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EFFECTS OF TERMITES ON CONSTRUCTION TIMBERS IN IBARAPA EAST LOCAL GOVERNMENT AREA OF OYO STATE IN NIGERIA

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ABSTRACT: Termites cause billions of dollars in damage each year. They primarily feed on wood, but also damage paper, books, insulation, and even swimming pool liners and filtration systems. Termites can injure living trees and shrubs. Besides the monetary impact, thousands of winged termites emerging inside one's home are an emotionally trying experience - not to mention the thought of termites silently feasting on one's largest investment.

Termites are able to assess wood sizes using vibrating signals, although the exact mechanism behind this assessment ability is not known. However, they are also dependent on the material characteristics of the block, such as mass, density and internal damping. Hence the termite effects on timbers used for construction in Ibarapa East Local Governments, area is hereby studied.

Buildings were surveyed in different locations and several observations were made on timbers affected by termite and different ways attempted in preventing the devastating impact of termites on building timbers were application of insecticides, locust beans water, the plant of local tree named pakan pakan. Analysis of the results shown that more than eighty-three percent buildings selected for study seriously devastated by termites in the studied area. Moreover, 21.43% buildings been abandoned, 32.14% had collapsed and the remaining 46.43% were still habitable for owners.

Conclusively, termite attack is the most common cause of insect attack on timber in the studied area and its damage could be extensive and can be expensive to repair. However, simple precautions like Timber treatment, Avoidance of contact of susceptible timber with ground by using termite resistant concrete steel or DPC, Use of timber that is naturally resistant to termites such as Syncarpia glomulifera (Turpentine Tree), Callitris glaucophylla (White Cypress), Ayin or one of the Sequoias before construction could reduce the risk, and finally, maintenance routine that would include pruning trees back from buildings, and checking for galleries on post timber decay should be employed.

Key words: Termite, building, wooden, filtration, timbers, pakan-pakan.

INTRODUCTION

Over many years, sandcrete blocks, bricks, mud, cements, raffia palm and concrete have been used as construction materials in building structure. However, the use of wood can not be avoided for its complex varieties of purpose such as roofs, ceilings, furniture, cabinet, doors and windows. Though the cost of wood is very high its beauty and durability is a priceless thing. Its beauty though may just end up devastated due to termite's invasion. These termites are extremely destructives because they tunnel their way into wooden structures, into which they burrow to obtain food. Given enough time, they will feed on the wood until nothing is left but a shell, which cause collapse or damage of the wooden members of the building. Today, termite proofing and control have been widely used. This is done by injecting the solution by the use of soil injector at 300mm interval along the perimeter of the building and under the slab, some slab injector is used. Treatment is done until the queen termite is exterminated.

Small, herbivous termite insect are known to loose substrate borne vibration signals in gathering information about their environment and in communication with members of their own species. Substrate born-vibration

signal are well suited for such purposes in small insect owing to biophysical constrain such as the sizes of the insect and its receptor organ and the environment in which they live.

Termite, being small, herbivous and social insect, are known to employed vibration signal alarm, for example are well reported recently, it was discovered that dry wood termite in the genius cryptotermes use vibration to asses wood food volume with the suggestion that the frequency response of the wood (i.e. from the elastic by-product of feeding on the block) might be used by termite as the assessment method. However, this conjecture remained to be explicitly proofed. How termites use this signal is not entirely clear and other factor such as wood block mass may also be important.

The vibratory characteristic of any structure are strongly dependent on its material properties. Two important material properties that influence structural vibration are the velocity of longitudinal vibration (speed of sound) and the amount of internal loss (damping) in the material. Wood, the food dry wood termites, displays highly variable materials properties and, for example, may be found as part of live tree or as a dead log on the ground and is often located in a varieties of environment and / or embedded in soil all these factors might alter the effective vibratory properties and increase the range of material properties in termite encounter. Termites forage in all of this diverse situations their ability to asses wood as a food source ought to have evolve to cope with these complexities the decision to eat a particular pieces of wood could be informed by the vibrational signals they receive, which in turn depend on the material properties of the food source.

If the cryptotermes termites do use the frequency response of the wood as the primary assessment method, then perhaps they can be fooled by altering the material properties of a wooden block so as to manipulate the frequency response. It is possible to construct a composite block that are present in a wooden surface to termites with different material behind, thus altering the vibratory response and other characteristics of the composite structures, compared to a block of pure wood. The different material could include one with low damping and high speed of sound and other with high damping and low speed of sound, relative to wood, and thereby identify which (if any) of these factor are employed by the termite.

Aim and objectives of study.

The aim of this research is to assess the termite effect on timbers and extent of damages on building components in studied area and objectives of study are as follows:

- To determine the effect of termite on construction timbers
- To know the type of termite that mostly affects the timbers in this area.
- To determine the way termite assess and damage the wood
- To know the particular area where termite affects the timbers in Ibarapa East Local Government Area.

This study only tells about the effect of timber in different locations in Ibarapa East Local Government which includes Lanlate and Eruwa as major towns with surrounded by villages like Maya, Akete,. Aderonmu, Dagilegbo, Okolo.

Timbers widely used for various building constructions in Ibarapa East Local Government have shown significant presences of termites owing to their ‘galleries’ made of soil between their nest and their food source, these galleries from the soil to the posts, beams and roofs of the buildings are the sign of termites attack on timbers of buildings in area.

Timber.

Timber is a material used for carpentry and joinery work. Carpentry mainly concerns with constructional works such as roofs, floors, partitions etc. it is the wood obtained from extrogenous trees by cutting these trees after their full growth. Timber being one of the most important materials in civil engineering works and other technical related work courses of a country. The timber is mainly of two types, namely soft wood and hard wood.

Soft wood

The soft wood is obtained from tree having needle shaped leaves or carnifalers, the various soft woods are kail, pine, deodar, chir, walnut, semal and sprue. It is widely used for building constructions; the soft wood has the following characteristics: It is light in colour and weight, it has straight fiber and fine texture, it has good tensile resistance but is weak across the fibers, it is readily catches fire because it is a resinous wood and also easy to be worked on.

Hard wood

The hard wood is obtained from tree having broad leaves or deciduous. The various hard woods are sail, teak, mahogany shishan, oak, beack, ash, bamboo, neon, mango etc. it is widely used for door, furniture, joinery etc. the hard wood have the following characteristics: It is dark in colour and heavier in weight, its fibres are quite

close and compact, it is non resinous wood, it is both good tensile as well as shears resistance and it is difficult to work with.

Seasoning of timbers which is the process of drying timber or removing moisture content or sap, present in a freshly fell tree, under controlled condition could be carried out by the following common methods:

Natural seasoning or air seasoning: The tree after felling is converted into logs, plank or batten. These are stacked in dry places about 300mm above the floor level with longitudinal and cross pieces arranged one upon the other. While stacking should be ensure that there is a space between them for free circulation of air all around each pieces in order to prevent the effect of moisture on the wood from the bottom. A layer of Ander ash or sand is spread on the level platform before stacking the wood. These stack woods are turned upside down periodically in order to accelerate the rate of dry the wood got dried due to the circulation of free air. This method is simple and cheap but very slow. *Artificial seasoning:* This is the quickest method of seasoning woods and is commonly used. It keeps the moisture content under control. The processes are carried out in a chamber under a control temperature and humidity condition with proper air circulation and ventilation system. Usually, steam is used for this purpose. The seasoning is started at a comparatively lower temperature and high humidity, the condition are changed as the timber dries. At the end of the seasoning, the air is fairly hot and humidity is low. The required humidity level is maintained to avoid warping and cracking of the wood, the drying of the wood at a uniform air is well maintained by the circulating air. The ventilation is provided to avoid over heating and excessive humidity. Before removing the wood, the kiln is allowed to cool the temperature inside the kiln is within 15°c and 20°c of outside temperature.

Termites are a group of eusocial insects that, until recently, were classified at the taxonomic rank of order **Isoptera** (see taxonomy below), but are now accepted as the epifamily Termitoidae, of the cockroach order Blattaria. While termites are commonly known, especially in Australia, as "**white ants**," they are not closely related to true ants. Like ants, some bees, and wasps which are all placed in the separate order Hymenoptera-termites divide labour among castes, produce overlapping generations and take care of young collectively. Termites mostly feed on dead plant material, generally in the form of wood, leaf litter, soil, or animal dung, and about 10 percent of the estimated 4,000 species (about 2,600 taxonomically known) are economically significant as pests that can cause serious structural damage to buildings, crops or plantation forests. Termites are major detritivores, particularly in the subtropical and tropical regions, and their recycling of wood and other plant matter is of considerable ecological importance. As eusocial insects, termites live in colonies that, at maturity, number from several hundred to several million individuals. Colonies use decentralised, self-organised systems of activity guided by swarm intelligence to exploit food sources and environments that could not be available to any single insect acting alone. A typical colony contains nymphs (semi-mature young), workers, soldiers, and reproductive individuals of both genders, sometimes containing several egg-laying queens.

Social organization Reproductives

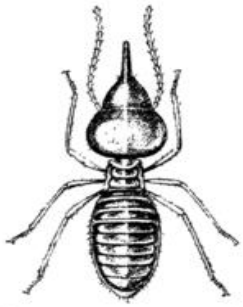
Preserved specimen of fertile termite queen, showing distended abdomen. The rest of its body is the same size as that of a worker. A female that has flown, mated, and is producing eggs is called a "queen." Similarly, a male that has flown, mated, and in proximity to a queen is termed a "king." Research using genetic techniques to determine relatedness of colony members is showing that the idea that colonies are only ever headed by a monogamous royal pair is wrong. Multiple pairs of reproductives within a colony are not uncommon. In the families Rhinotermitidae and Termitidae, and possibly others, sperm competition does not seem to occur (male genitalia are very simple and the sperm are anucleate), suggesting that only one male (king) generally mates within the colony. At maturity, a primary queen has a great capacity to lay eggs. In physogastric species, the queen adds an extra set of ovaries with each molt, resulting in a greatly distended abdomen and increased fecundity, often reported to reach a production of more than 2,000 eggs a day. The distended abdomen increases the queen's body length to several times more than before mating and reduces her ability to move freely, though attendant workers provide assistance. The queen is widely believed to be a primary source of pheromones useful in colony integration, and these are thought to be spread through shared feeding (trophallaxis). The king grows only slightly larger after initial mating and continues to mate with the queen for life. This is very different from ant colonies, in which a queen mates once with the male(s) and stores the gametes for life, and the male ants die shortly after mating. The winged (or "alate"') caste, also referred to as the reproductive caste, are generally the only termites with well-developed eyes, although workers of some harvesting species do have well-developed compound eyes, and, in other species, soldiers with eyes occasionally appear. Termites on the path to becoming alates (going through incomplete metamorphosis) form a subcaste in certain species of termites, functioning as workers ("pseudergates") and also as potential supplementary reproductives. Supplementaries have the ability to replace a dead primary reproductive and, at least in some species, several are recruited once a primary queen is lost.In areas with a distinct dry season, the alates leave the nest in large swarms after the first good soaking rain of the rainy season. In other regions, flights may occur throughout the year, or more commonly, in the spring and

autumn. Termites are relatively poor fliers and are readily blown downwind in wind speeds of less than 2 km/h, shedding their wings soon after landing at an acceptable site, where they mate and attempt to form a nest in damp timber or earth.

Worker termite

Worker termites undertake the labors of foraging, food storage, brood and nest maintenance, and some defense duties in certain species. Workers are the main caste in the colony for the digestion of cellulose in food and are the most likely to be found in infested wood. This is achieved in one of two ways. In all termite families except the Termitidae, there are flagellate protists in the gut that assist in cellulose digestion. However, in the Termitidae, which account for approximately 60 percent of all termite species, the flagellates have been lost and this digestive role is taken up, in part, by a consortium of prokaryotic organisms. This simple story, which has been in entomology textbooks for decades, is complicated by the finding that all studied termites can produce their own cellulase enzymes, and therefore can digest wood in the absence of their symbiotic microbes. Our knowledge of the relationships between the microbial and termite parts of their digestion is still rudimentary. What is true in all termite species, however, is that the workers feed the other members of the colony with substances derived from the digestion of plant material, either from the mouth or anus. This process of feeding of one colony member by another is known as trophallaxis and is one of the keys to the success of the group. It frees the parents from feeding all but the first generation of offspring, allowing for the group to grow much larger and ensuring that the necessary gut symbionts are transferred from one generation to another. Some termite species do not have a true worker caste, instead relying on nymphs that perform the same work without moulting into a separate caste.

Soldiers The soldier caste has anatomical and behavioural specializations, providing strength and armour which are primarily useful against ant attack. The proportion of soldiers within a colony varies both within and among species. Many soldiers have jaws so enlarged that they cannot feed themselves, but instead, like juveniles, are fed by workers. The pantropical subfamily Nasutitermitinae have soldiers with the ability to exude noxious liquids through either a horn-like nozzle (nasus) or simple hole in the head (fontanelle). Fontanelles which exude defensive secretions are also a feature of the family Rhinotermitidae. Many species are readily identified using the characteristics of the soldiers' heads, mandibles, or nasus. Among the drywood termites, a soldier's globular ("phragmotic") head can be used to block their narrow tunnels. Termite soldiers are usually blind, but in some families, soldiers developing from the reproductive line may have at least partly functional eyes.



Eutermes costaricensis, Nasute Soldier
After Banks and Snyder (loc. cit.).

Figure 1. A Nasute Soldier

A nasute: The specialization of the soldier caste is principally a defense against predation by ants. The wide range of jaw types and phragmotic heads provides methods that effectively block narrow termite tunnels against ant entry. A tunnel-blocking soldier can rebuff attacks from many ants. Usually more soldiers stand by behind the initial soldier so once the first one falls another soldier will take the place. In cases where the intrusion is coming from a breach that is larger than the soldier's head, defense requires special formations where soldiers form a phalanx-like formation around the breach and blindly bite at intruders or shoot toxic glue from the nasus. This formation involves self-sacrifice because once the workers have repaired the breach during fighting, no return is provided, thus leading to the death of all defenders. Another form of self-sacrifice is performed by Southeast Asian tar-baby termites (*Globitermes sulphureus*). The soldiers of this species commit suicide by autothysis—rupturing a large gland just beneath the surface of their cuticle. The thick yellow fluid in the gland becomes very sticky on contact with the air, entangling ants or other insects who are trying to invade the nest.

Termites undergo incomplete metamorphosis, with their freshly hatched young taking the form of tiny termites that grow without significant morphological changes (other than wings and soldier specializations). Some

species of termite have dimorphic soldiers (up to three times the size of smaller soldiers). Though their value is unknown, speculation is that they may function as an elite class that defends only the inner tunnels of the mound. Evidence for this is that, even when provoked, these large soldiers do not defend themselves but retreat deeper into the mound. On the other hand, dimorphic soldiers are common in some Australian species of *Schedorhinotermes* that neither build mounds nor appear to maintain complex nest structures. Some termite taxa are without soldiers; perhaps the best known of these are the Apicotermitinae.

Diet Termites are generally grouped according to their feeding behaviour. Thus, the commonly used general groupings are subterranean, soil-feeding, drywood, dampwood, and grass-eating. Of these, subterraneans and drywoods are primarily responsible for damage to human-made structures.

All termites eat cellulose in its various forms as plant fibre. Cellulose is a rich energy source (as demonstrated by the amount of energy released when wood is burned), but remains difficult to digest. Termites rely primarily upon symbiotic protozoa (metamonads) such as *Trichonympha*, and other microbes in their gut to digest the cellulose for them and absorb the end products for their own use. Gut protozoa, such as *Trichonympha*, in turn rely on symbiotic bacteria embedded on their surfaces to produce some of the necessary digestive enzymes. This relationship is one of the finest examples of mutualism among animals. Most so-called higher termites, especially in the Family Termitidae, can produce their own cellulase enzymes. However, they still retain a rich gut fauna and primarily rely upon the bacteria. Owing to closely related bacterial species, it is strongly presumed that the termites' gut flora are descended from the gut flora of the ancestral wood-eating cockroaches, like those of the genus *Cryptocercus*. Some species of termite practice fungiculture. They maintain a “garden” of specialized fungi of genus *Termitomyces*, which are nourished by the excrement of the insects. When the fungi are eaten, their spores pass undamaged through the intestines of the termites to complete the cycle by germinating in the fresh faecal pellets. They are also well known for eating smaller insects in a last resort environment.

Nests Termite workers build and maintain nests to house their colony. These are elaborate structures made using a combination of soil, mud, chewed wood/cellulose, saliva, and feces. A nest has many functions such as to provide a protected living space and to collect water through condensation. There are reproductive chambers and some species even maintain fungal gardens that are fed on collected plant matter, providing a nutritious mycelium on which the colony then feeds (*see "Diet," above*). Nests are punctuated by a maze of tunnel-like galleries that provide air conditioning and control the CO_2/O_2 balance, as well as allow the termites to move through the nest. Nests are commonly built underground, in large pieces of timber, inside fallen trees or atop living trees. Some species build nests aboveground, and they can develop into mounds. Homeowners need to be careful of tree stumps that have not been dug up. These are prime candidates for termite nests and being close to homes, termites usually end up destroying the siding and sometimes even wooden beams.

Mounds

Mounds (also known as "termitaria") occur when an aboveground nest grows beyond its initially concealing surface. They are commonly called “anthills” in Africa and Australia, despite the technical incorrectness of that name. In tropical savannas the mounds may be very large, with an extreme of 9 metres (30 ft) high in the case of large conical mounds constructed by some *Macrotermes* species in well-wooded areas in Africa. Two to three metres, however, would be typical for the largest mounds in most savannas. The shape ranges from somewhat amorphous domes or cones usually covered in grass and/or woody shrubs, to sculptured hard earth mounds, or a mixture of the two. Despite the irregular mound shapes, the different species in an area can usually be identified by simply looking at the mounds.

Shelter tubes

Nasutiterminae shelter tubes on a tree trunk provide cover for the trail from nest to forest floor.Termites are weak and relatively fragile insects that need to stay moist to survive. They can be overpowered by ants and other predators when exposed. They avoid these perils by covering their trails with tubing made of feces, plant matter, and soil. Thus the termites can remain hidden and wall out unfavourable environmental conditions. Sometimes these shelter tubes will extend for many metres, such as up the outside of a tree reaching from the soil to dead branches.

To a subterranean termite any breach of their tunnels or nest is a cause for alarm. When the Formosan subterranean termite (*Coptotermes formosanus*) and the Eastern subterranean termite (*Reticulitermes flavipes*) detect a potential breach, the soldiers will usually bang their heads apparently to attract other soldiers for defence and recruit additional workers to repair any breach.

RESEARCH METHODOLOGY

Description of the study area

Ibarapa East Local Government Area is one of the thirty three local governments of Oyo state, Nigeria. Land area of eight hundred and thirty eight (838) square kilometers with total population of about one hundred and eighteen thousand two hundred and twenty six (118,226) as at the 2006 national census, (NPC). Its local government head quarter is situated in a town named Eruwa.

Research Methodology

This focuses on the research method adopted for the collection of data such as administering questionnaire, direct oral interview and personal observations. Simple random sampling technique was also employed and the last stage involved data analysis using mainly descriptive statistics method.

Study Population

The population under study is the number of buildings sampled suffering from the impact of termites in Ibarapa east local government.

Method of Data Collection

The questionnaires were administered to the respondents concerned in addition to interviews and personal observations which altogether formed research instrumentation. The results obtained through these then formed the data to be analyzed. The close ended questionnaires were designed to collect data from the study areas in Ibarapa east local government and it was constructed in such a way that it brings out relevant information needed for the work at hand.

RESULTS AND DISCUSSIONS

About one hundred and forty buildings constructed of various materials were surveyed and selected for research work throughout Ibarapa East Local Government. Percentage of termites' effects based on materials and methods used for construction were collated and represented in the table 1 and figure 2 below. Based on materials and methods used, twenty houses were selected in each case which revealed that hundred percent (100%) of houses based on the following were greatly affected by termites: buildings constructed with mud, building constructed with grass and wood and the one made of grass, mud and wood. Also, about sixty percent (60%) houses made of damp proof course with either brick or block was severely attacked as well and buildings constructed of brick and block walls without damp proof course were ninety (90%) and eighty (80%) percent respectively. However, most of planks used for various constructions like ceilings, roof trusses, door frames, windows, and window frames of buildings were either made from thick, neem, ayin, iroko timbers etc. Moreover, table 2 and figure 3 were used to show the building stages in the location. About twenty-one (21%) percent of the houses were abandoned, thirty-two (22%) percent collapsed while about forty-seven (47%) percent were still habitable by their owners.

Termite damages were rampant in the studied areas was found to affect more than eighty-three (83%) percent of the selected buildings chose for study in Ibarapa East Local Government Area

Termite attack often started from the ground or from tree branches touching the building in addition to dead wood, tree stumps, wood stack and nearness to the forested area which in turn enhance the likelihood of said attack.

In addition, the termites, was discovered looking for their own food, and create nest under the ground and create a tunnel to a damp area of the building. They create the tunnel from the underground through the face of the wall to the timber part of the building such as window, roof, window frame, doors, and door lining and eat the wood and later destroyed the wooden member. They even create their mounds to the roof of the structure so that it will be easy for them to asses the nearest wood of the structure.

Table 1 Table Showing the Effect of Termites in Ibarapa East Local Government Area.

S/N	Type of Building	Members affected	Frequency	No. attack termites	% of Occurrence
1	Buildings constructed with mud.	Walls, windows, roofs.	20	20	17.09
2	Buildings constructed of damp proof course and brick walls.	Window frames, roof trusses.	20	12	10.25
3	Buildings constructed of damp proof course and block walls.	Window frames, roof trusses.	20	11	9.40
4	Buildings constructed of brick walls only.	Ceilings, roof trusses, door frames, windows, window frames.	20	18	15.38
5	Buildings constructed of block walls only.	Ceilings, roof trusses, door frames, windows, window frames.	20	16	13.68
6	Building constructed with grass and wood.	Wood planks and grass.	20	20	17.09
7	Building constructed with grass, mud and wood.	Mud walls, timbers and grass.	20	20	17.09
Total			140	117	100

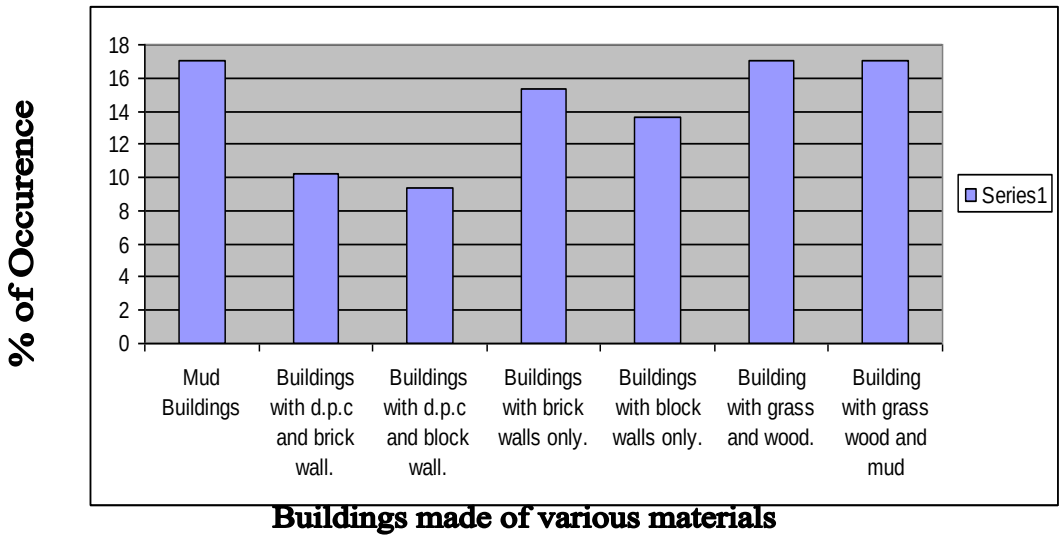


Figure 2. Bar Chart Showing Various Building Affected By Termite in Ibarapa East Local Government Area.

Table 2. Numbers and Percentages of Buildings Affected by Termites in Ibarapa East Local Governments Area.

Buildings	Number	Percentage (%)
Abandoned	30	21.43
Collapsed	45	32.14
Living	65	46.43
Total	140	100

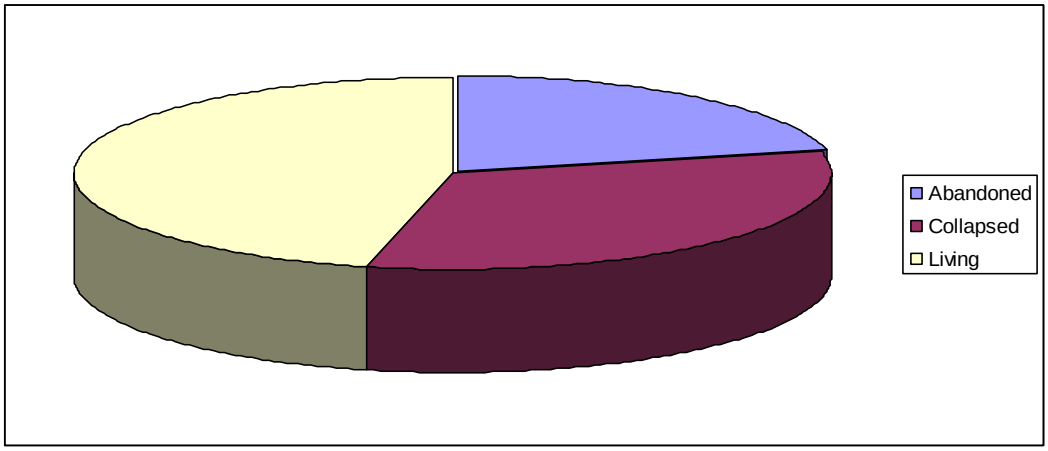


Figure 3. Pie Chart Showing the Numbers and Percentages of Buildings Affected by Termites in Ibarapa East Local Governments Area.

CONCLUSION

Timber decay is caused by a biological attack on the wood by certain species of fungi. The fungal spores lie dormant in the timber for years until the right conditions present themselves. The conditions needed are moisture or dampness and nutrients, with moisture being the critical component. If moisture is not present in timber, then the fungi will remain dormant, even when the nutrients they require are abundant. Termite attack is the most common cause of insect attack on timber in the studied area. A common misconception is that a termite is an ant. It is in fact a type of cockroach. Termite damage can be extensive and can be expensive to repair. Simple precaution before construction can reduce the risk, and maintenance routine should include pruning trees back from buildings, and checking for galleries on post.

Buildings should regularly be inspected so as to destroy the colony of termites that may by present at all time. Treatment with solegnum, creosote, locust beans water, appear to be effective in preventing the destructive impact of termite in the area. Furthermore, once termites invasion is discovered in a building, corrective control measure should be applied so as to cub the menace.

RECOMMENDATIONS

Considering the study findings, the following steps are hereby recommended as preventive and corrective measures in combating the harmful impact of termites in Ibarapa East Local Government Area of Oyo State in Nigeria:

- Timber treatment: Treatment with creosote appears to be effective, and the results of using different chemicals should be monitored and the cost-effectiveness of treatment by the Forest Research Centre and private firms compared.

- When termite have already penetrated a building, the first action is usually to destroy the colony with insecticides before removing the termites' means of access and fixing the problems that encouraged them in the first place.
- Avoid contact of susceptible timber with ground by using termite resistant concrete steel or masonry foundation with appropriate barriers (DPC) since findings show that building made of (DPC) were less prone to attack
- The intent of termite barriers (whether physical, poisoned soil, or some of the new poisoned plastics) should be provided to prevent the termites from gaining unseen access to structures.

- Use of timber that is naturally resistant to termites such as *Syncarpia glomulifera* (Turpentine Tree), *Callitris glaucophylla* (White Cypress), Ayin or one of the *Sequoias*. However, there is no tree species whose every individual tree yields only timbers that are immune to termite damage, so that even with well-known termite-resistant timber types, there will occasionally be pieces that are attacked. No species of tree produces timber that is completely immune to damage from every species of termite; some individual pieces of wood may be attacked.

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