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Study on community perception of termite expansion and control in Borana plateau: Case study of Southern Oromia, Ethiopia

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Ecologically termites can be divided into damp wood dwellers, dry wood dwellers under and above ground dwellers in Dire, Miyo and Moyale districts. The combination of methods and tools such as stakeholder, key informant interview, group discussions, timelines, transect walk, community sketches were used. About 90 pastoralists were interviewed formally on its expansion and control techniques. The cause of termite expansion in the study area is diverse and complex. Mound-less termites take the advantages of camel population growth in the Borana rangelands as reproduction ground to quickly reproduce and expanded in the grasslands. Participatory rural appraisal was also conducted to assess the trend of termite expansion in the past 50 years. It was found that the expansion of termite has been increasing linearly. Pastoralists expect the coming 20 years termites may forage human beings due to the extent of its abundance. According to the respondents mound-less termites prefer the *Adoolleessa* (cool dry season) and the onset of rain at the end of dry season (Bona-*Hagayyaa*). Termite invasion is a new phenomenon which becomes a threat to rangeland management. The termite fauna of Ethiopia is not well known. At present 62 species belonging to 25 genera and four families have been recorded and 10 of the species are endemic. Currently, 100% of interviewers' in responses of no traditional and modern termite control techniques. Accordingly after the bun of traditional prescribed burning techniques, termite infestation becomes serious. There are termite predators such as *ant*, different bird species and poultry but worth less in termite control. The only plant species that is resistant to termite species in the study locally called *Annannoo* which is foraged by camel.

Key words: Borana lowland, termite expansion, termite mound, community perception.

INTRODUCTION

The problem of termites from a broader systems perspective is complex. Various factors in the Borana rangelands might have contribution for the expansions of termites. The recent expansion and intensification of termites' damage is not well understood and documented. The past research and extension intervention did not

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Figure 1. Impacts of termite mounds on maize production.

focus on the identifying the root causes of termite expansion. The approach to manage termite damage in the study area is not well understood and therefore, needs of analyzing the situation of termite damage and infestation. This study also identifies potential social a *species* and informal institutions that are responsible for the termite control. Pastoralists' access to resources, technology support and other sources of information were gathered in the area. Furthermore, assessment of the termite damage, community indigenous knowledge, trend analysis, and ecological impact of termite in the rangelands has been identified. Ecologically termites can be divided into damp wood dwellers, dry wood dwellers, underground and the aboveground dwellers (Evans et al., 2013). Termites are important in many ways. Good maize color around termite mound than the mound adjacent could be taken as an example (Figure 1). The reason is that termite excretes nutrients rich in solid wastes from their body that are essential for vegetation around the mound.

On the other hand, a large number of termite workers are responsible for the seriousness of the damage they cause on grasses (Figure 2) and different crops at maturity time. This may have a relation with that of soil infiltration capacity due to soil compaction. Accompanied by the problem of bush encroachment, opportunistic cultivation, and recurrent drought, in the study area of Borana rangelands, a large portion of the rangelands has been attacked by termites.

MATERIALS AND METHODS

Descriptions of the study area

The study was conducted in three districts of the Borana range lands. Thèse are the Dire, Miyo and the Moyale District (Figure 3). These districts cover extensive areas in Borana pastoral system as well as the heart of Borana production system. Some crop production and animal rearing are the major pastoral community production system. These areas were under termite invasion for a long time. The study was conducted on two pastoral associations for each of the three districts; namely, Haralo and Dambala Badana in Dire district, Melbana and Boku-Luboma in Miyo district and Tilemedo and Dembi in Moyale district. The data collection comprises different techniques. Combination of methods and tools such as stakeholder, key informant interview, group discussions, timelines, transect walk, were used to collect data.

Questionnaires

Face-to-face or directly interviews used open-ended and closed-ended questions, individual interviews were carried out by the administration of a questionnaire to the respondents.

Direct observation

The research team has been interested in observing the termite situations in some areas. The status of termite expansion and trends, timelines has been considered in depth.

Key informants

The key informants were among the following; local chiefs, elders, corporal and program coordinators such as program coordinator of rangelands in different offices. The aim was to solicit additional data on local peoples' perception towards conflict and its management. Informal discussions have been held with the key informants.

Data management and statistical analysis

Both quantitative as well as qualitative statistical analyses were applied in the data analysis. Computer based data coding, storage and retrieval mechanisms were used. The collected data were analyzed using Statistical Package for Social Science (SPSS) software.

RESULTS AND DISCUSSION

History and spread of termite in Borana

All of the respondents agree that there is a termite problem in their area. The problem that 46% of the respondents indicated that termite induced damage on everything they encounter; while 54% listed that termites

Figure 2. Impact of termite mounds on grasses and vegetation around the mounds.

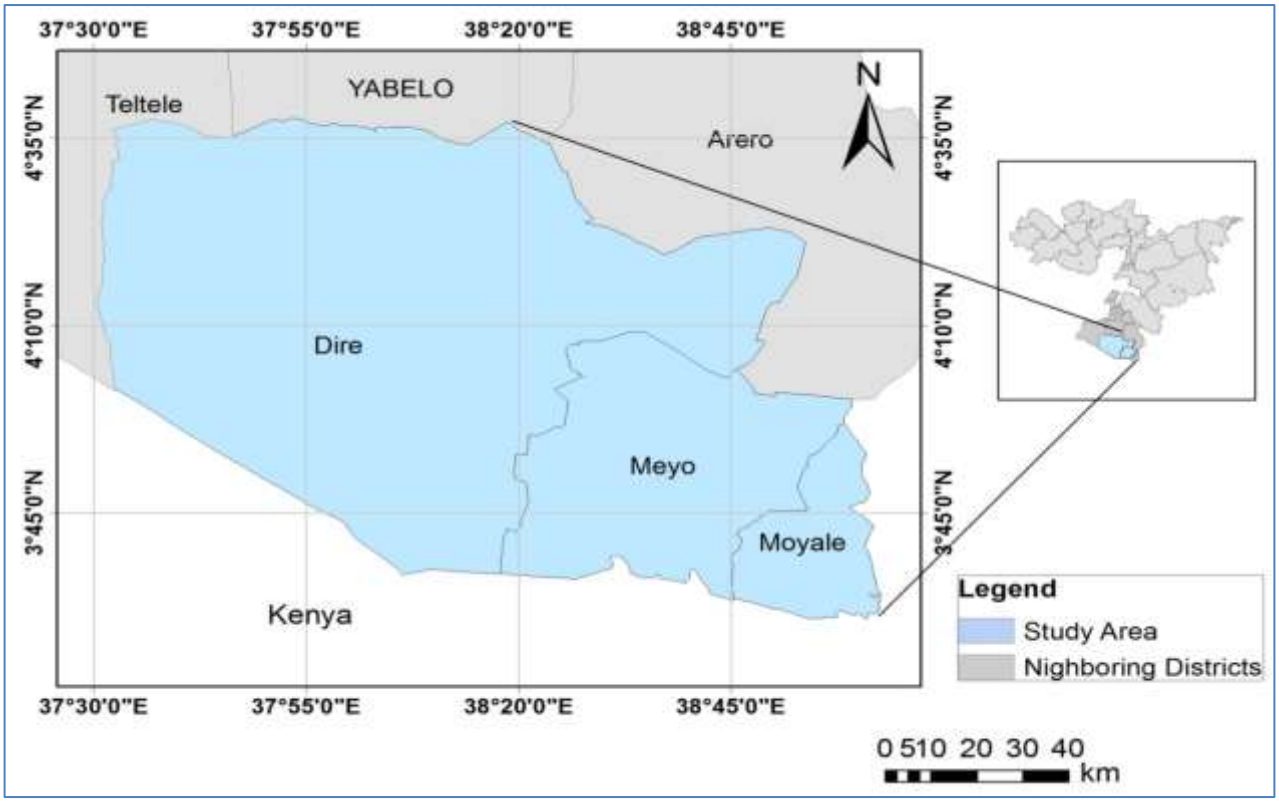

Figure 3. Map of the study area, showing the specific site in Dire, Miyo and Moyale district.

are damaging grass, crops and buildings. About 40% of the respondents know or presume that termite invasion was first seen around thirty to forty years ago, but not 60%. Locally, the communities identify the common species of termites as mound builder and non-mound builder; and in terms of size small, medium or large. 71% of respondents indicate that both mound-builder and mound-less termites are available in the Borana rangeland; while 16% had seen only termites which build mounds; and 13% classify the presence of termites in to different body size categories namely small, medium and large. When respondents compare the recent condition of termites in relation to the past 25 years ago their estimates were as follows: good (31%), fair (49%) and worst (20%). Among mechanisms of termite spread to new un-infested areas, underground tunnels, camel urine, cattle dug and spreading over surface by building tunnels are listed as a top system. According to the respondents the main causes of termite intensification are climate change and overgrazing.

Community perception about termites' damage in the rangelands

More than half of respondents think that mound building termites affect rangeland and crops by eating both grass and crops, while the others are not. According to 87% of the respondents eating grass, destruction of crops and degradation of rangeland are the main damage induced by mound-less termites. According to the respondents severity of termite intensification is higher in communal grazing land use type followed by degraded rangeland. When compared destroyed mounds soil with normal soil or adjacent soil around the mound area, the production is lower because of the bad nature of soil according to 44% of the respondent but 32% while argue that the dead or destroyed mound give high production due to its high level of fertility and the rest understood that there was no change on production.

Crop types that are more affected by termite intensification according to the respondents were ranked as *teff*, wheat and maize respectively. Due to this effect, around 32% of the respondents have changed their crops, while the other 68% have not changed the crop type. Sever damage to crops is reported to occur mostly during flowering followed by immediately after germination or the seedling stage, and the roots are the part of crop that are more affected as mentioned by the respondents. The types of fodders and trees susceptible and resist to termite effect are identified by the respondents (Table 1).

High crop damage in maize confirms the findings of Umeh and Ivbijara (1997), obtained from farm interviews with famers in south western Nigeria. Termites feed on roots of grasses, grasses, soil seed banks and barks of tree; and thereby damage valuable tree species.

Termites damage fences and crops in the study area. Pastoralists of Haralo PA reported that termites damaged eucalyptus stands including its seedlings. Termites have the potential to completely damage big trees over a long period. Termites' mounds are reported to be one of the problems in the rangelands. No grasses grow near the mounds. According to the pastoralists, this could be due to pulverization of the soils and some termite secretions. In Moyale district termite mounds are viewed as equivalent to bush encroachment. Some termite species are reported to damage the rangeland more than the others. In the study area the whitish grey termite with big abdomen causes more than the other kinds of termites. This species feeds more on grasses and thereby damage the rangeland. The reported information is in line with study conducted in Ghana by Akutse et al. (2012).

Causes of termite expansion

The cause of termite expansion in the study area is diverse and complex. According to the key- informants, it is directly related to the shortage of rainfall, recurrent drought, ecological change, and increased settlement. Termites prefer long dry seasons accompanied by shortage of rainfall for their reproduction. Big showers wash away the routs and feeding holes of the mound-less termites. Therefore, their damage and reproduction is reduced sharply during the rainy season. Mound-less termites take the advantages of camel population growth in the Borana rangelands. They use camel dung as reproduction ground to quickly reproduce and expand in the grass lands. Also, mound-less termites use some bush species (*acacia melifera* and to some extent *acacia drepanolobium*) as host for their reproduction. Pastoralists stress about the expansion of termites that the ecological change is responsible particularly after the ban of traditional rangeland management. Termites' mounds are more serious on red soils than on whitish (Calcic) soils. No termite mound is observed on the black soils (Vertisols) in the study area. This could be due to the compacted nature of the soils and the soil temperature which is cold during the night time. Increased human and livestock population accompanied by ban of traditional rangeland management (that is, ban of prescribed burning), overgrazing, and restriction of livestock mobility due to rangeland shrinkage and conflict have contributed to rangeland degradation and intensification of the termite problems in Borana lowlands. The damages caused by termites have forced pastoralists to abandon their pasture and thus create a threat for livestock production. Termite damages are serious where the ecosystems have been much disturbed as is currently still observed in pastoral areas in Dire, Miyo and Moyale districts. Our findings confirmed the previous reports by Grace and Yamamoto (2009) who concluded that termites are capable of ingesting and utilizing virtually all of the cellulose in the

Table 1. List of species of fodder and of trees and shrubs most affected in the area of study and those deemed to be resistant.

Susceptible /most affected fodder	
Scientific name	**Local name**
Cenchrus ciliaris	Matagudessa
Plectranthus cosmosus	Barbaarersa
Bidens hilderrandti	Abune
Digitaria milanjiana	Hiddoo
Themedatriandra	Gaaguroo
Cynodon dactylon	Sardoo/qarcaa
Bothriochloa insculpta	Luucolee
Susceptible /most affected trees and shrubs	
Scientific name	**Local name**
Combretum molle	Rukeessaa
Acacia bussei	Halloo
Commiphora spp.	Hameessaa
Commiphora kua vollensen	Calanqaa
Dodonea angastifoli	Dhitacha
Ehretia cymosa	ulaagaa
Acacia nilotica	Burquqqee
Resistant tree/shrubs	
Scientific name	**Local name**
Olea europaea	Ejersaa
Grewia bicolor	Harooressa
Boscia mossambicensis	Qalqalchaa
Croton macrostachyus	Makkanisaa
Juniperus procera	Hindheensaa
Cordia gharaf	Madheeraa
Acacia tortilis	Dhadachaa

wood upon which they feed, and therefore seriously disturb the ecosystem.

Trend analysis

Participatory rural appraisal was conducted to study the trend of termite expansion in the past 50 years in the study area. It was found that the expansion of termite has been increasing linearly. It has been said by the Borana key informants that in each Gada system, the existence of termite increases sharply. Termite mounds appeared in the Borana land in the mid-1960s in sparse manner. Then after, the expansion progressed linearly and eventually, nowadays, has covered most of the rangeland in the study area. The mound-less termites species, which are relatively new to the study area, are the most serious types in destroying everything of the rangelands. If the termite invasion continues, it would be hard to find productive rangeland in the coming few decades in or around the study area. Pastoralists were asked about the termite situation in the past 20 years and responded that it was good in terms of its expansion. However, these days the situation seems worse; termites have invaded much of the rangelands. According to the key informants, the situation of invading termites continuously increases and most of their lands will likely be taken by termites in the study area. This will end up with the collapse of the total production systems. Pastoralists expect that in the coming 20 years, termites may forage human beings due to the extent of its abundance.

Seasonal occurrence of termites

Mound-less termites prefer the *Adoolleessa* (cool dry season) and the onset of rain at the end of dry season (*Bona-Hagayyaa*). After the first rain showers, mound-less termites invade the ground immediately. Long showers wash the roots and feeding holes of termites

thereby eliminating them from the ground.

Livestock production constraints and termite expansion

Pastoralism is under stress due to constraints in the study area. These include shortage of adequate rains, bush encroachment, conflict, recurrent droughts, livestock diseases, cultivation of valley bottoms and termite invasion. Termite invasion is a new phenomenon, which becomes a threat to rangeland management. The mound-less termites which are of two types in the study region destroy grasses and other useful rangeland resources. Termites have infested grazing areas in the study sites during the dry season as well as wet season. Fall-back sites including Melbana, Golbo, Wayama, and Borbor are under sever termite infestation.

Distribution of termites and species composition

Termites are abundant and widely distributed throughout the study area and pose a threat to crops, rangeland and domestic houses in the study area. The termite fauna of Ethiopia is not well known. At present 62 species belonging to 25 genera and four families have been recorded and 10 of the species are endemic (Cowie et al., 1990). Among termite species recorded by Cowie et al. (1990), about 25% of these species are pests of agricultural crops, forestry, seedlings and grazing lands. The four families that contain the pest species are *Kalotermitidae, Hodotermitidae, Rhinotermitidae,* and *Termitidae* (Amsalu, 2009). Most species *Macrotermes, Odontotermes, Pseudacanthotermes, Ansistrotermes,* and *Microtermes* are found throughout the savannah and wooded steppe of tropical Africa (Homann, 2008). It is expected that most of the above-mentioned species are found in the study are where the vegetation is characterized by acacia-dominated savannah grass land. Pastoralists of the study area classify termites in three groups based on color, size and shape. Locally termites are classified into two types which are mound-less and mound-forming ones. The mound-forming ones are red and big-headed termites.

Association of termites with environmental factors

More than 98% of the respondents agreed upon that there were no termite resistance fodder species introduced. But 88% reported that there was no relation between termite invasion and livestock disease. However, around Dugda dawa district some of them indicate that a host for certain diseases like Awarsa (snake disease), or 'luxa' (body weight loss), which come from shortage of feed. Physical destruction and snake disease are among the other problems induced by mound-building termites and mound-less termites. Among major problems which are induced by termites some respondents indicated in rank order from first to fourth as follows: 1) crop damage (before and after harvesting), 2) impact on buildings, 3) reduced feed sources (in terms of space occupied by mound, eating grasses and land degradation) and 4) physical damages on livestock and children.

More than 70% of the respondents agreed that termites have impact on copping strategies of drought by destroying conserved feeds. Mounds did not have mineral lick in Borana rangelands. Instead according to 65% of the interviewed community respondents, locally mounds give a benefit to construct houses and "naniga" which are water canals for livestock watering at water points throughout the rangeland.

Environmental relationship of termites

More than 55% of the respondents indicate that there was no impact due to bush encroachment on termite infestation and spread; and about 40% of the respondents justified that due to the fact that the bush serves as a feed source for termites. In relation with the effect of bush clearing on termite infestation, more than 60% of the respondents elaborated that it has an effect in the way that disturbance reduces termite spread, and the bush serves termites as feed source; as well as there was no indication of the ban on rangeland burning as a cause of termite infestation. Cultivation reduces mound building by physical destruction and flooding according to half of the participants responses. The severity of damage and infestation of termite is higher in flat lands than of hilly and valley bottoms. The season for termites to spread on new or uninfected areas is greater in long rainy seasons and cool dry seasons. Furthermore, "wayama" red deep soil is the soil type where termite infestation and damage is severe. Cool dry season is the favorable condition for termite damage pronounced on grass, building and crops than the other season. Mound building takes place also in the cool dry season, than short rainy season. 45% of the respondents agree that drought and the presence of termites are related.

Traditional termite management, research, policy and extension

Currently, 100% of the interviewed pastoralists said that they have no traditional as well as modern termite management techniques. According to the informants, after the ban of traditional prescribed burning techniques, termite infestation has become serious in the study area. There are termite predators in the study area, including ant species, different bird species and poultry. However, the reality is that the predators are worthless in termite

control. 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.

Resistant fodder species in the study area

The only plant species that is resistant to termite species in the study area is locally called *Annannoo or Kinchib*. This plant is foraged by camel and it is drought tolerant.

CONCLUSION AND RECOMMENDATIONS

Borana rangeland has been under stress starting from the past few decades. Termite intensification in this area has been increasing from time-to-time. Even if termites are believed to be ecological engineers, the destruction of crop and fodder needs to be minimized at an optimum level. This has to be considered and to enhance the indigenous people's knowledge of termite control mechanisms which include organic methods that must be used. Introduction of termite-resistant fodder species to the region is mandatory. The rate of termite intensification must be quantified using remote sensing techniques. The fertility status of termite mound needs to be assessed in further studies for the area.

The termite invasion poses a great problem for pastoral livelihoods in the study area. Therefore, the following socioeconomic and policy considerations should be practiced.

Increase livestock off take

The study area has a high number of livestock, though the rangeland has been shrinking both in quality and quantity; yet the number of livestock population is increasing over time. This has resulted in overgrazing, intensification of termite problems and finally rangeland degradation and land abandonment. Livestock off take should be increased to relieve pressure on the rangelands in the study area of Dire, Moyale and Miyo districts.

Reduce human population

Pastoral communities have been increasing significantly in the past decades. This has resulted in denser settlement, limited livestock mobility, and competition for individualizing the commons, and settlement in wet as well as dry season grazing sites. The combined effects of these situations have created ecological imbalances and caused the problem of rangeland deterioration and aggravated termite problems. Therefore, population control policy and strategy should be practiced in the study area by direction of the government as well as the consensus of concerned stakeholders in the region.

Community participation

To tackle termite problems there is a need to develop participatory community based approaches to matters of rangeland management. The need for pastoralists' education on this aspect needs to be addressed with emphasis. Overall, a more vigorous research and development agenda should focus on community interests in relation to the issue of termites. Appropriate policy on environmental issues is essential to sustainability of the system.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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