surface albedo is increased leading to temperature increases and decreases in precipitation, which may transform the ecosystem.

Number of termite mounds is prevalent throughout the agricultural farm settlements which were evenly distributed. Only in Kwanti Kirim settlement that more nests were evidenced, the community allows for fallow, since not all farms are cultivated each year, more so, there is the presence of seasonal stream, hence high moisture availability sustain the termite population. The population of nests is determined by micro climate of the agricultural areas leading to aggregation of termite mounds.

Although we have higher number of mounds in Kwanti Kirim, peak areas of land denuded was in Lankaviri farm settlement, indicative that larger mounds featured prominently here, while maximum disturbance in the custom House settlements could mitigate against proliferation and extant growth of mounds, since every year compartments are added to previously established mounds. Thus the termite mound size greatly accounts for quantity of land area denuded. This habit is species specific since termites’ aggregates soils into mounds transferring particles from different soil layers which economically impacts on the structure of agricultural lands and its productivity through changes in soil physical properties, i.e. soil water retention, aeration, drainage and stability.

It was observed that all through the study, uniform mounds distances was observed to nearest tree in the farms. However, College of Agriculture Farms had most mounds away from the nearest trees, this however was not the case in other farm settlements in the study areas, most probably trees in the college of Agriculture farms has been consistently hewn down, or killed by the termites invasion; thus exposing much of the termite mounds, nevertheless, it was clear that mounds in other farms had closer association to most trees within the farms.

The distances between mounds in metres (m) was uniform throughout the farms, indicating physical contact, from each colony, since it could be most probable that populations within an agro-ecological zone spreads out to form new nests are physically in touch, with other populations within a zone. This attribute was observed throughout the farm settlements surveyed as a likely behavioral pattern accounting for distribution of mounds around the farms. This is in opposition to finding of Bong et.al, (2012), that
depending on the biotic and a biotic elements present in an ecosystem, the abundance of each termiteria differs with different ecosystems.

In conclusion, several studies in African Savanna found termites to significantly improve Soil fertility, disparately affecting the ecosystem carbon flow, elevates levels of phosphorus and nitrogen, which greatly enhances plant and animals activities and productivity at local levels (Pringle et.al, 2010). Thus with much conflicts and land ownership struggles, termite mounds additively constrained agricultural productivity within the Northern Guinea savanna ecosystems.

REFERENCES


Table 1. Mean land area denuded by termite mounds per hectare in farm settlements around Jalingo

<table>
<thead>
<tr>
<th>Farm Btw Settlements</th>
<th>No of Mounds Per Hectare</th>
<th>Land Area (M²)</th>
<th>Distance of Mounds To Nearest Tree (M²)</th>
<th>Distance Mounds Between Settlements</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHFM</td>
<td>22.75a</td>
<td>66.5a</td>
<td>4.575ab</td>
<td>44.50a</td>
</tr>
<tr>
<td>KGFM</td>
<td>30.00a</td>
<td>95.1a</td>
<td>12.375bc</td>
<td>36.50a</td>
</tr>
<tr>
<td>COAFM</td>
<td>31.25a</td>
<td>157.6ab</td>
<td>16.250c</td>
<td>41.75a</td>
</tr>
<tr>
<td>JYFM</td>
<td>32.25a</td>
<td>184.1bc</td>
<td>1.500a</td>
<td>46.25a</td>
</tr>
<tr>
<td>LKFM</td>
<td>41.25ab</td>
<td>261.0c</td>
<td>6.750ab</td>
<td>47.50a</td>
</tr>
<tr>
<td>KKFM</td>
<td>61.75b</td>
<td>99.0ab</td>
<td>11.550bc</td>
<td>37.50a</td>
</tr>
<tr>
<td>G/MEAN</td>
<td>36.5</td>
<td>144</td>
<td>8.8</td>
<td>42.3</td>
</tr>
<tr>
<td>SED</td>
<td>10.00</td>
<td>46.7</td>
<td>4.66</td>
<td>6.49</td>
</tr>
<tr>
<td>Prob. of F</td>
<td>2.77</td>
<td>0.006</td>
<td>0.031</td>
<td>0.450</td>
</tr>
<tr>
<td>CV(%)</td>
<td>38.7</td>
<td>45.9</td>
<td>69.8</td>
<td>21.7</td>
</tr>
</tbody>
</table>

Means followed by same letters within a column are not significantly different (P<0.05//0.01) according to DMRT.
Fig. 1.0 Termite mounds,
Fig. 2.0 Proximity of termite mound to a tree (shade) effect.

Fig. 3.0 Cultivated maize around termite mounds.