

**PRESERVATIVE AND PESTICIDE USAGE IN SOME SAWMILLS IN  
OVIA-NORTHEAST LOCAL GOVERNMENT AREA OF EDO STATE  
NIGERIA**

**BY**

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## CERTIFICATION

This is to certify that this project work was carried out by **Mercy Janet OLUWADUN. (MISS)** in the Department of forest resources and Wildlife Management, Faculty of Agriculture, University of Benin, Benin City, Edo State, Nigeria.

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## **DEDICATION**

This project is dedicated to Almighty God, my parents, MR and MRS Blessing Oluwadun, my siblings, my friends and every single person that has helped me throughout my stay in UNIBEN.

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## ABSTRACT

This study was conducted to examine the preservatives and pesticide usage in some sawmills in Ovia North East Local Government Area Benin City. This study adopted purposive sampling techniques. Data collection, involved field survey and the field survey involved using questionnaires to collect data in conformity with the objectives. The survey data were analyzed using descriptive statistics such as, frequency distribution table, mean, and percentages. The majority (98%) of the respondents were male and the age distribution showed a predominance of relatively young workers. Most (63.1%) of the workers were married, and the educational distribution of respondents shows that the largest group has completed senior secondary school (34.5%), Work experience was also diverse, with a substantial number of experienced workers in the industry. *Khaya spp* (Mahogany), *Milicia excelsa* (Iroko), *Triplochiton scleroxylon* (Obeche), and *Lovoa trichilioides* (African Walnut) were among the most commonly supplied species. The source of timber supply to the sawmill indicated a higher percentage from natural forests and from another sawmill. While using naturally rot-resistant wood was a common method of treatment, the presence of wood-attacking insects of the order: Isoptera, Hemiptera and Coleoptera posed challenges to wood preservation. Chemical preservatives like Solignum and Attack were widely used. Pesticides and preservatives are used to protect wood products against these insect attacks, thus extending their lifespan. The method of application of preservatives and pesticides showed that brushing and spraying were the most prevalent methods. Based on the study and results obtained, the following recommendations are suggested: Sawmill operators should explore and adopt environmentally friendly wood preservation methods, such as heat treatment, borate-based preservatives, and naturally rot-resistant wood species. This will help minimize environmental impacts and enhance the industry's eco-friendliness.

## CHAPTER ONE

### 1.0 INTRODUCTION

Wood is in the forefront of world raw materials. It is one of the most abundant renewable raw materials in the forest. It is cheap and easy to work and fashion into different shapes and sizes (Ifebueme, 1993). It is a natural organic material whose use is widely spread (FAO, 2006). In most places and phases of use, there is possibility of deterioration from any of biological, physical and chemical agents (Wong *et al.*, 2005). The most important of these agents are the biological namely: termite and fungi which cause tremendous havoc whenever the right conditions are available. Where these agents are absent, wood is really very resistant and can survive in construction for a long time (FAO, 2006). Pests like beetles and termites destroy wood by feeding on its structural components; with cellulose being their principal food, thereby reducing its structural ability and appearance (Owoyemi *et al.*, 2020). This implies that wood and wood products such as paper, fabrics and wood structures are avidly consumed, and hence, a constant effort is directed towards their control or prevention (Brossard *et al.*, 2007; Peralta *et al.* 2004). Therefore, in outdoor applications, in order to arrest this destructive situation and reduce the loss incurred in terms of money and materials, a form of preservative treatment must be given; which are chemical preservatives in most general cases to prevent damage by these aggressive biodeteriorating agents (Evans, 2002; Schultz and Nicholas, 2002).

The rapid depletion of forest resources has put the environment in jeopardy causing life threatening problems as climate change, food insecurity, water scarcity, epidemics, erosion, poverty, deaths and conflicts due to competition for resources around the world (Izekor and Amiandamhen, 2011). This situation has resulted in insufficient availability of raw materials for wood-based industries. The economic value of a species has a major effect on its exploitation, hence its supply. Sawmill industry in Nigeria has an estimated capacity of

approximately 12 million m<sup>3</sup> per year in log equivalent, though only 40 percent of this capacity is actually used (Tembe *et al*, 2010). Izekor and Amiandamhen (2011) further reported that out of 100 percent volume of logs in sawmill, only 25% of these volumes are used as finished products while 65 percent is left as waste and 10 percent as mill loss as a result of spoilage due to pest. However, as a result of the inadequate information for proper wood management planning and excessive exploitation of wood, the guarantee for continuous supply is limited.

A better and more environmentally friendly use of timber resources is made possible by the use of suitable preservatives, which significantly extend the useful service life of wood products and structures. This reduces the overhead costs associated with maintaining and replacing such products or structures. Knowledge now in existence has demonstrated that some preservatives are more effective than others and that some are better suited to particular application conditions (Lebow, 2010). Lebow (2010) added that the type of preservative used, appropriate entry (absorption), and retention of the chemicals are all dependent on the type of treated wood and the treatment method used, which in turn are both dependent on the level of protection attained using the preservatives.

## **1.1 Objective of the study**

The objectives of this study were to;

1. Assess the source and various timber species supplied to the sawmill
2. Identify various insects and most common insects that attack wood in sawmill
3. Identify various preservatives and pesticides used in treating the wood and method of applications

## **1.2. Justification of the study**

Given the depletion in the rain forest (over exploitation, species extinction, various forms of encroachments in to the forest area etc.), on one hand, and the myriads of problems (aforementioned) regarding wood procurement in the south, if the locally preservative solution are favorable in Nigeria, this will help new sawmill available timber preservatives in the market and hence serve the life of many Nigerian trees for the health and environmental sustainability.

Similarly, the research work is intended to provide relevant information that will serve as baseline for further researches. Generally, wood is of commercial importance (Akpan, 2006). It has been used for thousands of years as material for construction and wood also plays an important role in furniture making.

Efforts were made to study the effects of pesticide available on timber species. This study was designed to assess appropriate preservatives for woods. This may lower the price of timber and hence make it available for the common man.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Uses/Importance of wood

Wood is a valuable natural resource and is widely available and relatively inexpensive in most areas. It has many uses because of its electrical and thermal conductivity, workability, beauty, density and strength. Unfortunately, it is subject to attack by insects, bacteria, fungi and marine worms and if left unprotected in the landscape, wood deteriorates. Fortunately, some woods are naturally durable or resistant to deterioration (Pinyuh, 1995). Inner heartwood is more resistant than outer, because wood is porous or permeable, it can be protected for many years with preservatives.

Wood is a hard, fibrous tissue found in many plants. It has been used for centuries for both fuel and as a construction material for several types of living area such as houses (Briffa, 2008). It is an organic material, a natural composite of cellulose fibres (which are strong in tension) embedded in a matrix of lignin which resist compression (Anon.,2007b). In the strict sense, wood is produced as secondary xylem in the stems of trees and other woody plants (Samuel, 2004). In a living tree it transfers water and nutrients to the leaves and other growing tissues, thus has a supporting function, enabling woody plants to reach large sizes or to stand up for themselves.

Jerrold (2005), reported that wood is an extremely versatile material with a wide range of physical and mechanical properties; it is also a renewable resource with an exceptional strength to weight ratio. Wood is a desirable construction material because the energy requirement of wood for producing a usable end product are much lower than those of competitive materials such as steel, concrete or plastics. Wood is the only self-regenerating building material that is extremely energy efficient (FAO, 2006). It can be used for several purposes ranging from household to industrial uses, and it has also been identified as a raw material for a number of

industries (Opeyemi, 2001). Among the industries that depend on wood for production are sawmills, particle board, fibre board, plywood, furniture and pulp and paper. Wood and wood products are export commodities for some of the West African countries (Osho,1998). Useful chemical and byproducts can be obtained from wood. These include animal feeds, adhesives, lacquers, turpentine, plastics, photographic film, rayon and artificial vanilla. Chemicals obtained from wood are used to give special properties to various materials, including explosives and concrete.

## **2.2 Causes of Deterioration in Wood**

Any decrease in the performance of wood is deterioration. The effect of deterioration on the value of the wood may depend upon the wood's use. Although borer holes may make an attractive plywood veneer, the strength of the wood is greatly reduced for most uses. Fungal or bacterial straining may not weaken the wood, but it makes it unattractive for fine furniture (Curtis and Williams, 1990).

Bacteria, fungi, marine worms, and insects all deteriorate wood and wood products. Climatic conditions, particularly increased moisture and fluctuating temperatures, interact with biological organisms in deteriorating wood (Gutzner, 1991). Warm, moist environments hasten the breakdown of wood. Periodic treatment of wood exposed with simple water repellents that keep wood dry helps prevent physical damage and reduce fungal and bacterial decay.

Five groups of fungi attack wood: brown rots, white rots, soft rots, stains and moulds. The first three deteriorate wood and the last two discolor its surface. Wood that is intermittently moist is particularly susceptible to fungal attack. Several insects infest wood. Some cause damage as adults, others as larvae. Several attack living trees, while many prefer sawed seasoned wood. Some insects infest hardwoods, but not softwoods and vice versa. Powder post, antacid and longhorn beetles are also very important destroyers of wood (Harris and Dines, 1988).

### **2.3 wood deterioration**

According to Samuel (2004), Wood must be used in defect free state and maintained so in its service life. In order to achieve this, wood must be protected from the felling stage, through the processing stage to the intended end use, and the two phases of deterioration are

**(i) Chromatic deterioration** : mainly colour degradation resulting from weathering which practically does not affect the mechanical resistance or properties of wood. It is also very slow as the rate of removal surface is about 1mm in every 20years.

**(ii) Proper deterioration**: This results from attack of fungi and insects. It brings about reduction of mechanical resistance of wood (Samuel, 2004). This can occur at any stage in the life of wood- standing tree, logs, converted assortments etc.

### **2.4 Density of wood**

Akpan, (1998) defined density as the mass per unit volume of wood that is obtained by dividing the mass of the wood by its volume. Wood density is the most important single factor influencing the strength of timber (ASTM, 1985; Akpan, 1998), though, there are many other variables. While some of these variables are anatomical in origin (Knots, slope of grain, tension wood, compression wood and microfibrillar angles) others are environmental (moisture content and temperature). All of these factors play a significant role in determining the strength and stiffness of wood (Akpan, 2006).

The density or weight per volume of wood varies considerably between and within wood species (Thomas and Williamson, 2002). Wood density is always reported in combination with the moisture. This is due to the significant influence moisture content has on overall density. The weight is determined on a balance or pair of scales, to accuracy depending on the purpose for which the determination is required (Dinwoodie, 1981). As mentioned earlier, the density of wood exclusive of water varies greatly both within and between species. It has been reported (Baker, 1980) that, although the density of most species falls about 320 and 720 kg/m<sup>3</sup>, the

range of density actually extend from about 160 kg/m<sup>3</sup> for balsa to more than 1,040 kg/m<sup>3</sup> for some other wood such as *Lophira alata* Ekki. According to this authority, a coefficient of variation of about 10% is considered suitable for describing the variability of density within common domestic species. It has, however been reported (Dinwoodie, 1981) that the relative density of the solid wood material of cell wall has been found to be similar in all timbers, and is in the neighborhood of 1.5 that is the cell wall are about one and a half times as heavy as water. This, invariably, means that a cubic metre of solid wood, without cell cavities and intercellular spaces would weight roughly 1500 kilograms. Variation exist between different timbers, which may vary in weight from about 160 to 1250 kilograms per cubic metre, a variation caused by differences in the ratio of cell wall to air space in different timbers.

## **2.5 Wood properties**

### **2.5.1 Wood physical properties**

Physical properties of wood are the quantitative characteristics of wood and its behaviour to external influences. Included here are the grains directional properties, moisture content, dimensional stability, thermal and pyrolytic (fire) properties, density, electrical, chemical and decay resistance. Physical properties significantly influence the performance and strength of wood used in structural application (Malami, 2010).

### **2.5.2 Wood mechanical properties**

Mechanical properties are characteristics of a material in response to externally applied forces. They include elastic properties, which characterize resistance to deformation and distortion, and strength properties, which characterize resistance to applied loads (Malami, 2010). Mechanical property values are given in terms of stress (force per unit area) and strain (deformation resulting from stress) e.g MOE (Modulus of Elasticity), MOR (Modulus of Rupture).

## **2.6 Major insects of wood**

### **2.6.1 Termites (Isoptera)**

These are the most destructive among wood destroying insects. They attack both living and dead tree and eat wood from ground level to roof tops, although termites feed on wide range of substances which include leaves, seeds, fabrics, etc, their main food is cellulose (Peralta *et al.*, 2004). Termites are social animals which live in colonies and consist of workers, soldiers, king and productive queen. The queen produces eggs at a high rate of about 30,000 eggs per day. The workers build the nest (mound) and feed the king, queen and soldiers, while the soldiers protect the colony from attack. They work together corporately. Termites thrive well only in warm climate both on land or underground and can be grouped into subterranean and those that live completely isolated from the ground and the dry wood termites Rhinotermitidae belong to the families Kalotermitidae respectively (Grimaldi and Engel, 2005).

#### **2.6.1.1 *Coptotermes formosanus* Subterranean Termites (Isoptera: Rhinotermitidae)**

Subterranean termites (Order: *Rhinotermitidae*). These can have up to 2 million members in a colony. Their colonies are divided into three groups: workers, soldiers and reproductives (king and queen). They are creamy brown in colour, have six legs, wings and antenna. They eat wood, wallpaper, plastics and fabric made from plants.

Sub-terranean termites need contact with the soil to survive. They live in underground colonies or in wet areas above ground. They build tunnels to reach food and every spring, groups of reproductive termites fly off to start new colonies. Subterranean termites are the most destructive kind of termites. They can eat a lot of wood and they can cause a lot of damage to a house. They can destroy building foundations, wooden support beams, plastic plumbing pipes, sub-flooring, insulation and even swimming pool liners and filtration systems. It can also injure or destroy living trees and shrubs (Malaka, 1996).

### **2.6.1.2 *Cryptotermes cavifrons* Drywood Termite (*Isoptera: Kalotermitidae*)**

Dry wood termites form colonies of up to 2,500 members. Dry wood termite colonies don't have workers. Younger termites, called "false workers", do all the work for the colony. It is light brown, and has antenna and wings with six legs. They feed on wood, wallpaper, plastics and fabric made from plants. Colonies are usually found in dry wood and they do not require moisture or contact with the soil. A major impact of dry wood termite is that they can build nests and dig tunnels in buildings. These tunnels cause major damage because the wooden support beams can become weak and make the building lean or fall down.

No wood is completely immune to termite attack, but some wood offer considerable resistance relative to others. The degree of resistance depends on the wood extractive concentration and toxicity. Species like *Tectona grandis*, *Khaya senegalensis* and *Eucalyptus camaldulensis* have developed effective defence against termites (Grimaldi and Engel, 2005). There is an observable balance between the growth of the plant and the feeding of termites (Engel and Krishna, 2004). Defence is typically achieved by secreting anti-feeding chemicals such as oils, resins and lignin into the woody cell walls. Termite workers feed on the wood structure by biting and chewing with their mandibles while the others feed on the residue and partly digested materials from their stomach (Peralta *et al.*, 2004). The presence of cellulose digesting protozoa enables them to utilize wood as food. Infestation of wood by termites may take place in standing trees, wood works that have been in service for years or at any intermediate stage depending on the wood species or the treatment it has previously undergone.

### **2.6.2 *Lyctoxylon dentatum* Lyctus (*Coleoptera: Bostrichidae*)**

This is known as the powder post beetle. The adult is reddish brown and about 5mm in length. The larvae are yellowish white in color with brown jaws also about 5mm in length. The female beetle lays about 30 to 50 eggs in sapwood of open grained wood. The activities are restricted

only to the sapwood where it finds the starch it needs for food (Solomon and Payre, 1986). The heartwood which is denser and of little value to the insect is hardly attacked. In tropical warm conditions, the life cycle is usually less than one year, as a result of which infestation is quite rapid (Engineers, 2010). The beetle attacks newly felled timber. Generally, the starch in wood dries out and has no food value within 15 years of felling or conversion (Solomon and Payre, 1986).

### **2.6.3 *Hylotrupes bajulus* longhorn beetle (Coleoptera: Latreille)**

The beetle is large and may be up to 7.5mm in length. It is of brown color and mainly attacks unseasoned wood, drying trees and newly felled logs especially when the bark is left on the trunk (Solomon and Payre, 1986). The longhorn beetle rarely attack seasoned wood and is hardly seen in properly conducted log yard.

### **2.6.4 *Xeslobium rufovillosum* Death watch beetle (Coleoptera: Anobiidea)**

The beetle is about 6mm long and it is chocolate brown color with yellow hairs on the wing cover (Solomon and Payre, 1986). It generally attacks hardwoods especially in old building where the wood may damp and decay. The beetle rarely attacks sound timber and this is very important for control operations (Engineers, 2010). The eggs are laid on the surface of wood, where they hatch and the larvae bore holes into the wood. The adult beetle eventually emerges from an exit in the galleries.

### **2.6.5 *Myoplatypus flavicornis* Furniture Beetle (Coleoptera: Curculionidae)**

These are the most common wood boring beetles. It attacks both hard and soft wood either as furniture or structural timber. The beetle is from 2.5 to 5mm in length and lays eggs in crevices of wood work where they hatch and burrow into the wood consuming the cellulose that makes up the cells (Samuel, 2004).

The grub metamorphoses into pupa and pupa to adult which eats its way out and flies to infest any other wood (Solomon and Payre, 1986).

### **2.6.6 *Componotus pennsylvanicus* Carpenter ants (*Hymenoptera: Formicidae*)**

These insects nest in the wood particularly wet wood. They do not actually eat it but they nest on it. A tell-tale sign of the presence of carpenter ants is small recurring piles of sawdust. Carpenter ants are especially fond of soft wood, where it is easier to curve out their nest (Solomon and Payre, 1986). Typically, they will simply infest on a small not a large portion of whole wood as is often the case with termite. In building, water entry from plumbing leaks or other sources often encourage carpenter ant activity (Samuel, 2004).

### **2.6.7 *Xylocopa viginica* Carpenter bees (*Hymenoptera: Apidae*)**

These are somewhat like carpenter ants with striped uniforms, often blue or black, and they look like bumble bees. They like to nest in the exposed softwoods on the exterior woods- exterior siding, trims, sophist, fascia, etc. Unpainted wood is more prone to its damage than painted finishes (Solomon and Payre, 1986). Their also pointed out that Carpenter bees bore round holes in the wood.

## **2.7 Factors that influence the visit of insect**

Insects are naturally drawn to specific types of wood, with softwoods like pine and cedar being more susceptible due to their porous nature, providing easy access for insects. Additionally, the moisture content of wood plays a crucial role; high moisture levels create an ideal habitat for insects, making well-seasoned, dry wood less attractive to them. In warm, humid conditions, insects become more active, seeking out soft and damp wood, which they can easily burrow into (Grimaldi and Engel, 2005). Wood that has been damaged, whether due to physical factors or improper handling, provides entry points for insects, especially if the protective layers of the wood are compromised. Moreover, the presence of fungi and mold on the wood's surface further entices insects, as they feed on these organic materials, making decaying wood a prime target. The location of the furniture matters too; dark, damp, and poorly ventilated spaces create perfect conditions for infestations, especially if there are nearby food sources for insects (Samuel, 2004).

Regular maintenance is essential; neglected furniture, accumulating debris and moisture, becomes an attractive breeding ground. Previous infestations leave residual pheromones and remnants, continuing to lure insects back. Wood chemical composition matters, as certain natural compounds within the wood, such as resins and oils, act as deterrents, with cedar being a prime example. Considering these factors, preventive measures, including using insect-resistant wood and maintaining optimal indoor conditions, are crucial to safeguarding furniture from insect infestations (FAO, 2006).

## **2.8 Wood preservation and preservatives**

Wood preservation is the process of preserving wood from the wood destroying agents like insects or fungus so that the life span of the wood can be extended. It refers to the treatment of wood to impart resistance to degradation and deterioration by living organisms (Tsoho, 2008). The proper application of chemical preservatives can protect wood from decay and stain fungi, insects and marine borers, thus prolonging the service life of wood for many years (Anon., 2007b). The wood contains cellulose, hemicelluloses, starch and other susceptible materials that attract fungi and insects to be degraded and eaten. After the preservative treatments, the fungi and insects cannot decompose and feed on the wood, hence the durability of wood is increased (Anon., 2007b).

The main aim of wood preservation is to protect the wood against destructive agents. Various methods have been advocated for preserving wood and the use of preservatives was an acceptable and standard procedure in the area of wood conservation and utilization (Adetogun, 1998). The extended serviceable life of the treated wood in particular reduces very considerably the drain on the forest resources (FAO, 2006). Average cost of preservation may amount to 25 to 35% of the initial value of the wood and ensures a service life of not less than three to five times of untreated timber.

Encyclopaedia Britannica (2006), outlined the factors affecting the penetration of preservatives. These include species and structure of wood, density, moisture content, and direction of grain, types of preservatives and the treatment process used.

### **2.8.1 Importance of wood preservation**

Wood is a biodegradable and versatile construction material which needs protection from degrading factors, most especially, insect and fungi attack, fire and decay (Allan, 2000). It has excellent potential as a structural material and has multifarious application in construction, furniture, wood based panels and a host of other industries. However, most wood species consist of distinct heartwood and sapwood. A cross section of the trunk has heartwood in the centre which is surrounded by a light rim of sapwood. The sapwood conduct fluid but the heartwood is generally drier and is biologically dead. Metabolic by-product generally referred to as extractives are deposited at the sapwood-heartwood boundary which expands as the tree grows. The extractive darken the heartwood and makes it naturally durable due to their toxicity to fungi, termites and borers, the sapwood of most species are highly susceptible to bio deterioration in view of the presence of the food substance that they contain. Consequently, if wood is to be effectively utilized in construction and furniture industries it is imperative that the wood undergo adequate treatment to increase its lifespan in service.

According to Allan (2000), the wood preservation industry provides the most sustainable opportunity for forest conservation. McClain (1999) reported that Formosan Subterranean Termite (FST) caused damage equivalent to \$300 million annually in new Orleans, USA, while Ring (1999) reported that about \$2 billion was used to replace the wood damages caused by FST in 1999. Consequently, necessary measures should be taken to extend the lifespan. There are a number of different preservatives and processes that can extend the life of wood, timber, wood structure and engineered wood. The preservatives treatment of only 10% of total wood

utilized in Nigeria for about 60 years could lead to savings of as much as 1.5 billion trees or 1 million hectares of forests (Allan, 2000). Currently, less than 5% of the total volume of wood used is adequately preserved while in countries such as New Zealand and Australia, about 40% of the total wood consumed is treated. Although the cost of preserving wood represents about 5 to 15% of the cost of timber, the additional cost has proved worthwhile as chemically treated wood can last for hundred of years while untreated wood can decay and collapse within 5 to 10 years in service.

### **2.8.2 Properties of good preservatives**

The following properties of good wood preservatives have been documented (Encyclopedia Britannica, 2006).

- i Highly poisonous to insects and other destructive agents
- ii Readily absorbed by wood penetrating the cell and cell wall.
- iii Remain effective for many years.
- iv It should be cheap readily obtainable, safe to use, easy to apply, clean, colour and odourless.
- v Harmless to wood and metals and to finishing material.
- vi Fire resistance or at least should not increase flammability.

### **2.8.3 Types of preservatives**

Types of preservatives commonly used on insects and other non insect deteriorating agents are:  
Natural preservatives and Chemical preservatives

#### **2.8.3.1 Natural preservatives**

**Use of naturally rot-resistant wood:** Some wood species are resistant to decay in their natural state, due to high level of organic chemicals called extractives, mainly phenols. Extractives are

chemical that are deposited in the heartwood of certain tree species. The natural durability or rot and insect resistance of wood species is always based on the heartwood. The sap of all timber species are non durable without preservative treatment (Anon., 2007b).

**Heat treatment:** This is the use of heat in timber preservation. It is done by heating timber to a certain temperature ranging from 180-230°C for a period of 24-48 hours depending on the species. Richardson (2005), pointed out that, this method makes wood fibre less appetizing to most deteriorating agents and unlikely to be as effective as chemical preservatives. These processes increase the durability, dimensional stability and hardness of the treated wood and in some species even the colour can be altered.

**Mud Treatment:** This practice is widely used in Vietnam. In this method, wood and bamboo can be buried in clay mud mixed with rice hay to prevent it from insect and decay. (Anon., 2007b). Roger *et al.*, (2006), stated that, it is possible that the predominantly clay soils prevalent in Vietnam provide a degree of mechanical protection against insects attack which compensates for the accelerated rate of decay.

### 2.8.3.2 Chemical preservatives

These are categorized in to water-borne preservatives, oil –borne preservatives, and light organic solvent preservatives (Anon., 2007b)

**Water-borne preservatives or chemicals:** Water is the most common solvent carrier in preservative formulations due to its availability and low cost. Water-borne systems do however have the drawback that they swell timber, leading to increased twisting, splitting and checking than alternatives. Examples are copper-chrome-arsenic preservatives, Borate (Boron) preservatives and Fluorine compounds (Anon., 2007b).

**Oil-borne preservatives:** These chemicals are toxic, have unpleasant odour and are generally not used in consumer products. These oil preservatives derived from cold-tar, petroleum or wood tar, are usually known as oil borne preservatives. Examples: tar oil creosote, Tar oil (pyridine, acridine & quinolene), Neutral oil (white spirit, kerosene, diesel oil) (Anon., 2007b).

**Light Organic solvent preservatives** are preservatives containing chemicals toxic to fungi and insects. This kind of preservative is soluble only in organic solvent. Examples are Copper pentachlorophenate (CPCP), Benzene hexachloride, pentachlorophenol and Dieldrin (Anon., 2007b).

#### **2.8.4 Preservative Application Methods**

The various methods of applying preservatives are broadly categorized into: Pressure and Non Pressure processes

**Pressure processes:** They are those processes in which the treatment is carried out in closed cylinder with applied preservatives and Pressure and /or vacuum. The various pressure processes are: Empty cell process: in this process wood is placed in to the closed cylinder and preservatives are pumped under hydraulic pressure while full cell process in this process wood is dehydrated first before pumping the preservatives into the cylinder.

**Non pressure processes:** There are numerous non pressure processes of treating wood which vary primarily in their procedures. The most common of these treatments involve the application of the preservatives by means of brushing, spraying, dipping, soaking, steeping or by hot and cold bath.

#### **2.9 Preservatives analysis of wood in sawmills**

Owoyemi *et al.*, (2020) studied the efficacy of three commonly used wood preservatives in Akungba-Akoko, against subterranean termites attack. Samples were prepared according to

ASTM D3345-17 for durability test. All samples were oven dried for 24 hours at  $103\pm 2^{\circ}\text{C}$  prior to preservative treatments. Treated wood samples were buried half way in the soil and exposed to subterranean termites for 12 weeks at a timber grave yard. Weekly visual rating of the stakes was performed, while a gravimetric weight loss assessment was carried out after the 12 weeks of exposure. Owoyemi *et al.*, (2020) revealed the presence of two termite species: *Macrotermes subhyalinus* Rambur and *Microtermes spp.* within the graveyard. Density of the wood species ranged from  $542.28\pm 42.40\text{ Kg/m}^3$  (*P. macrocarpa*) to  $237.99\pm 6.94\text{ Kg/m}^3$  (*R. heudelotii*). Kinematic viscosities ( $25^{\circ}\text{C}$ ) of the liquid preservatives ranged from  $1433.25\pm 30.96\text{ cSt}$  (Timbguard™) to  $3909.75\pm 225.76\text{ cSt}$  (Solignum). Preservative absorption capacity ranged from  $7.82\pm 2.31\%$  (*P. macrocarpa* treated with spent engine oil) to  $52.16\pm 9.36\%$  (*R. heudelotii* treated with Timbguard™), while preservative retention ranged from  $2.57\pm 0.17\text{ Kg/m}^3$  (*R. heudelotii* treated with spent engine oil) to  $14.42\pm 1.13\text{ Kg/m}^3$  (*A. boonei* treated with Timbguard™). Owoyemi *et al.*, (2020) stated that all the three preservatives were effective in protecting the three selected wood species with gravimetric weight loss values less than 10 %; establishing their efficacy in protecting wood material against subterranean termites.

## **CHAPTER THREE**

### **3.0 MATERIALS AND METHODS**

#### **3.1 The Study Area**

This study was carried out in different sawmills in Ovia North-East local government area. Ovia North-East local government area which is the specific area of study is one of the 18 local governments in Edo state. The local government headquarter is Okada town which consists of Adolor, Iguoshodin, Isiuwa, Oduna, Kokhuo, Oghede, Okada, Oluku, Uhen, Uhiere and Utoka. The LGA lies between latitude 6°28' 0"N and longitude 5°35' 59"E. The main river which is the Ovia river flows through all of the communities in the LGA. It has an area of about 2,301km<sup>2</sup> and a population of 153,849 (NPC, 2006). It is one of the largest LGA in Edo state in terms of land mass and it shares boundary with Egor LGA and Idanre LGA of Ondo state. The climate is tropically two major seasons; the wet and dry season that favours timbers production. The people in Ovia North-East LGA are mainly farmers and also engaged in wood processing.

#### **3.2 Sampling technique**

This study adopted purposive sampling techniques. There are 128 sawmills in Ovia North East, but only 14 are functional. Out of the 14 sawmills, 50% of the sampling intensity was purposefully selected for the study. This approach ensured that the study focuses on active sawmills, with easy accessibility, providing relevant and representative data for the research. Each sawmill has an average of 16 staffs, and 75% of the staffs for each sawmill were selected, which amount to a total of 84 respondents for the study.

### 3.3 Data collection

Data collection involved field survey. The field survey involved using questionnaires to collect data in conformity with the objectives. The questionnaire information included various timber species supplied to the sawmill, source of supply to the sawmill, various insects that attack wood in sawmill, the most common insect that attack sawn wood in the sawmill, various preservatives and pesticide used in treating the wood and the method of applications of preservatives and pesticide. Secondary data sourced from journals and other relevant information media.

### 3.4 Data Analysis

The survey data was analyzed using descriptive statistics such as, frequency distribution table, mean, and percentages. SPSS Software was used for the analysis.

This study adopted purposive sampling techniques for selecting 84 respondents for the study.

**Table 3.1: Gps Location/ Name of sawmills/location/coordinate**

Name of sawmill	Name of owner	Location	Local Government Area	GPS Coordinate
De Mercy sawmill	Mr Daniel Osawaru	Upper Siluko	Ovia North East LGA	6.39329 ° N, 5.56952 ° E
Eagle Timber sawmill	Mr Solomon	Isihior	Ovia North East LGA	6.41574 ° N, 5.60440 ° E
Abuja sawmill	Mr Chukuemeka	163, New Lagos Road	Ovia North East LGA	6.37761 ° N, 5.61160 ° E
Osazee David Igbinovia sawmill	Mr David Osazee	Oluku	Ovia North East LGA	6.45786 ° N, 5.59404 ° E
Mercy Iyamu sawmill	Mr Iyamu	Oluku	Ovia North East LGA	6.45273 ° N, 5.59153 ° E
Gidihgha sawmills	Mr Ifaluyi	Ovbioge	Ovia North East LGA	6.47725 ° N, 5.58815 ° E
Victoria Ohions sawmills	Mrs Victoria	Upper Siluko	Ovia North East LGA	6.39210° N, 5.56829 ° E

Identified insects in the sawmill



**Plate 1: Subterranean termite**

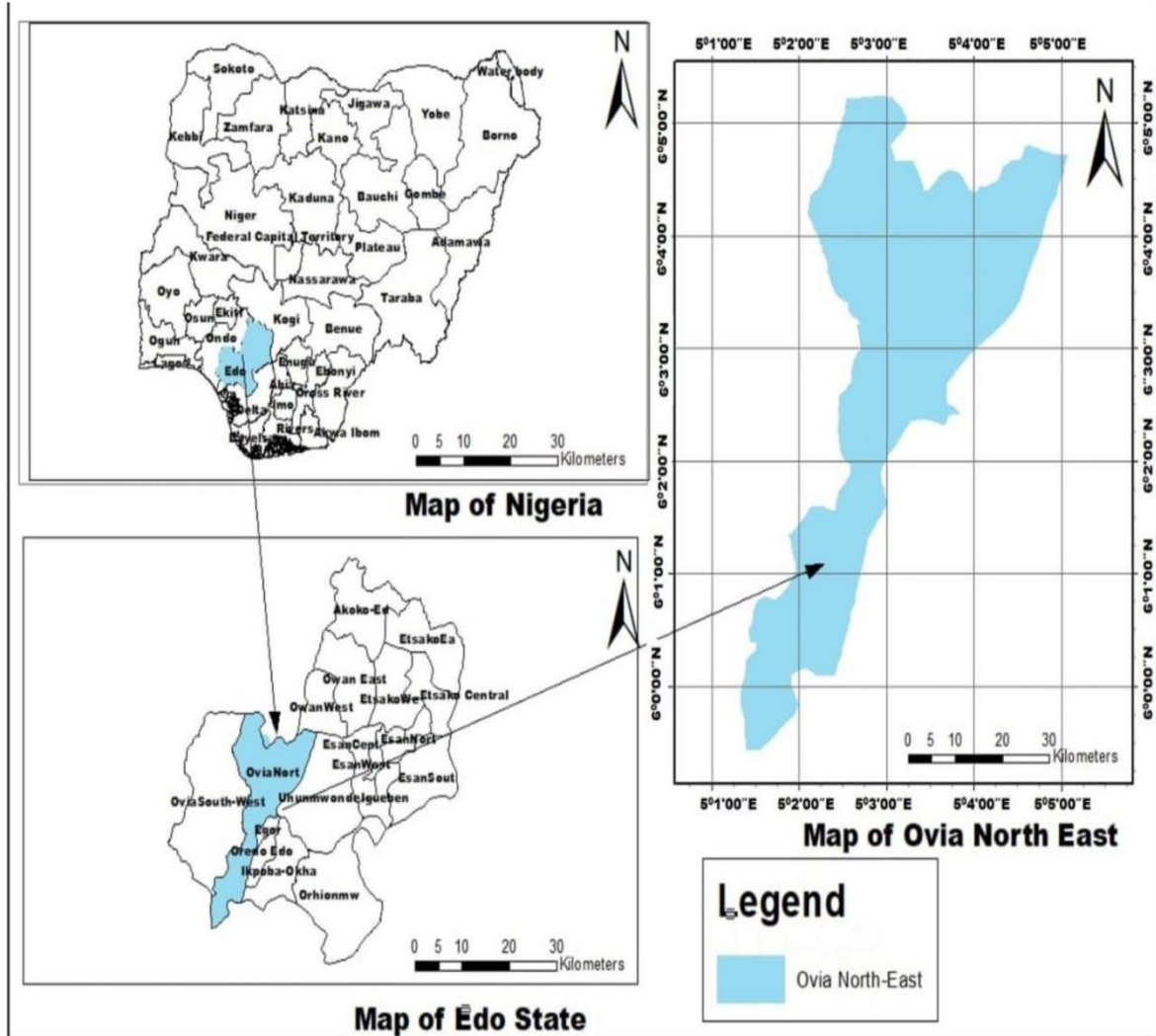


**Plate 2: Picture of study site, Eagle sawmill at Isihor in Benin City, Edo**



**Plate 3: Picture of study site, Abuja Sawmill at New Lagos Road, Benin city, Edo State**

**Plate 4: Map of study Area, Ovia North East Local Government Area, Edo State**



## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### **4.1: Distribution of respondents according to their Socio-Economic Characteristics**

Table 4.1 revealed the socio-economic characteristics of different sawmill workers in Ovia North-East local government area. The result shows that 98% of the total populations were male while 1.2% of the total populations were female. This implies that more males are involved in wood processing than females in the study area. This suggests that there is a significant gender imbalance among the respondents in the study on preservatives and pesticide usage in sawmills. The implication of this result is that any findings or conclusions drawn from the study may not be fully representative of the female workforce in the sawmills. It highlights the need for a more inclusive approach and gender-specific investigations to understand the potential variations in preservatives and pesticide usage practices between male and female workers.

The age distribution of respondents shows that the largest group falls within the age range of 26-35 (38.1%), followed by 19-25 (25%), and 36-45 (22.6%). The implication of this finding is that the sawmill workforce predominantly consists of relatively young individuals. This information can be crucial for understanding the generational impact on preservative and pesticide usage practices. Younger workers may have different attitudes, awareness, and safety practices compared to older workers, which should be taken into account while formulating policies and safety measures in sawmills.

The majority of respondents were married (63.1%), followed by single (32.1%) and divorced (3.6%) individuals. There was only one respondent each for the widow and widower categories (both 1.2%). The implication of this result is that the majority of the workforce were married, which may have implications for their work-life balance and safety practices. Married individuals may have additional responsibilities outside of work, and this could

impact their exposure and attitudes towards preservative and pesticide usage. Understanding the marital status of workers helps in tailoring safety programs and support systems that consider the specific needs and challenges faced by married workers.

The educational distribution of respondents showed that the largest group completed senior secondary school (34.5%), followed by primary school with a living certificate (29.8%), no formal education (22.6%), and tertiary education (13.1%). The implication of this result is that the sawmill workforce comprises individuals with diverse educational backgrounds. The level of education can influence workers' understanding of the potential risks associated with preservatives and pesticides, as well as their ability to comprehend safety guidelines and regulations. Designing training programs and safety materials at different educational levels can help improve workers' awareness and compliance with safety measures.

The majority of respondents have work experience between 11-20 years (40.5%) and less than 10 years (31.0%), followed by 21-30 years (21.4%) and above 30 years (7.1%). The implication of this result is that the sawmill workforce is relatively experienced, with a substantial number of workers having spent a significant amount of time in the industry. Experienced workers may have accumulated knowledge and familiarity with preservative and pesticide usage, but they might also be less receptive to new safety practices. Therefore, targeting safety training and interventions towards both experienced and less-experienced workers can help maintain a safe working environment and reduce the potential risks associated with chemical usage.

**Table 4.1: Distribution of respondents according to their socio-economic characteristics**

<b>Parameter</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Sex</b>		
Male	83	98.8
Female	1	1.2
<b>Age</b>		
19-25	21	25
26-35	32	38.1
36-45	19	22.6
46-55	10	11.9
56-65	2	2.4
<b>Marital Status</b>		
Single	27	32.1
Married	53	63.1
Divorced	3	3.6
Widow		
Widower	1	1.2
<b>Educational Level</b>		
No formal education	19	22.6
Primary School living certificate	25	29.8
Senior Secondary school	29	34.5
Tertiary	11	13.1
<b>Years of experience</b>		
Less than 10 years	26	31.0
11-20	34	40.5
21-30	18	21.4
Above 30	6	7.1

Field Survey, (2023)

#### **4.2: Distribution of respondents according to the various timber species supplied to the sawmill**

Table 4.2 reveals the distribution of respondents according to the various timber species supplied to sawmill. Mahogany is the most supplied timber species to sawmill, accounting for 100% of the timber sourced. This result implies that sawmill heavily relies on Mahogany as its primary raw material. While *Khaya spp* (Mahogany) is a popular and valuable timber species, such heavy dependence on a single species poses risks to saw mill's sustainability. It can lead to environmental concerns if not managed responsibly, and any potential threat to the Mahogany population, such as disease or overharvesting, could significantly impact sawmill's operations. *Milicia excelsa* (Iroko) is the second most supplied timber species, representing 98.8% of the timber sourced. Similar to the implication with Mahogany, the high reliance on *Milicia excelsa* may pose ecological risks if not adequately managed. Diversification of the timber sources can mitigate risks associated with overreliance on a particular species and ensure the long-term sustainability of the sawmill's supply chain.

*Lovoa trichilioides* (African Walnut) accounts for 97.6% of the timber supplied to the sawmill, ranking it third in terms of popularity. Again, while African Walnut may be a valuable timber species, the sawmill should be cautious about relying too heavily on a limited range of species. Ensuring a diverse supply of timber species can enhance resilience to market fluctuations and potential ecological challenges. *Triplochiton scleroxylon* (Obeche) constitutes 96.4% of the timber sourced, placing it fourth in rank order. This result highlights the importance of *Triplochiton scleroxylon* in the sawmill's operations. However, the sawmill should monitor the availability and sustainability of this timber species to avoid depletion or ecological imbalances in the long run.

Sapele accounts for 95.2% of the timber supplied, making it the fifth most popular species. While Sapele is valued for its use in various applications, the sawmill should continue to

assess its sourcing practices and consider the ecological impact of harvesting this species to maintain a sustainable supply. *Hevea brasiliensis* (Rubberwood) constitute 94.0% of the timber supplied, ranking them sixth in popularity. The sawmill should monitor the sourcing and management of these species to ensure they are sustainably harvested and to avoid potential negative environmental consequences. *Cedrela odorata* (Cedar) represents 86.9% of the timber supplied, ranking it seventh in popularity. The sawmill should monitor the harvesting and management of Cedar to maintain its ecological balance and ensure a consistent supply.

**Table 4.2: Distribution of respondents according to the various timber species supplied to the sawmill**

<b>Timber</b>	<b>Percentage</b>	<b>Rank order</b>
<i>Khaya spp.</i> (Mahogany)	100%	1 <sup>st</sup>
<i>Milicia excelsa</i> (Iroko)	98.8%	2 <sup>nd</sup>
<i>Triplochiton scleroxylon</i> (Obeche)	96.4%	4 <sup>th</sup>
<i>Lovoa trichilioides</i> African Walnut	97.6%	3 <sup>rd</sup>
<i>Entandrophragma cylindricum</i> (Sapele)	95.2%	5 <sup>th</sup>
<i>Cedrela odorata</i> (Cedar)	86.9%	7 <sup>th</sup>
<i>Hevea brasiliensis</i> (Rubberwood)	94.0%	6 <sup>th</sup>

Field Survey, (2023)

#### **4.3: Distribution of respondents according to the source of supply to the sawmill**

Table 4.3 displays the distribution of respondents based on the source of supply to the sawmill in the Ovia North East Local Government Area, Benin City. The percentage of each supply source and their rank order are presented. Natural forests are the primary source of timber supply to the sawmill, representing 98.8% of the sourced timber. The high reliance on natural forests raises significant environmental concerns. Overexploitation of natural forests can lead to deforestation, loss of biodiversity, and adverse ecological impacts. The implication of this result is that sustainable forest management practices, conservation efforts, and responsible harvesting techniques should be adopted to ensure the long-term viability of natural forests as a timber supply source. The second most significant source of timber supply to the sawmill is from another sawmill, accounting for 88.1% of the sourced timber. While this may indicate interdependence between sawmills, it also raises questions about the sustainability of timber sourcing practices across multiple sawmills. The implication is that the sawmill should monitor and verify the legality and responsible sourcing practices of the supplying sawmills to ensure the timber is obtained ethically and sustainably.

Timber sourced through legal and regulated logging practices accounts for 77.4% of the supply. This result suggests that a significant portion of the timber supply comes from responsibly managed logging operations. The implication is that the sawmill should prioritize sourcing timber from legally compliant and regulated sources to ensure adherence to environmental and social sustainability standards. Timber from community forests constitutes 73.8% of the supply, ranking it fourth. Community forests play a vital role in supporting local livelihoods and maintaining ecological balance. However, it is essential to ensure that community-based timber sourcing follows sustainable practices and respects the rights and interests of local communities.

Salvaged timber represents 63.1% of the timber supply, placing it fifth in rank order. Utilizing salvaged timber can be environmentally beneficial as it reduces waste. However, the sawmill should ensure that salvaging is done responsibly, following proper environmental guidelines to avoid negative impacts on ecosystems. Plantations are the least significant source of timber supply, contributing 53.6%. While plantations can help reduce pressure on natural forests, the relatively low percentage may indicate a need to promote and expand sustainable plantation forestry as a timber supply source to meet demand and support environmental conservation efforts.

**Table 4.3: Distribution of respondents according to the source of supply to the sawmill**

<b>Source</b>	<b>Percentage</b>	<b>Rank order</b>
Natural Forests	98.8%	1 <sup>st</sup>
Plantations	53.6%	6 <sup>th</sup>
Legal and Regulated Logging	77.4%	3 <sup>rd</sup>
Community Forests	73.8%	4 <sup>th</sup>
Salvaged Timber	63.1%	5 <sup>th</sup>
From another sawmill	88.1%	2 <sup>nd</sup>

Field Survey, (2023)

#### **4.4: Distribution of respondents according to various insects that attack wood in sawmill**

Table 4.4 presents the distributions of respondents based on the various insects that attack wood in sawmill located in the Ovia North East Local Government Area, Benin City. The percentage of each insect and their rank order are presented. *Isoptera* (termites) are the most common wood-attacking insects, with 89.3% of respondents reporting their presence in sawmill. The high prevalence of *Isoptera* (termites) poses a significant threat to the integrity of wood materials. Termite infestation can lead to structural damage and economic losses. The implication is that the sawmill should implement effective pest control measures to protect their wood inventory and structures, such as using termite-resistant wood treatments and ensuring regular inspections. *Hemiptera* (Bugs) are the second most prevalent wood-attacking insects, with 88.1% of respondents reporting their presence. Bug infestation can cause aesthetic and structural damages to wood, affecting the quality of products and leading to potential customer dissatisfaction. The implication is that the sawmill should invest in proper storage and handling practices to prevent bug infestation, such as keeping wood materials off the ground and using protective coverings.

*Coleoptera: Anobiidea* (Woodworm) rank third in prevalence, with 84.5% of respondents reporting their presence. Woodworm infestation can compromise the structural integrity of wood materials, making them more susceptible to breakage and reducing their lifespan. The implication is that the sawmill should closely inspect and identify signs of woodworm infestation early on and apply appropriate treatment or disposal measures to prevent further damage. *Hymenoptera* (Ants) are reported by 78.6% of respondents as wood-attacking insects. *Hymenoptera* (Ants) can excavate galleries in wood, affecting its strength and appearance. While *Hymenoptera* (Ants) may not cause as much damage as *Isoptera* (termites) or *Coleoptera: Anobiidea* (Woodworm), they can still lead to significant quality issues in

wood products. The implication is that the sawmill should implement preventive measures to keep *Hymenoptera* (Ants) away from wood materials, such as maintaining a clean and organized working environment. *Coleopterans* (Beetles) are the least prevalent among the reported wood-attacking insects, with 71.4% of respondents reporting their presence. *Coleopterans* (Beetles) can cause damage to the surface and interior of wood materials, leading to potential quality and structural issues. The implication is that the sawmill should continue to monitor for beetle infestations and take appropriate measures to prevent their spread and control their population.

**Table 4.4: Distribution of respondents according to various insects that attack wood in sawmill**

<b>Insects</b>	<b>Percentage</b>	<b>Rank order</b>
<i>Isoptera</i> (Termite)	89.3	1 <sup>st</sup>
<i>Coleopterans</i> (Beetle)	71.4	5 <sup>th</sup>
<i>Coleoptera:Anobiidea</i> (Woodworm)	84.5	3 <sup>rd</sup>
<i>Hymenoptera</i> (Ants)	78.6	4 <sup>th</sup>
<i>Hemiptera</i> (Bugs)	88.1	2 <sup>nd</sup>

Field Survey, (2023)

#### 4.5 Method used in wood seasoning/Drying

Figure 4.1 reveals the method used in wood seasoning/drying. The result shows that all the sawmills adopted air drying method for wood seasoning while kiln drying method is yet to be adopted.

#### Method used in wood seasoning/Drying



#### 4.6: Distribution of respondents according to the names of products/preservatives/pesticides used to preserve logs, timber and sawn planks

Table 4.6 presents the distribution of respondents based on the names of products, preservatives, and pesticides used to preserve logs, timber, and sawn planks in the sawmills located in the Ovia North East Local Government Area, Benin City. The percentage of each product and its rank order are presented. Solignum is the most commonly used product for preserving logs, timber, and sawn planks, with 94.5% of respondents reporting its usage. Solignum is a well-known wood preservative brand and its high usage indicates its popularity and effectiveness in protecting wood from decay, insect attack, and fungal growth. The implication is that the sawmills are actively using a reliable and trusted wood preservative, which is likely contributing to the longevity and quality of their wood products. Attack is the second most used product, with 90.8% of respondents reporting its usage. While not as

prevalent as Solignum, Attack still enjoys significant usage among the sawmills. The implication of this result is that Attack might be an effective alternative or complementary wood preservative to Solignum, offering additional options for wood treatment and protection.

Sniper is the least prevalent among the reported wood preservatives, with 66.7% of respondents reporting its usage. While not as commonly used as the other products, Sniper still has a significant presence in the sawmills. The implication is that Sniper might be a specialized or niche product with unique features or applications that cater to specific preservation needs.

**Table 4.6: Distribution of respondents according to the names of products/preservatives/pesticides used to preserve logs, timber and sawn planks**

Products	Active ingredients	Percentage	Rank order
Attack	Esfenvalerate: 0.05%	90.8	2 <sup>nd</sup>
Solignum	Permethrin, Propiconazole	94.5	1 <sup>st</sup>
Sniper	Bifenthrin	66.7	3 <sup>th</sup>

Field Survey, (2023)

#### **4.7: Distribution of respondents according to the list the preservatives and pesticide used in treating the wood**

Table 4.7 presents the distribution of respondents based on the list of preservatives and pesticides used in treating wood in the sawmills located in the Ovia North East Local Government Area, Benin City. The most common method of wood treatment reported by 82.7% of respondents is using naturally rot-resistant wood species. This method involves selecting wood species that have inherent resistance to decay and pests. The implication of this result is that the sawmills prioritize using naturally resistant wood species, which can reduce the need for chemical treatment and contribute to the overall durability and longevity of the wood products. The second most prevalent method, with 82.4% of respondents reporting its usage, involves using neutral oils such as white spirit, kerosene, or diesel oil for wood treatment. These oils can provide some protection against decay and insects. The implication is that neutral oils are commonly available and cost-effective treatments, but they might have limited effectiveness in long-term protection compared to chemical preservatives. Tar oil treatment is reported by 76.5% of respondents, ranking it third in usage. Tar oil contains substances like pyridine, acridine, and quinolene, which provide wood with some resistance to decay and insects. The implication is that tar oil is a traditional and widely recognized wood preservative, but its usage might be decreasing due to the availability of more advanced and environmentally friendly alternatives.

Tar oil creosote treatment is used by 73.7% of respondents, placing it fourth in rank order. Creosote is a type of tar oil derived from wood distillation, and it has strong preservative properties. The implication is that creosote treatment is still popular for certain applications, such as railway ties and utility poles, where long-term protection against decay and insects is critical. Heat treatment is reported by 68.4% of respondents, ranking it fifth in usage. Heat treatment involves subjecting wood to high temperatures to improve its durability and

resistance to decay. The implication is that heat treatment is gaining popularity as an eco-friendly alternative to chemical preservatives, offering natural protection without using potentially harmful substances. Borate preservatives are used by 65.0% of respondents, placing them sixth in rank order. Borate treatment involves applying boron-based compounds to the wood to protect against decay and insects. The implication is that borate treatments are effective and widely used for certain wood applications, especially for indoor use and areas with low decay risks. Copper-chrome-arsenic (CCA) preservatives are reported by 63.4% of respondents, ranking them seventh in usage. CCA treatment involves using a combination of copper, chromium, and arsenic to protect wood from decay and insect attack. The implication is that CCA preservatives have been commonly used historically, but their usage might be decreasing due to environmental and health concerns associated with arsenic.

Fluorine compounds are the least prevalent among the reported wood treatments, with 41.5% of respondents using them. Fluorine compounds can offer protection against insects and decay. The implication is that fluorine compounds might be less commonly used due to their specific application requirements and availability of more widely accepted alternatives. The result implies that the use of pesticides and preservatives these days because most wood used has not attain maturity before been cut from the wild which make them susceptible to decay when exposed to moisture, pest, fungi, and insects. Pesticides and preservatives are used to protect wood products from these factors, extending their lifespan.

**Table 4.7: Distribution of respondents according to the list the preservatives and pesticide used in treating the wood**

<b>Preservatives and pesticide</b>	<b>Percentage</b>	<b>Rank order</b>
Use of naturally rot-resistant wood	82.7%	1 <sup>st</sup>
Heat treatment	68.4%	5 <sup>th</sup>
Neutral oil (white spirit, kerosene, diesel oil)	82.4%	2 <sup>nd</sup>
Tar oil (pyridine, acridine & quinolene)	76.5%	3 <sup>rd</sup>
Tar oil creosote	73.7%	4 <sup>th</sup>
Copper-chrome-arsenic preservatives	63.4%	7 <sup>th</sup>
Borate (Boron) preservatives	65.0%	6 <sup>th</sup>
Fluorine compounds	41.5%	8 <sup>th</sup>

Field Survey, (2023)

#### **4.7 The method of applications of preservatives and pesticide**

Table 4.8 and figure 4.2 displays the distribution of respondents based on the methods of application of preservatives and pesticides in the sawmills located in the Ovia North East Local Government Area, Benin City. The frequency and percentage of each application method are presented. Brushing is the most commonly used method of applying preservatives and pesticides, with 44.0% of respondents using this technique. Brushing involves manually applying the preservatives or pesticides to the wood surface using a brush. The implication of this result is that brushing is a widely adopted and accessible method for treating wood, offering flexibility and ease of application for the sawmill workers. Spraying is the second most prevalent method, with 25.0% of respondents using this technique. Spraying involves using a spray gun or nozzle to apply the preservatives or pesticides evenly over the wood surface. The implication is that spraying can provide efficient coverage and is suitable for treating large quantities of wood in a relatively short time. However, it requires proper equipment and safety measures to avoid potential hazards during application. Dipping is the third most used method, with 17.9% of respondents applying preservatives and pesticides using this technique. Dipping involves immersing the wood into a solution of preservatives or pesticides. The implication is that dipping can provide thorough penetration of the treatment into the wood, ensuring comprehensive protection. However, it may be time-consuming and suitable mainly for smaller-sized wood pieces.

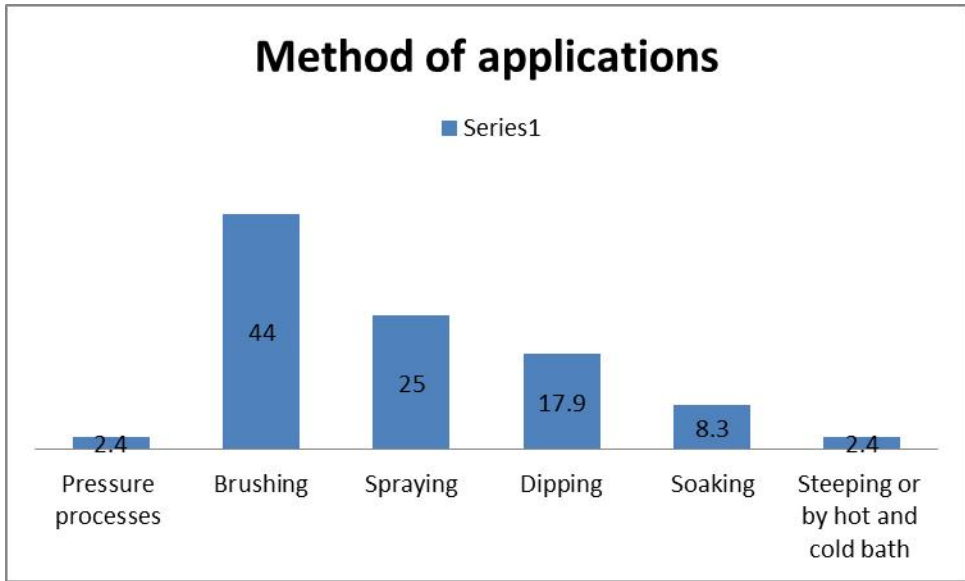


Figure 4.2: Method of applications of preservatives and pesticide

Soaking is reported by 8.3% of respondents as the method of application. Soaking involves leaving the wood submerged in a solution of preservatives or pesticides for an extended period. The implication is that soaking can be effective for deep penetration and treatment of larger timber or logs. However, it requires significant time and careful monitoring to avoid over-soaking and potential damage. Pressure processes are used by only 2.4% of respondents. Pressure treatment involves using specialized equipment to force preservatives or pesticides deep into the wood under pressure. The implication is that pressure treatment is a highly effective method for long-lasting protection, especially for outdoor or ground-contact applications. However, it requires substantial investment in equipment and expertise, making it less common among the respondents. Steeping or using hot and cold bath processes are also used by 2.4% of respondents. Steeping involves immersing the wood in hot or cold solutions of preservatives or pesticides. The implication is that steeping can offer thorough treatment, particularly for smaller wood pieces or craft items. However, it may require careful temperature control and monitoring to achieve desired results.

**Table 4.8 The method of applications of preservatives and pesticide**

<b>Method of applications</b>	<b>Frequency</b>	<b>Percentage</b>
Pressure processes	2	2.4
Brushing	37	44.0
Spraying	21	25.0
Dipping	15	17.9
Soaking	7	8.3
Steeping or by hot and cold bath	2	2.4

Field Survey, (2023)

## DISCUSSION

Mahogany is the most supplied timber species to sawmill, accounting for 100% of the timber sourced. This result implies that sawmill heavily relies on Mahogany as its primary raw material. While Mahogany is a popular and valuable timber species, such heavy dependence on a single species poses risks to saw mill's sustainability. It can lead to environmental concerns if not managed responsibly, and any potential threat to the Mahogany population, such as disease or overharvesting, could significantly impact sawmill's operations (Nott *et al.*, 2020).

Natural forests are the primary source of timber supply to the sawmill, representing 92% of the sourced timber. The high reliance on natural forests raises significant environmental concerns (Keenleyside, 2011). Overexploitation of natural forests can lead to deforestation, loss of biodiversity, and adverse ecological impacts. The implication of this result is that sustainable forest management practices, conservation efforts, and responsible harvesting techniques should be adopted to ensure the long-term viability of natural forests as a timber supply source (Keenleyside, 2011; Jari *et al.*, 2001).

Termites are the most common wood-attacking insects, with 88.5% of respondents reporting their presence in sawmill. The high prevalence of termites poses a significant threat to the integrity of wood materials. Termite infestation can lead to structural damage and economic losses (Ugbomeh and Diboyesuku 2019). The implication is that the sawmill should implement effective pest control measures to protect their wood inventory and structures, such as using termite-resistant wood treatments and ensuring regular inspections (Tagbor, 2009). Solignum is the most commonly used product for preserving logs, timber, and sawn planks, with 94.5% of respondents reporting its usage. Solignum is a well-known wood preservative brand and its high usage indicates its popularity and effectiveness in protecting wood from decay, insect attack, and fungal growth. The implication is that the sawmills are

actively using a reliable and trusted wood preservative, which is likely contributing to the longevity and quality of their wood products. Attack is the second most used product, with 90.8% of respondents reporting its usage. While not as prevalent as Solignum, Attack still enjoys significant usage among the sawmills. The implication of this result is that Attack might be an effective alternative or complementary wood preservative to Solignum, offering additional options for wood treatment and protection (Arya, 2005).

The most common method of wood treatment reported by 82.7% of respondents is using naturally rot-resistant wood species. This method involves selecting wood species that have inherent resistance to decay and pests. The implication of this result is that the sawmills prioritize using naturally resistant wood species, which can reduce the need for chemical treatment and contribute to the overall durability and longevity of the wood products (Arya, 2005).

Brushing is the most commonly used method of applying preservatives and pesticides, with 44.0% of respondents using this technique. Brushing involves manually applying the preservatives or pesticides to the wood surface using a brush. The implication of this result is that brushing is a widely adopted and accessible method for treating wood, offering flexibility and ease of application for the sawmill workers (<https://www.bennykuriakose.com/post/what-are-the-methods-of-timber-treatment>).

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATION

#### 5.1 Summary

This study was conducted to examine the preservatives and pesticide usage in some sawmills in Ovia North East Local Government Area Benin City. This study adopted purposive sampling techniques. Data collection, involved field survey and the field survey involved using questionnaires to collect data in conformity with the objectives. The survey data were analyzed using descriptive statistics such as, frequency distribution table, mean, and percentages.

The socio-economic characteristics of sawmill workers in the Ovia North-East Local Government Area, Benin City, were examined. The majority of the respondents were male, indicating a significant gender imbalance in the sawmill workforce. The age distribution showed a predominance of relatively young workers, which can have implications for their attitudes and safety practices. Most of the workers were married, and their educational backgrounds varied, which can influence their understanding of preservatives and pesticides' risks. Work experience was also diverse, with a substantial number of experienced workers in the industry.

The study also explored the various timber species supplied to the sawmill. *Khaya ivorensis*, *Milicia excels*, *Triplochiton Scleroxylon*, and *Lovoa trichilioides* were among the most commonly supplied species. While these species are valuable and sought after, the heavy reliance on certain species raises ecological concerns. Diversifying the supply of timber species is essential to ensure sustainability and reduce environmental impacts.

The source of timber supply to the sawmill indicated a significant dependence on natural forests and imported timber. While using naturally rot-resistant wood was a common method of treatment, the presence of wood-attacking insects like *Isoptera* (termites), *Hemiptera* (Bugs), and *Coleoptera: Anobiidea* (Woodworm) posed challenges to wood preservation. Chemical preservatives like Solignum and Attack were widely used, but there is room for exploring more environmentally friendly options.

The method of application of preservatives and pesticides showed that brushing and spraying were the most prevalent methods. Each method has its advantages and implications, emphasizing the importance of appropriate safety measures and training for the workers.

## **5.2 Conclusion:**

The findings of this study provide valuable insights into the socio-economic characteristics of sawmill workers, timber species supply, wood preservation methods, and the presence of wood-attacking insects. The heavy reliance on certain timber species and chemical preservatives warrant attention to ensure sustainability and environmental protection in the sawmill industry. Addressing gender imbalances, tailoring safety programs based on age groups, and promoting environmentally friendly wood preservation practices are crucial steps in enhancing the sawmill industry's overall performance and sustainability.

## **5.3 Recommendation:**

Based on the study results, the following recommendations are proposed:

1. **Gender Inclusivity:** Sawmill owners and policymakers should implement measures to promote gender inclusivity in the workforce. Encouraging and supporting female participation in the sawmill industry can lead to diverse perspectives and more inclusive practices.

2. **Sustainable Timber Sourcing:** Sawmills should actively explore and diversify their sources of timber to reduce reliance on a few species. Sustainable forestry practices, responsible logging, and afforestation efforts should be encouraged to ensure a continuous and ecologically balanced supply of timber.
3. **Environmentally Friendly Preservatives:** Sawmill operators should explore and adopt environmentally friendly wood preservation methods, such as heat treatment, borate-based preservatives, and naturally rot-resistant wood species. This will help minimize environmental impacts and enhance the industry's eco-friendliness.
4. **Training and Safety Measures:** Workers should receive regular training on proper wood preservation techniques, safe handling of chemicals, and pest control measures. Implementing stringent safety measures can protect workers' health and ensure high-quality wood products.
5. **Monitoring and Compliance:** Sawmills should monitor their wood treatment practices to ensure compliance with safety regulations and environmental standards. Regular inspections and audits can help identify areas for improvement and ensure adherence to best practices.
6. **Research and Development:** Encourage research and development in wood preservation technologies, seeking innovative and sustainable solutions that are effective in protecting wood while minimizing environmental impact.

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## APPENDIX

### SURVEY QUESTIONNAIRE ON PRESERVATIVES AND PESTICIDE USAGE IN SOME SAWMILLS IN OVIA NORTH EAST LOCAL GOVERNMENT AREA BENIN CITY (For Bachelor degree in Forestry, Research in University of Benin)

#### Questionnaire identification

Phone number \_\_\_\_\_

Name of respondents \_\_\_\_\_

Name of the Sawmill \_\_\_\_\_

Location of sawmill \_\_\_\_\_

**Instruction: Please tick (✓) in the box and fill in the blank space where applicable**

#### Socio-Economic Characteristics

1. Sex: Male [  ] Female [  ]
2. Age: 19-25 [  ] 26-35 [  ] 36-45 [  ] 46-55 [  ] 56-65 [  ]
3. Marital Status: (a) Single [  ] (b) Married [  ] (c) Divorced [  ] (d) Widow [  ] (e) Widower [  ]
4. Educational Level: (a) No formal education [  ] (b) Primary School living certificate [  ] (c) Senior Secondary school [  ] (d) Tertiary [  ]
5. Years of experience: \_\_\_\_\_

#### **Various timber species supplied to the sawmill (multiple choice. You can tick more one)**

Timber	Tick
1. Mahogany ( <i>Khaya</i> spp.)	
2. Iroko ( <i>Milicia excelsa</i> )	
3. Obeche ( <i>Triplochiton scleroxylon</i> )	
4. African Walnut ( <i>Lovoa trichilioides</i> )	
5. Sapele ( <i>Entandrophragma cylindricum</i> )	
6. Nigerian Satinwood ( <i>Chlorophora excelsa</i> )	
7. Cedar ( <i>Cedrela odorata</i> )	
8. Rubberwood ( <i>Hevea brasiliensis</i> )	

#### **Source of supply to the sawmill (multiple choice. You can tick more one)**

Source	Tick
1. Natural Forests	
2. Plantations	
3. Legal and Regulated Logging	
4. Community Forests	
5. Salvaged Timber	
6. From another sawmill	

**List various insects that attack wood in your sawmill**

- i. \_\_\_\_\_
- ii. \_\_\_\_\_
- iii. \_\_\_\_\_
- iv. \_\_\_\_\_
- v. \_\_\_\_\_
- vi. \_\_\_\_\_
- vii. \_\_\_\_\_
- viii. \_\_\_\_\_
- ix. \_\_\_\_\_
- x. \_\_\_\_\_

xi. What most common insect attack sawn wood in the sawmill  
\_\_\_\_\_

**List the preservatives and pesticide used in treating the wood (multiple choice. You can tick more one)**

Preservatives and pesticide	Tick
Use of naturally rot-resistant wood	
Heat treatment	
Neutral oil (white spirit, kerosene, diesel oil)	
Tar oil (pyridine, acridine & quinolene)	
Tar oil creosote	
Copper-chrome-arsenic preservatives	
Borate (Boron) preservatives	
Fluorine compounds	
Others	

**The method of applications of preservatives and pesticide.**

- i. Pressure processes [ ]
- ii. brushing, [ ] spraying [ ] dipping [ ] soaking [ ] steeping or by hot and cold bath  
[ ]