

**EXPLORING COCONUT TREE AS
AN ALTERNATIVE WOOD CARVING
MATERIAL**

By

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DECLARATION

I hereby declare that this submission is my own work towards the Master of Arts in Art Education and that to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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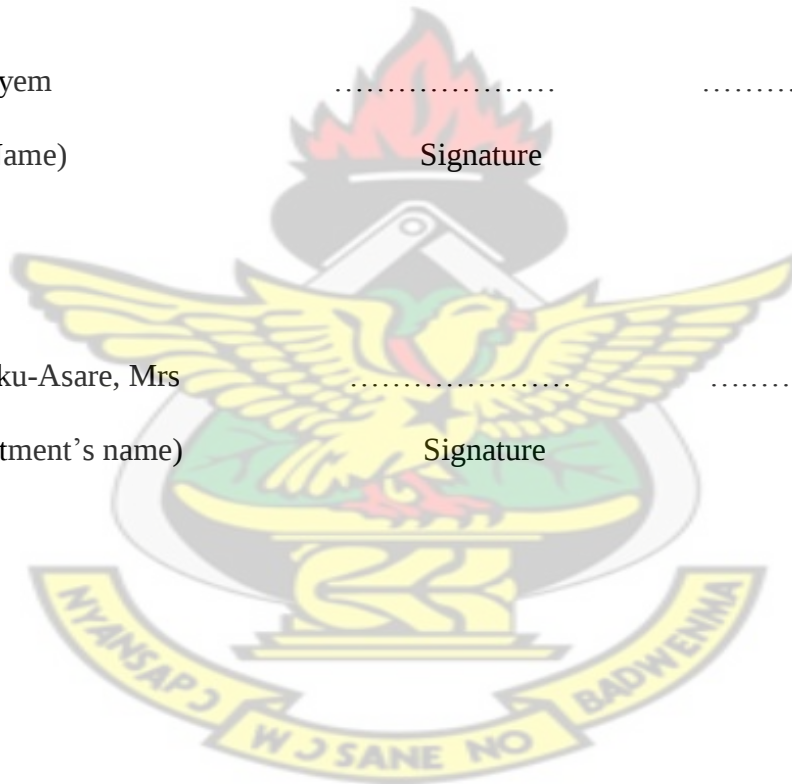
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ABSTRACT

Wood carving has been practiced in Ghana using conventional wood species such as *Odum*, *Sese*, *Kyenkyen*, *Ebony*, *Mahogany* and others but due to the increasing depletion of these conventional wood species as a result of over exploitation leading to scarcity of the raw materials they provide, there is now the ardent campaign that non-conventional wood species such as mango, neem and coconut are good alternative wood carving materials (Masera, n.d.; Okrah, 2002). The shift to these non-conventional wood species will help salvage the conventional wood species and the carving industries. This study explored the use of coconut tree as an alternative wood carving material. The researcher focused on 25 year old hybrid and 30 year old tall varieties for the production of relief carvings. The researcher employed qualitative and quantitative approaches of research to carry out the study using semi-structured interview and observation to collect the data. From the findings, processes, tools and equipment used for woodworking are the same used for processing and working with the coconut tree. The spiky nature of the grains of the coconut wood makes carving difficult and uncomfortable without protective gloves for the hand and goggles for the eyes, the carver can be harmed by split pieces. The quality of work produced was found to be like that of the conventional wood. The researcher recommends that Ghana Education Service (GES) should encourage schools in the coastal towns of Ghana to harvest, process and use the senile coconut trees standing in plantations for woodworking. The Ministry of Tourism, Culture and Creative Arts should encourage the nation's wood carvers in the coastal towns to harvest, process and use the over-aged coconut trees for wood carving and other related use.

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CHAPTER ONE

INTRODUCTION

1.1 Overview

This is the introductory part of the thesis which describes the Background to the Study, Statement of the Problem, Objectives, Research Questions, Delimitation, Limitation, Definition of Terms, Importance of the Study, List of Abbreviations and Organisation of the Rest of the Text.

1.2 Background to the Study

During the eighteen (18) years that the researcher has been a student, and during the four (4) years that she has been a school teacher, the researcher empirically observed that teachers of the visual art of wood carving seemed to shy from the woody material that the coconut tree yields. She also noted that the Ghanaian traditional wood carvers, too, never seemed to use coconut tree as wood carving material.

While researching for her first degree in Integrated Rural Art and Industry, a team of her classmates researched into the use of the stem of oil palm, *Elaeis guineensis*, as wood working material. They used the palm wood to make a bed, bedside drawers and an assortment of carvings. The success of that research provoked interest in enquiring into the use of coconut tree as an alternative wood carving material.

Another rationale for this study is to help reduce pressure on traditional hardwoods, which are becoming less and less available and increasingly expensive with the depletion of Ghana's natural forests.

1.3 Statement of the Problem

As a result of the over reliance on utilization of traditional wood species without adequate provision for resource renewal, the wood industry in Ghana now faces scarcity and high cost of conventional wood, especially for Senior High School

students offering sculpture. There is the need to look for lesser known wood material that can be used as substitute material for commercially known wood species to overcome the problem of inadequate supply of carving material and at the same time to help preserve the depleting forests of Ghana. This research therefore seeks to use coconut tree as an alternative material for carving.

1.4 Objectives

1. To identify, describe and document the properties of coconut tree which make it possible for carving
2. To process coconut tree for carving
3. To introduce the processed tree to Senior High School sculpture students and wood carvers to produce sample artefacts.

1.5 Research Questions

1. To what extent is coconut tree similar to wood?
2. How can coconut tree be used in carving?
3. In what ways can coconut tree be introduced to Senior High School sculpture students and wood carvers?

1.6 Delimitation

This research is limited to the use of 25 and 30 year old coconut trees as material for carving relief sculpture.

1.7 Limitations

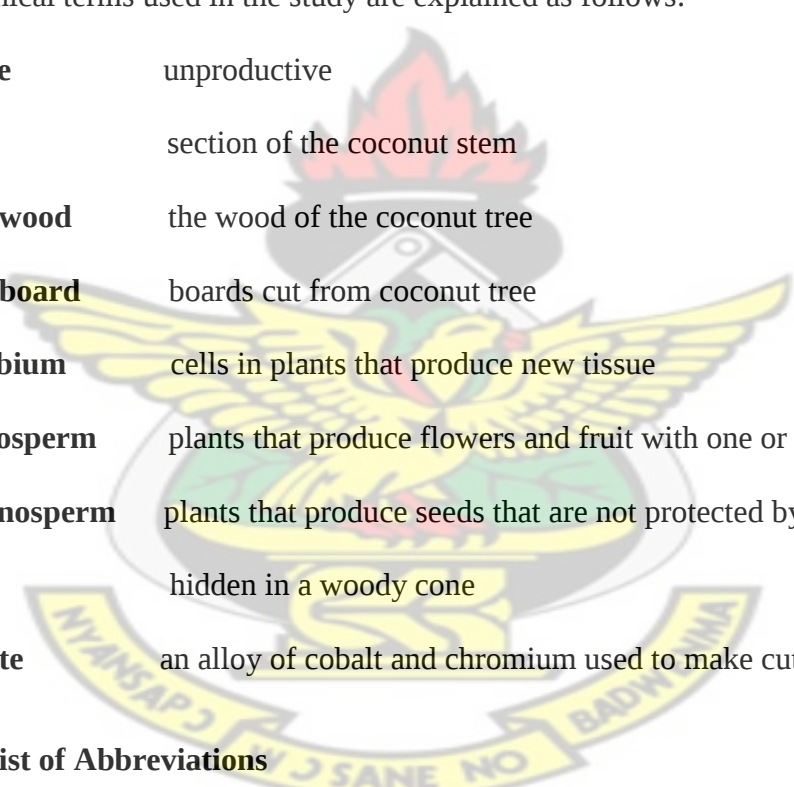
- Acquisition of the coconut tree was difficult because senile trees could not be located within reach of the researcher and the farmers who had some on their farms were not willing to sell the trees because they were still yielding fruits

that they sell for money. This made it difficult for the researcher to get coconut trees older than 30 years to work with.

- Most of the known senile trees available in Ghana can be located along the coast in the Central and Western regions of Ghana but due to limited time, financial and transportation constraints the researcher was unable to get the fully matured coconut trees to work with.

1.8 Definition of Terms

Technical terms used in the study are explained as follows:



Senile	unproductive
Log	section of the coconut stem
Cocowood	the wood of the coconut tree
Cocoboard	boards cut from coconut tree
Cambium	cells in plants that produce new tissue
Angiosperm	plants that produce flowers and fruit with one or more seeds
Gymnosperm	plants that produce seeds that are not protected by fruit but are hidden in a woody cone
Stellite	an alloy of cobalt and chromium used to make cutting tools

1.9 List of Abbreviations

KNUST	Kwame Nkrumah University of Science and Technology
GES	Ghana Education Service

1.10 Importance of the Study

1. This study will create the awareness of a suitable alternative material for wood carving which could be introduced to schools where sculpture is a subject of study and the local wood carving industry.

2. The study will also serve as a reference material for researchers, writers, publishers, sculptors, practising artists, art historians, students and art educators.

1.11 Organization of the Rest of the Text

The thesis has been presented in five chapters: Chapter one is the Introduction containing the Background to the Study, Statement of the Problem, Objectives, Research Questions, Delimitation, Limitation, Definition of Terms, Importance of the Study, and Organization of the Rest of the Text. Chapter two presents Review of Related Literature. Chapter three covers the Methodology employed. Chapter four is the Presentation and Discussion of Findings. The final chapter gives the Summary, Conclusions and Recommendations of the Study.



CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

The researcher reviewed related literature under the following sub-topics: wood, wood carving, carving techniques, carving tools, the coconut palm, properties of coconut palm, coconut craft and appreciation.

2.2 Wood

Walker (2006) writes that "wood forms in the stems and roots of both the cone bearing plants and many dicotyledonous flowering plants" (p. 1). Unger, Schniewind and Unger (2001) describe wood as "the secondary permanent tissue of woody plants i.e. trees and shrubs made up of interconnected cells which vary in appearance, size, number, type and arrangement" (p. 9).

Wood is commonly classified as either softwoods or hardwoods (Peters, 2000; Forest Products Laboratory, 2010; Walker, 2006). The hardwoods are the angiosperms which produce seeds within ovaries of flowers, nuts and fruits. They bear broad leaves and are mostly deciduous such as oak and mahogany. Softwoods are gymnosperms, that is, the seeds are not enclosed in the ovaries of flowers. Softwoods are from conifers which bear needle-like or scale-like leaves such as pines and firs and are commonly known as evergreen (Forest Products Laboratory, 2010; Green, 2007; Peters, 2000; Shmulsky & Jones, 2011; Walker, 2006). "Unfortunately and inconveniently" as cited in Green (2007) "the terms hardwood and softwood do not accurately describe the actual physical characteristics of density and hardness,...these terms actually relate to [the] two different ways the trees reproduce" (para. 6). Shmulsky and Jones (2011, p.5) confirm that "despite the

implication in the names hardwood and softwood, many softwoods produce wood that is harder and denser than wood produced by some hardwoods." For example, balsa wood is a hardwood species but is softer than some softwood. Forest Products Laboratory (2010, p.17) also admits that "these names can be confusing because some softwoods are actually harder than some hardwoods, and conversely some hardwoods are softer than some softwoods."

According to Hoadley (2000), all trees have certain common characteristics. They are "vascular, perennial plants capable of secondary thickening or adding yearly growth to previous growth" (p. 7). Forest Products Laboratory (2010) therefore asserts that:

All wood is composed of cellulose, lignin, hemicelluloses, and minor amounts (usually less than 10%) of extraneous materials contained in a cellular structure. Variations in the characteristics and proportions of these components and differences in cellular structure make woods heavy or light, stiff or flexible, and hard or soft. (p. 16)

2.3 Wood Carving

Boateng, (n.d., p. 103) defines carving as "the analytic study of the medium using the requisite tools to remove the unwanted parts to arrive at a final product which has been previously conceived in the storehouse of the mind." Boateng further states that, particular sets of carving tools are used to facilitate easy carving processes and the achievement of the ultimate aim. Media such as wood, ivory, metal, bone, marble, plaster of Paris, stone, PVC and many other forms of hardware can be used to produce artifacts.

Choge (2004) and Masera (n.d.) agree that carvers depend on hardwood from local forests and farms for their raw materials. "Varieties of tropical wood species used as raw material for carving included the following: *Afromosia*, *Kokrodua*, *Kyenkyen*, *Mahogany*, *Odum*, *Dwuma*, *Sese*, *Twenebua*, *Wawa*, *Onyina*, *Funtum* etc" (Boateng, n.d., p. 104). Supplies from these trees have been decreasing in recent years due to the high demand and long time span needed for regeneration. Research has indicated that species like neem (*Azadirachta indica*), mango (*Mangifera indica*), grevillea (*Grevillea robusta*) and jacaranda (*Jacaranda mimosifolia*) are best alternatives for conventional wood (Choge, 2004; Masera, n.d.).

Masera (p. 421) points out that:

Other species such as coconut (*Cocos nucifera*), casuarinas (*Casuarina equisetifolia*), melia (*Melia azedarach*), eucalyptus (*Eucalyptus spp.*) and *Prosopis spp.* are being tested. As most of these species have multiple uses and are fast growing they have a good potential for being raised in local farms and plantations. The practical use of these woods for carving has shown that they are equally good and – if accepted – will relieve the pressure from the declining and already over exploited indigenous carving species.

Boateng (n.d.) mentions that carving in Ghana started as a form of communal expression based on the ideas and ideals of the entire community or ethnic group. Carving provided a wide range of objects and household equipment such as mortars, pestles, wooden bowls, ladles, combs, stools, chairs, walking sticks, linguist staves and countless range of traditional games, canoes, hoe handles, boxes, beds, cupboards, swords and many more

Boateng further states that:

Carving in the contemporary sense dwells massively on creativity. It therefore depends on the sculptor's ability to make it big using creatively [sic] as the means. The challenge lies ahead of both the academic and the traditional carvers. The more creative one becomes the more vocal and attractive the productions become.

The interesting aspect of the carving industry is that it is gradually dissipating itself from that static poise which has characterized the profession since time immemorial. A new era has dawned on the profession where creativity signifies the key to success. Wood carvings are becoming beautiful everyday. (p. 106)

2.4 Carving Techniques

Carving techniques include relief carving which consist of low relief and incised carving, and carving in the round (Jones, 1996). Jones further defines these techniques as:

- Relief carving is a technique of carving that raises the design into prominence by removing all the surrounding wood.
- Low relief carving is a "relief carving technique that uses undercutting, texturing, and manipulation of perspective between background and foreground on a relatively flat workpiece to create the illusion of depth" (p. 141).
- Incised carving is "carving an image in wood by removing the waste in intersecting angled cuts, usually between 1/8 and 1/4 inch deep" (p. 140).
- Chip carving - an "incised carving technique in which designs are created with patterns of small, inverted pyramids cut into the wood surface" (p. 140).

- Carving in the round -"The technique of carving free-standing, three-dimensional subjects that can be viewed from all side, e.g., busts or wild-life carvings" (p. 140).
- High relief carving is "when more than half the thickness of the wood is removed" (Hillyer, 2002, p. 19).

2.5 Carving Tools

According to Boateng (n.d.)

The strange beginnings of the carving profession embodied the manufacture of carving tools. Carvers manufactured their own set of tools from iron scraps. This implies that the early carvers were equally skillful in the use of iron. Rather, for convenience sake, one either chose to be a carver or a smith.

Tradition had it that, after the carver has successfully manufactured all the tools he needed, he has to pacify the tools before using them. Special libation prayers were offered to the ancestors and the gods to protect the carver from injuries during the use of the carving tools. (p. 104)

Okrah (2002) and Amoh (2009) agree that carvers mostly use locally handmade tools such adze, axe, cutlass, knives, gouges and chisels. Okrah (2002) further states few use both local tools and modern machinery for their works. Jones (1996) again also asserts that"The three fundamental types of carving tool are the chisel, which has a straight blade; the gouge, which has a curved blade; and the knife.... In addition to the chisels, gouges, and knives, you will also need some accessories to get you started.

These range from files, rasps, planes, and mallets, to clamps to secure the workpiece in place" (p. 13).

2.6 The Coconut Palm

Angiosperms are subdivided into dicotyledons and monocotyledons. Palms are monocotyledonous flowering plants which produce relatively large-diameter fibrous solid stems and roots but the material in them is not true wood and has very different properties. The stems are strong when left in the round but tend to fall apart when cut into lumber. Some species produce stems suitable for production of local construction lumber (Shmulsky & Jones, 2011; Walker, 2006).

The coconut palm, *Cocos nucifera*, is a monocotyledon found in the tropical and subtropical regions (Arancon, 1997; Broschat & Crane, 2011; Chan & Elevitch, 2006; Killmann & Fink, 1996; Ohler, 1999) "between the Tropics of Cancer and Capricorn" (Ohler, 1999, para. 1). Coconut palms are naturally found along sandy shorelines. They grow well on well drained soils ranging from sand to clay (Broschat & Crane, 2011; Chan & Elevitch, 2006). "Alluvial loam and sand soils are more suitable ..." (Oduor & Githiomi, 2006, p. 1). Coconut "requires 1000mm of well distributed rainfall in the year with a mean annual temperature of 27°C with a lower limit of 20°C" (Oduor & Githiomi, 2006, p. 1). According to Chan and Elevitch (2006) coconut needs rainfall of "1500–2500 mm (60–100 in)" (p. 1). Broschat and Crane (2011) also state that "Successful growth requires a minimum average temperature of 72°F and an annual rainfall of 30 - 50 inches or more" (p. 3).

"Coconut is a versatile product and has multiple uses" (Sudalaimuthu, Senthilkumar & Sivakumar, n.d., para. 1) and has been described as "the tree of life" (Chan & Elevitch, 2006; Oduor & Githiomi, 2006; Ohler, 1999), "tree of heaven" (Chan &

Elevitch, 2006) and nature's greatest gift to man (Oduor & Githiomi, 2006). Copra which is the source of coconut oil is the major product from coconut (Broschat & Crane, 2011; Killman & Fink, 1996). Other products include: coir, from the husk, used in making mats, ropes, brushes and strings, food (palm cabbage, coconut), drinks (coconut juice, coconut milk, toddy), thatch, brooms, mats and baskets from the leaves, fuel from the shells, husks, dried leaves and the stem, cups, kitchen utensils, buttons also from the shells, timber from the stem, furniture, tool handles, building construction materials, boat building (Chan & Elevitch, 2006; Oduor & Githiomi, 2006; Ohler, 1999; Killmann & Fink, 1996) and many others. Encyclopaedia Britannica 2011, states that the coconut timber "is also exported as cabinet wood called porcupine wood" (Coconut palm, para. 6).

Cocos nucifera L. has a slender, smooth and straight or slightly curved trunk which can grow to the height of about 20-25 metres with diameter of 30cm- 40 cm rising from a swollen base, the bole sometimes reaching a metre (Arancon, 1997, 2009; Ohler, 1999). According to Chan and Elevitch (2006), "A 40-year old palm typically attains a height of 20–22 m (66–72 ft), and an 80-year-old palm may attain a height of 35–40 m (115–130 ft)" (p. 3). Ohler (1999) also states that "The coconut palm grows up to a height of about 25 m and in exceptional cases to about 30 m, depending on ecological conditions and age"(p. 2). "The first mature fruits can be produced 5–6 years from planting" (Chan & Elevitch, 2006, p. 5). According to Broschat and Crane (2011) the coconut palm produces fruits from 6 - 10 years after the seed sprout and reaches full production at 15- 20 years of age. Productivity declines from 60 to 80 years where the tree is considered senile (Arancon, 2009; Oduor & Githiomi, 2006; Ohler, 1999).

Coconut palms can be grouped into two types based on height of the stem (Chan & Elevitch, 2006; Killmann & Fink, 1996; Sudalaimuthu et al., n.d.). The groups are tall varieties and dwarf varieties (Chan & Elevitch, 2006; Killmann & Fink, 1996; Sudalaimuthu et al., n.d.). Ohler (1999) also writes that "... two main groups can be recognized, the tall palms, *C. nucifera* typica, and the dwarf palms, *C. Nucifera* nana" (p. 2). Tall palms are mostly cross pollinated and this creates more variations in the characteristics. The dwarf varieties on the other hand are usually self-pollinated which makes them more uniform although there are types (Chan & Elevitch, 2006). Dwarfs start bearing at 3 years (Chan & Elevitch, 2006). Sudalaimuthu et al., (n.d.) also hold the view that the dwarf variety has a comparatively short productive age and starts producing fruits in 4 to 5 years time. Broschat and Crane (2011) write that tall varieties may reach a height of 80 – 100 feet (24 - 31 m). And according to Sudalaimuthu et al., (n.d.) the tall variety produces fruits 6 to 10 years after plantation and remains productive even at the age of 80 to 120 years but Chan and Elevitch (2006) infer it starts bearing fruit at 5 years.

2.6.1 Properties of Coconut Palm

Unlike conventional trees, coconut palm is a monocotyledon with no tap root and has no outer cambium layer. Because the palm lacks cambium, when the stem is injured it cannot repair the wound by new growth (Oduor & Giothiomi, 2006; Ohler, 1999). Ohler (1999) and Oduor and Giothiomi (2006) agree that because of the lack of cambium, once the coconut stem is formed it does not increase in diameter with age. "The diameter varies from 200 to 300 mm, with a gradual reduction towards the top" (Ohler, 1999, Properties of coconut wood, para. 1).

2.6.2 Structure of the Coconut Palm

The cross section of the stem has three distinct zones: dermal, sub-dermal and the central zone. The dermal is most peripheral portion just below the bark; the sub-dermal is a zone between the dermal and the central zone or core (Arancon, 1997; Ohler, 1999; Oduor & Giothiomi, 2006).



Fig. 1 Cross Section of Coconut Trunk Source: Bailleres et al. (2010)

A - Bark B - Dermal
C - Sub-dermal D - Central zone or core

Arancon (2009) writes that:

The hardest, densest part of the wood is found on the outer perimeter of the trunk, which gives the palm its strength, while the wood's high silica content gives the palm elasticity. Towards the centre of the trunk, the wood gets relatively softer. (p. 6)

Killmann and Fink (1996) also describe the structure of coconut wood as:

Unlike “conventional” trees, palms, like many other monocotyledons, have vascular fibre bundles (red-brown spots on a cross-section) scattered in a yellowish parenchymatic ground tissue. These bundles contain the water and nutrient transport

system (xylem vessels and phloem) as well as thick-walled fibres giving the stem its strength, and paratracheal parenchymatic cells.

The ground parenchyma has mainly a storage function and contains starch among other things. The anatomical features result in a rather non-homogenous distribution of physical properties both over cross-section and height, and thus in a very non-homogenous raw material. (para. 1.2)

Arancon (1997) description of the structure of coconut wood reads:

Its main anatomical elements include the fibrovascular bundles, fibrous bundles and the ground tissue.

The fibrovascular bundles consist of phloem, xylem, axial parenchyma and thick-walled schlyrenchyma fibres. The latter element serves as the palm's major mechanical support. The cell walls of the schlyrenchyma fibres become progressively thicker from the centre to the cortex of the stem. The xylem is enveloped by parenchyma cells usually containing two wide vessels, a combination of wide and small vessels or clusters of several small and wide vessels.

The ground tissue is parenchymatous and its cell wall thickness decreases from cortex to the inner zone of the central cylinder. (Structure/Anatomy, para. 3)

2.6.3 Physical Properties

Arancon (1997) and Palomar (1990) as cited in Ohler (1999) assert that, physical properties of coconut wood depend largely on the density, moisture content and

shrinkage. Basic density (oven-dry weight to green volume) decreases with increasing height of the stem and at any given height increases from the core to the bark. Basic density ranges from 100 to 110 kg/m³ at the top core near the crown, to 850 to 900 kg/m³ at the bottom dermal portion of old palms. "... moisture content decreases with increasing basic density and vice versa. The amount of moisture in coconut stem increases with increasing stem height and decreases from the core to the cortex" (Arancon, 1997, Physical properties, para. 3).

Arancon (1997) adds that:

The dimensional stability of the wood is determined by its shrinkage or swelling which accompanies a decrease or increase in moisture content below fibre saturation point. Shrinkage and swelling cause drying defects such as checks and split. Unlike conventional wood where tangential shrinkage is almost twice the radial shrinkage, the tangential and radial shrinkage of cocowood are not significantly different. (Physical properties, para. 4).

2.6.4 Mechanical Properties

The mechanical properties of coconut which define the use are closely related to the basic density (weight/volume at given moisture content) (Arancon, 1997; Killmann and Fink, 1996). "All values of the strength properties decrease with decreasing basic density" (Arancon, 1997, Mechanical properties, para. 2).

Coco wood contains three degrees of density that dictate its uses:

- **High-density wood** (dermal or at the periphery of the trunk)
 - hard: basic density of 600-900 kg/m³

- **Medium-density wood** (sub-dermal or next to the high-density portion) –medium/hard: basic density of 400-600 kg/m³
- **Low-density wood** (found at the core of the trunk) – soft/medium: basic density of 200-400 kg/m³[sic]
(Arancon, 1997;2009, pp. 1 & 6)

2.6.5 Chemical Properties

"Chemical properties of coconut wood can be compared to conventional hardwoods and softwoods, as the holocellulose, lignin and pentosan contents are similar. However, the ash content of coconut wood is much higher" (Ohler, 1999, Properties of coconut wood, para. 4).

Arancon (1997) confirms by stating that:

Coconut wood is comparable to Philippine hardwood/softwood and bamboo as far as holocellulose, lignin and pentosan content are concerned. However, it contains higher ash than Philippine woods. The proximate chemical composition of coconut wood are the following: holocellulose (66.7%); lignin (25.1%) and pentosans (22.9%). (Chemical properties, para. 1)

2.6.6 Processing Coconut Wood

Arancon (2009) writes that "coconut utilization involves primary and secondary processing. Primary processing includes logging, sawmilling, anti-sapstain treatment, lumber grading, drying and preservation. Secondary processing includes machining, assembly and finishing of products (furniture, handicraft, etc)" (p. 27).

2.6.6.1 Logging

Arancon (2009) further states that "harvesting or logging of the coconut consists of: a) felling and bucking; b) skidding and loading and c) transporting to the sawmill" (p. 27). Operations for harvesting coconut palms are similar to that of conventional trees (Arancon, 1997; Bailleres, et al. 2010).

Bailleres et al. (2010) affirm that "standard chainsaw equipment and tree-felling techniques used for forest trees are also used for coconut palms. Tractors used for snigging the palm logs to the loading site are the same as those used in timber harvesting operations" (p. 14).

2.6.6.2 Sawmilling

Arancon (2009) defines sawmilling as: "This is the process of cutting or milling the coconut stem into lumber using either band sawmills or circular mills" (p. 28).

Bailleres et al. (2010) and Arancon (2009) agree that "standard hardwood sawmilling equipment" is appropriate for milling coconut stem.

Killmann and Fink (1996) admit and suggest that:

One of the reasons that coconut stems have, as yet, rarely been converted into lumber on a larger scale, is their peculiar texture. In a very soft parenchymatous tissue strands of hard, sclerenchymatous vascular bundles are embedded. While the parenchyma easily gives way and disintegrates into fine particles during sawing, the sclerenchyma cells in the vascular bundles are very hard and abrasive. The sawing of both tissues together results in rapid blunting of conventional saw-blades. Various techniques have been applied to prolong the life of the saw teeth. Results are:

-circular and frame-saw blades should either be

- tipped with tungsten carbide (TC) or be
- equipped with stellite, inserted teeth

-band-saw blades should be stellite

-the gullet size has to be increased in order to facilitate the removal of the very fine sawdust during sawing. (para. 4.5)

Arancon (2009) confirms this by stating that:

Compared to many hardwoods coconut is more difficult to saw due to variation in density within the stem. Hence, hard-facing materials, like stellite and tungsten carbide are recommended on conventional saw blades to overcome the rapid dulling of saw teeth.

Due to the hardness of the dermal portion of coconut trunks, sawing them in green condition is suggested. When the logs are sawn dry, the sawing rate is reduced and wearing of the saw teeth is increased. (pp. 28-29)

Bailleres et al. (2010) also affirm that:

The high mineral content (2–3%) and the variation in grain angle caused by the structure of the vascular bundles means that sharp, high speed steel (HSS) blades, tungsten-carbide or Stellite-tipped saw blade edges are most appropriate for processing cocowood. Regular sharpening intervals are recommended when breaking down logs. (p. 16)

2.6.6.3 Grading

The lumber has to be graded and stacked according to size, quality and density group (Killmann and Fink, 1996). Grading or sorting is done visually by looking at the colour and visual bundle of the newly sawn lumber. The visual process is slow and only visible defects can be assessed. Grading by determining the specific gravity of the stiffness of the lumber can be used (Arancon, 2009; Bailleres et al. 2010).

The techniques applied can be according to Schulte (1991) and Fruehwald (1992) as cited in Killmann and Fink (1996),

- "- visual grading
- grading by weight (deflection)
- basic density determination
- pilodyn-grading" (Grading, para. 5).

2.6.6.4 Preservation

Freshly sawn timbers are dipped in anti-sapstain chemicals for 2-3 minutes before seasoning to prevent mould and stain fungi attacks (Bailleres, et al. 2010; Arancon, 2009; Ohler, 1999; Killmann & Fink, 1996). Chemicals used include Basilit PN and Pentabrite with the standard sodium pentachlorophenate as the active ingredient; Difolatan with tetrachloroethylthio and Daconil with tetrachloroisophthalnitrile, both agricultural fungicides (Palomar, 1992 as cited in Arancon, 2009; Ohler, 1999). According to Bailleres et al. (2010) "... solution of a treatment containing chlorothalonil (450g/L) and carbendazim (100g/L) is effective for minimising staining"(p. 18).

Coconut wood used in the interior does not need treatment e.g. wall-panelling or furniture. Treatment is needed if it is low density (Ohler, 1999; Killmann & Fink, 1996). "Coconut is not naturally durable when used in situations favourable to attack

by decay fungi and wood boring insects particularly in ground contact and exposed to the weather" (Arancon, 1997, Preservative treatment, para. 1). Arancon (2009) also asserts that "When exposed to weather, coco wood will degrade in a very short time. Decay fungi and termites destroy the hard portion of the trunk within 2-3 years, when used in ground contact. The soft portion will deteriorate within a few months" (p. 31). Cocowood is treated with appropriate preservatives to protect it from insects and decay organisms. Depending on the solvent, the types of preservatives are oil-borne, water-borne (Arancon, 2009; Killmann & Fink, 1996) and organic solvent-borne (Killmann & Fink, 1996). "There are two methods of preserving coconut wood: the pressure and non-pressure methods. In the pressure method, the wood is impregnated in a closed cylinder under pressure"(Arancon, 2009, p. 32). "Timber scheduled for treatment should be free of defects. The timber has to be seasoned in order to achieve adequate penetration of the preservative and its uniform distribution" (Killmann & Fink, 1996, para. 7.3).

2.6.6.5 Seasoning

The differences in density and moisture content across the stem of the coconut makes it difficult when drying sawn coconut timber therefore boards belonging to the same density group must be dried together. The drying methods include air drying, forced-air and kiln drying. During the process of seasoning, the high-density outer portions develop fine surface checks and twists while the low density portions tend to spring, cup, twist and collapse if not properly seasoned (Arancon, 1997; Bailleres, et al. 2010; Killmann & Fink, 1996; Ohler, 1999).

According to Ohler (1999):

Combinated drying methods have been found to be effective, particularly with 50 mm boards because of reduced drying costs and defects. Air and kiln drying is one method, the other is the forced-air and kiln drying method. The use of air at atmospheric temperature initially, and application of heat in the second stage, facilitates obtaining good quality timber (Drying coconut wood, para. 4).

2.6.6.6 Machining

Arancon (2009; 1997) defines machining as the process of cutting and milling the cocowood into various shapes, patterns and sizes using simple machine tools or more complex woodworking machines such as moulders, routers, lathes, and sanders. Arancon (2009) continues by adding that "The machining quality of coconut wood is influenced by the moisture content, density of specific gravity, and cellular structure of the wood itself or by the factors attributed to the machine used, such as knife angle, feed rate, depth of cut, number of knives, sharpness of knives, and others" (p. 33).

Killmann and Fink (1996) and Ohler (1999) also agree that secondary processing involves producing various shapes and sizes using all woodworking machining methods such as sawing, planing, sanding, boring and mortising, lathing, gluing techniques, surface finishing and assembly.

Ohler (1999) states that similar to conventional hardwoods, high density coconut wood is not easy to work on, tools and equipment become dull and blunt. Killmann and Fink (1996) suggest that "The tool-blunting properties of coconut palm wood are probably caused by the large density difference between the vascular bundles

and the ground tissue together with the fine dust that is formed during machining" (para. 8.3).

2.6.6.7 Finishing

Finishing is one of the last manufacturing processes in all furniture and wooden products. Its main function is to protect the wood surface against environmental effects, enhance the appearance and service life through preservative action and for decorative finishing (Killmann & Fink, 1996; Ohler, 1999).

Arancon (1997; 2009) writes that just like other furniture timber, cocowood needs the application of finishes to preserve and show "the grain, color, or figure and to enhance its natural beauty. Finishes also impart good protection against abrasive wear, warping, raising of the grain, cracking, and shrinkage." Sanding and filling are also part of surface preparation, sanding levels the wood surfaces and removes the tool and machine marks to produce a smooth surface. Mechanical sanders instead of manual sanding ease finishing the surface of the wood. Also Killmann and Fink (1996) assert that:

With regard to pre-conditions and results, there are considerable differences between the sanding directions along, across and perpendicular to the fibre (perpendicular to the end-grain). A rougher surface is obtained when sanding across the grain and a considerably higher amount of material is removed per unit of time (up to 100 %) than when sanding along the grain, under identical sanding conditions.... It may be beneficial to use the following work sequence, among others, when sanding wide faces of solid wood:

1. Sanding across the grain.

2. Sanding along the grain.

This combination is often used to achieve high-quality surfaces, since the first sanding pass (across the grain) shears off the fibres at the pore side edge and thus enables a better sanding quality. In addition, more material volume can be removed per unit time when sanding across the grain, as already mentioned. As a rule, the only additional thing that happens during the subsequent sanding along the grain is that the surface is freed from the transverse grooves left by the sanding grit of the cross-grain sanding, and is smoothed.

(para. 8.6.7)

Coating involves the sequence application of stain, filler, sealer and top coating materials such as lacquer, polyurethane, polyester, shellac, wax and oil finish to enhance the natural beauty of the grain, colour and figure of cocowood products. Normally two or more coats of finishes are applied to cocowood to improve the appearance and quality of the wood products. Since these are transparent, dyes or stains can be used if the wood needs to look darker (Arancon, 1997; Ohler, 1999).

Killmann and Fink (1996) write that:

Stains are materials for changing the colour shade of the wood. Their purpose is to equalize the colour, to emphasize the grain structure and to modify the colour shade. Stains consist of soluble dyes, pigments, chemical reactants, solvents and additives. The main types that are used are water stains and solvent stains (organic solvents). Quick-drying solvent stains are especially suitable for use in continuous processes. In contrast to the environmentally

friendly water stains, they do not roughen the wood (do not raise the grain). (para. 8.8)

Also Killmann and Fink (1996) continue to caution that:

Cocos n. [*nucifera*] can also be treated successfully with synthetic or natural oils and waxes. In a combined treatment, dissimilar materials must be matched to the sub-strate, i.e. to the density of the specific palm wood and to each other. The parenchyma is particularly absorbent when using oil or glaze. When using wax it may in some situations be necessary to refrain from using oil previously. Greying of the surface may occur if the above instructions are not obeyed. (para. 8.8)

2.7 Coconut Craft

"Furniture, handicraft and novelty items can be made from coconut wood as it has an unusual but attractive grain, hence its name 'porcupine' timber" (Ohler, 1999, Utilization of coconut wood, para. 1). According to Arancon (2009), Coconut wood has properties that make it ideal for furniture and handicrafts:

1. *Density* – the wood's high density is ideal for products like furniture, but chairs and tables which are quite heavy
2. *Durability* – coconut has adequate resistance to insect borers. High density wood appears to withstand the test of time in interior application
3. *Good working properties* – the wood has fair to good machining properties
4. *Finishing* – the wood can be finished fairly well with transparent finishes. (p. 8)

Arancon (2009) continues by asserting that:

...c. The hard portion can be machined satisfactorily to obtain a smooth surface. But machining the medium and soft materials may result in *chipped grains*. But extra sanding effort or using wood fillers resolves this problem.

d. During staining, the *soft portion absorbs more stain* and tends to become darker than the other portions of the wood. But this can be controlled now by applying a very thin coat of sanding sealer and lacquer thinner mixed at a ratio of 1:6 before staining.

e. Glossy finishes applied over the *softer portion tend to lose their luster*. But this can be corrected now by applying more coating materials to the softer portion than to the harder portions. There is about 10-30 percent change in finish consumption per 0.1 change in the density of the wood....

g. Coconut wood is difficult to machine. *It dulls blades of woodworking machines* because of its silica content. But this can now be corrected by using stellite (Ste) or Tungsten Carbide (TCT) in the saw. (p. 22)

"Coconut shell and wood craft has gained popularity only in the last few decades, and hence does not have a long history to boast of" ("Coconut craft", n.d. para. 3). This documentation is about using coconut shell for artefacts like jewellery, cups and bowls, and using lathe-turning machine to produce candle stands.

Lotlikar (2009) also describes how coconut shells are fashioned into items like jewellery, key chains, crockery and cocollage. Lotlikar continues:

In Goa, not much work has been done on the use of coconut wood (except for roof-beams and other rough utility items). Some of the coconut trees, which are over a hundred years of age, offer very good quality wood for making craft articles – including showpieces, lamps, or even furniture, doors and windows, decorative articles, spoons, cups, mugs, walking sticks and the like.

Coconut wood of this kind can be very tough. (p. 73)

2.8 Appreciation

Barrett (2007) infers that "appreciation entails valuing, positive or negative; it is dependent on acquired perception that requires initiation and practice, training one's sensibilities, and learning how to apply apt vocabulary to distinguish aspects of what is being appreciated" (p.1). Barrett further states that

Appreciation is also affected by understandings of concepts of perception, sensibility, interpretation, taste, preference, and evaluation or judgment. Appreciation is meshed with beauty and beauty to aesthetic experience. In aesthetic philosophy as well as in daily living, concepts of beauty and appreciation are applied to nature, works of art, and a wide range of artifacts. (p.1)

Amenuke, Dogbe, Asare, Ayiku and Baffoe (1993) are of the view that appreciation is a full awareness of all the good qualities in what we see, read and hear. It has to do mainly with the visual arts and performing arts. Appreciation is intelligent discussion about works of art which involves silent and deep thinking about them. Amenuke, et al. further reveal that art appreciation promotes understanding and friendship between people of different cultures and helps to develop ideas about

beauty. It also helps to assess and appraise a work of art without passing judgement on it.

Amenuke, et al. propose that a work of art may raise questions such as What is it? Who made it? What does it mean? and What is it made for? in our minds when we see, read or hear it. These questions have to be answered intelligently and in an orderly manner. The steps used in art appreciation to answer these questions are:

Step 1: Identification of work

This step states what the work is, the title, name of artist, date work was produced, size of work and location of the work.

Step 2: Inventory of items in the work of art

At this stage all the items seen in the work are named and described. The characteristics or features of the items are stated.

Step 3: Technical qualities

The media and methods used by the artist are stated. The nature of the composition is also stated at this stage.

Step 4: Interpretation

This step involves stating the atmosphere created in the work, relating the items in the work to the cultural background of the artist or the work and the function or uses of the work.

From the above studies made by the various writers, it can therefore be concluded that coconut tree is being experimented with to alternate with conventional wood species for making furniture, crafts and other products wood is used for and it has been successful. Also reviewing literature on appreciation would guide the researcher as to how to appreciate the works that would be produced.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter discusses the Research design, Library research, Population for the study, Sampling design, Primary and Secondary data, Data collection instruments, Validation of instruments, Administration of instruments, Data collection procedures, Data analysis plan and General procedure in executing the work.

3.2 Research Design

The researcher employed qualitative and quantitative approaches of research to carry out the study. Action, descriptive and quasi-experimental research methods were used.

Qualitative research is concerned with collecting and analysing information in as many forms, chiefly non-numeric, as possible. It tends to focus on exploring, in as much detail as possible, smaller numbers of instances or examples which are seen as being interesting or illuminating, and aims to achieve 'depth' rather than 'breadth'. (Blaxter, Hughes & Tight, 2006, p. 64)

Leedy and Ormrod (2005) also assert that:

...qualitative research encompasses several approaches to research that are, in some respects, quite different from one another. Yet all qualitative approaches have two things in common. First, they focus on phenomena that occur in natural settings-that is, "in the real world." And second they involve studying those phenomena in all their complexity". (p. 133)

Peshkin (1993) as cited in Leedy and Ormrod (2005) declares that qualitative research studies distinctively serve one of the following purposes: description, interpretation, verification and evaluation.

3.2.1 Descriptive Research

Descriptive study, according to Hendrick et al. (1993) as cited in Gray (2004, p. 32), is providing a picture of a phenomenon as it naturally occurs. This may be purely descriptive or a normative study comparing the data against some standard. Leedy and Ormrod (2005) contend that descriptive research "involves either identifying the characteristics of an observed phenomenon or exploring possible correlations among two or more phenomena. In every case, descriptive research examines a situation *as it is*" (p. 179).

3.2.2 Quasi-experiment

According to Shuttleworth (2008), quasi-experiment is useful for measuring social variables and in generating results for general trends. Quasi-experimental design is often integrated with individual case studies; the figures and results produced often reinforce the findings in a case study giving room for some sort of statistical analysis to take place. Grimshaw, Campbell, Eccles and Steen (2000, p. S11) also write that "quasi-experimental studies often are conducted where there are practical and ethical barriers to conducting randomized controlled trials".

3.2.3 Action Research

According to Blaxter, Hughes and Tight (2006), action research

... lends itself to the direct involvement and collaboration of those whom it is designed to benefit. This is particularly the case for participatory action research, which is not designed and undertaken

by research 'experts' alone, but in partnership with people who are involved in the issues that the research is addressing.(p. 69)

Gray (2004) also asserts that:

.... Within this approach there are varied methodologies, each with their own priorities and modes of inquiry (although there are as many overlaps and similarities between the approaches as there are distinctions)....All approaches, however, have at least three common features:

- Research subjects are themselves researchers or involved in a democratic partnership with a researcher.
- Research is seen as an agent of change.
- Data are generated from the direct experiences of research participants.

A mode of action research that takes this latter point particularly seriously is *participatory action research* (PAR). (p. 374)

Somekh (2008) holds the view that "the outcomes of action research are both practical and theoretical: The knowledge it generates has a direct and ongoing impact on changing practice for participants and on a wider audience through its publications" (p. 4).

In this study, the quasi-experiment was therefore found to be very useful for the processing of the coconut log into boards and the descriptive method was used in recording, analysing, synthesising and interpreting the processes and procedures used in accomplishing the research project. Also the action research was also useful

for gathering data from the participants on their experiences after working with the processed coconut boards.

3.3 Library Research

The literature closely related to this work was obtained with the help of some works from previous researchers from the KNUST Libraries and Forestry Research Institute of Ghana Library, all in Kumasi. Online journals which were related to the research were also reviewed.

3.4 Population for the Study

"... population as a concept in research methods refers to every individual who fits the criteria (broad or narrow) that the researcher has laid out for research participants" (Saumure and Given, 2008, p. 644). The population is homogenous. All wood carvers in Kumasi and Toase Senior High School sculpture students in Atwima Nwabiagya district constitute the target population. However the target population cannot be reached therefore an accessible population was selected based on easy availability to the researcher. Wood carvers at Centre for National Culture in Kumasi and all Year Three sculpture students at Toase Senior High School respectively were selected as the accessible population.

3.5 Sampling Design

According to Morgan (2008, p. 798), "sampling is the process of choosing actual data sources from a larger set of possibilities". He also defines the sample size as "the number of data sources that are actually selected from the total population" (p. 799). The researcher used the purposive sampling technique to draw the sample size

for this study. Purposive sampling is a technique of handpicking supposedly typical or interesting cases (Blaxter, Hughes & Tight, 2006).

Five students were drawn purposively from the Year Three sculpture class at Toase Senior High School by their sculpture teacher based on their ability to carve well. Each student was given one board of cocowood to work with under the supervision of their teacher and the researcher. Three wood carvers at the Centre for National Culture also availed themselves for the project. One of the carvers did all the blocking and the two others did the detailing and finishing under the researcher's supervision.

3.6 Primary and Secondary Data

Primary data were collected through focus group discussion, interview, direct observation at the workshops of the wood carvers and students and field notes.

The secondary data comprised the entire literary materials sought, cited and used from books, articles, thesis, internet sources, journals, magazines and others that were related to the study.

3.7 Data Collection Instruments

Leedy and Ormrod (2005) assert that qualitative researchers often use multiple forms of data such as observations, interviews, objects, written documents, audiovisual materials, electronic documents in any single study. Qualitative studies, with the exception of content analyses rely heavily on observations, interviews or both as a source of data. Therefore, data for this thesis were collected through observation and semi-structured interview.

3.7.1 Semi-Structured Interview

"The semi-structured interview is a qualitative data collection strategy in which the researcher asks informants a series of predetermined but open-ended questions." Interview guides or a list of topics to be covered is developed by the researcher (Ayres, 2008, p. 810).

According to Gray (2004), in the semi-structured interview, additional questions which were not anticipated at the beginning of the interview may be asked as new issues arise. Responses can be documented by note-taking or tape-recording the interview. The semi-structured allows for probing of views and opinions where it is desirable for respondents to expatiate on their answers. In this study, the semi-structured interview was used to gather data from wood carvers at Centre for National Culture and the Year Three sculpture students at Toase Senior High School using the interview guide shown as Appendix to this study.

3.7.2 Observation

"Observation involves the systematic viewing of people's actions and the recording, analysis and interpretation of their behaviour" (Gray, 2004, p. 239). Blaxter, Hughes and Tight (2006) also assert that "The observation method involves the researcher in watching, recording and analysing events of interest" (p. 178). Leedy and Ormrod hold the view that:

... observations in a qualitative study are intentionally unstructured and free-flowing: The researcher shifts focus from one thing to another as new and potentially significant objects and events present themselves. The primary advantage of conducting observations in this manner is flexibility: The researcher can take advantage of unforeseen data sources as they surface. (p. 145)

In this study, the process of cutting the coconut logs into boards, and the process of carvers and students carving with the cocoboards and finishing of the carvings were observed.

3.8 Validation of Instruments

The first draft of the interview guide was prepared, proofread by the researcher. The interview guide was later shown to colleagues for further vetting and then to the supervisor for final approval.

3.9 Administration of Instruments

The research demanded direct observation and face to face interaction so the researcher made several personal visits to the Centre for National Culture where the researcher met the wood carvers and enquired if they could experiment carving with the cocoboards and they consented to it and appointment was booked for the carving to start. After the first visit, dates were booked for the subsequent visits and during these visits the carvers were observed at work and interacted with them.

The Toase Senior High School sculpture students were contacted through their teacher and five students from the Year Three sculpture class in the school were also observed and interacted with while they worked in the school's Visual Arts studio.

3.10 Data Collection Procedure

The coconut trees had already been felled on the respondent's land for over six months before this exercise. The respondent gave the coconut logs out willingly for free.

A sawmill operator was contacted by the researcher and a suitable appointment date was booked with him. The researcher gave specifications as to how the boards were to be sawn, took notes of the unstructured interview, observation and also took

photographs of the process. The interview was done in the Twi language because that was the medium of communication the respondent preferred.

The researcher visited the wood carvers and booked an appointment with them. On the first appointment date, the researcher visited the carvers with the cocoboards with sketches for carving. The respondents were also given the opportunity to carve anything of their choice. The researcher visited the wood carvers at the appointed dates to observe, interview, take pictures and document her observations throughout the process of carving, sanding and finishing.

The interviews with the wood carvers were conducted in the Twi dialect because Twi is the medium of communication they preferred.

On the part of the students, the interview was conducted in both Twi and English. This is because the students understood some of the wood carving terms better in Twi. The students were observed and interviewed during and after carving, sanding and finishing for their views on the properties of the cocoboards. Their comments and the secondary sources were put together and analysed.

3.11 Data Analysis Plan

The data collected were assembled, analysed and interpreted to derive the findings, conclusions, recommendations as stated in chapter four.

3.12 General Procedure in Executing the Work

Design and Production Stages

The seasoned cocoboards were given to the woodcarvers at the Centre for National Culture and students of Toase Senior High School. The designs carved by the woodcarvers were drawn directly onto the cocoboards with white chalk. The

students also made sketches on paper and glued them on the boards. The researcher also made some sketches for the carvers and students.

The designs and images were simple ones, based on Ghanaian themes such as adinkra symbols, masks, drummers and flowers. Simple designs were chosen because the respondents were being introduced to cocowood with which they were not familiar.

3.12.1 Tools, Equipment and Materials Used

In this study hand and machine operated tools and equipment employed in woodworking and carvings were used for the project. These include mallet, flat chisels, gouges, sandpaper, sander, planer, band saw, circular saw, table saw, painting brush, machine oil, oilstone, chainsaw and locally forged tools. Materials used include stains, mansion polish, varnish, lacquer and coconut logs.

Tools and Equipment

Chisels and Gouges

Chisels and gouges of different shapes and sizes (Plate 3.1) were used in the main carving of the works.



Plate 3.1 A set of Woodcarving Tools

Locally forged adze (soso)

A locally forged adze (Plate 3.2) known as soso was used in scooping the inner portion of the round coconut log.



Plate 3.2 Locally Forged Adze (soso)

Sandpaper

Sandpaper (Plate 3.3) was used for smoothening the carved works.



Plate 3.3 Sandpaper

Brushes

The painting brush (Plate 3.4) and the shoe brush (Plate 3.5) were used for both applying the stains and also polishing of the carvings.



Plate 3.4 Painting Brush



Plate 3.5 Shoe Brush

Machine oil and Oilstone

The oil was used in lubricating the stone (Plate 3.6) for sharpening the chisels and gouges.



Plate 3.6 Machine oil and Oilstone

Mallet

The mallet (Plate 3.7) was used for driving other tools such as chisels. This was used in driving the chisels when carving the works.



Plate 3.7 Mallet

Chainsaw

Chainsaw (Plate 3.8) was used for felling the coconut tree and cross-cutting it into the required pieces.



Plate 3.8 Chain saw

Planer

This equipment (Plate 3.9) was used in planing the coconut boards.



Plate 3.9 Planer

Band saw

The band saw (Plate 3.10) used for cutting curves, circles and irregular shapes, was used in cutting the circular board and the Ghana map from the coconut board.



Plate 3.10 Band saw

Sander

This power tool (Plate 3.11).was used in sanding the works.



Plate 3.11 Sander

Circular saw

This machine, (Plate 3.12) equipped with circular metal blade was used in cutting the coconut log into boards.



Plate 3.12 Circular saw

Table saw

This equipment (Plate 3.13) was used in straightening the edges of the smaller cocoboards.



Plate 3.13 Table saw

Materials

Stains

These are dyes or paints applied on wood to darken it or change its colour. Potassium permanganate (Plate 3.14) and acrylic paint (Plate 3.15) were used in staining some parts of the carving.

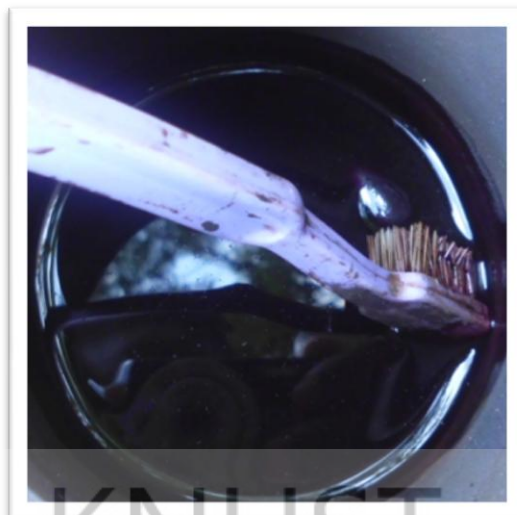


Plate 3.14 Potassium Permanganate in Container



Plate 3.15 Acrylic Paint in Container

Turpentine, Varnish and Mansion Polish

Turpentine (Plate 3.16) was used to thin out the varnish (Plate 3.17) which was applied on some of the works as the final finish. The mansion polish (Plate 3.18) which is a wax polish was also used as a final finish for some of the works.



Plate 3.16 Turpentine in Bottle



Plate 3.17 Varnish in Bottle



Plate 3.18 Mansion polish

Coconut Logs

This is the main material used in the execution of the project (Plate 3.19).



Plate 3.19 Coconut Logs

3.12.2 Felling and Cutting of the coconut Logs into Boards

The coconut tree had been felled by the respondent on his land at Okyerekrom near Fumesua off the Kumasi-Accra road for about six months. There were two varieties of the coconut, the tall and the hybrid. According to the farmer who provided them, the tall variety, which is also called ‘local’, was around 30 years old and the hybrid 25 years old. Logs obtained from the portions of the stems that were closer to the ground were intact, but those closer to the branches had started decomposing. The researcher chose two logs each from both the tall and hybrid varieties.



Plate 3.20 Logs from the Tall Variety of Coconut



Plate 3.21 Logs from the Hybrid Variety of Coconut

The shorter log from the tall variety measured about 25 inches in length and about 10.3 inches in diameter at one end and about 10.2 inches at the other end. The longer log measured about 44 inches in length, 12 inches in diameter at one end and 10.4 inches in diameter at the other end. From the hybrid, one measured about 30 inches in length, 7.5 inches in diameter at one end and 6.5 inches at the other end. The second one measured about 24.5 inches in length and 7.5 inches in diameter. The outer covering on the logs measured about $\frac{1}{2}$ inch.

The researcher sent the logs to Davis Woodwork Co. Ltd. Sawmill at Fumesua where the circular saw was used to split the logs into boards of 2 inches in thickness (Plates 3.22-3.26). The researcher stacked the boards in a shed for a month for air drying. The boards were raised off the ground using cement blocks. Four of the blocks were arranged and the coconut boards were placed on the blocks. Sticks / Ceiling battens were arranged in between the boards to allow air movement to all parts of the boards for even drying.



Plate 3.22 Sawing a Coconut Log into Two



Plate 3.23 Sawing off the outer Surface of the Coconut Log



Plate 3.24 Sawing of Coconut Log into 2-inch Boards



Plate 3.25 Two-inch Board being removed from the Saw



Plate 3.26 Boards Sawn from the Logs

3.12.3 Production of the Works

Carving at the Centre for National Culture, Kumasi

Six flat boards, one curved board, a log and a sketch were given to the wood carvers at the Centre for National Culture, Kumasi, to produce sample artefacts. The carvers made sketches directly on the boards using white chalk and later used pencil to show details and indicate the edges. Chalk was used to sketch first, so that if there was any mistake or a change of mind the sketch could be easily cleaned and drawn again.



Plate 3.27 Carver Sketching on one of the Boards with Chalk



Plate 3.28 Carver using Pencil to Draw the Details of the Sketch

After sketching, the carver used a broad edged chisel and the C and V- gouges to block the outline of the sketches to indicate the positive and negative areas while chipping out some of the unwanted areas.



Plate 3.29 Carver Blocking

Following the blocking, the details were carved, using smaller chisels and gouges, as necessary.



Plate 3.30 Carver Cutting out the Details

The next stage after cutting the details was sanding. The carvers used the sander for sanding first and then used smooth sandpapers such as grade 120 to smooth the work by hand. The carvings were then coated with sanding sealer and then sanded again by hand with grades 120 and 320 sandpaper.



Plate 3.31 Carver Sanding one of the Carvings with the help of the Sander

Some areas of some of the works were stained with potassium permanganate (Plates 3.32 & 3.33) after the sanding to show contrast. The potassium was mixed with water and applied on the desired area with a painting brush. The potassium was used because it spread to all corners easily without leaving some areas unstained. After staining the work, it was sanded with the smooth sandpaper again to remove the stains that had spilled over.



Plate 3.32 Adinkra Motif Stained with Potassium Permanganate



Plate 3.33 "Issues of Life" Stained with Potassium Permanganate



Plate 3.34 Unpolished Composition of “Sankofa”



Plate 3.35 Unpolished Composition of Drummers

Subsequent to staining is polishing which is the final finish given to the carvings. Varnish and mansion polish were used finishing the works. The varnish was thinned with turpentine and applied with the painting brush. The mansion polish was also applied with the mansion polish.



Plate 3.36 Carver Applying Mansion Polish on a Work Titled "The Village Scene"

Carving by Year Three sculpture students at Toase Senior High School

Five cocoboards, - three rectangular, one circular and one Ghana map-shaped board were given to the students to work with. The researcher asked one of the students to use the Ghana map to make a clock and another to use one of the rectangular boards to carve 'Art Education'. The remaining three students carved anything of their choice and they produced an African mask, a Tulip flower and the *Gye Nyame*

adinkra symbol. The students carved under the supervision of their sculpture teacher and the researcher.

This lettering (Plate 3.37) was given to the students by the researcher to carve and the researcher chose the lettering "Art Education" because of the researcher's background as a student of Art Education.



Plate 3.37 Sketch of "Art Education" for the Students to Carve

The tulip flower (Plate 3.38) was sketched on paper by the student and transferred onto the cocoboard. He traced it with the help of carbon paper and made it bolder by using white chalk.



Plate 3.38 A Sketch of a Tulip Flower

After the sketching the student used the C and V gouges and broad edged chisel to block the sketches (Plate 3.39) and detailed the carvings with the other chisels.



Plate 3.39 Student Blocking the Tulip Flower



Plate 3.40 Student Carving 'Art Education'



Plate 3.41 Student Carving the Numerals for the Clock

After carving the mask, a student whittled the carving, that is, she used the chisel to level and smoothen the carved surface (Plate 3.42).



Plate 3.42 Student Whittling Parts of the Mask

The students used sandpaper grade 60 which is rough for the initial sandpapering and then used grades 80 and 120 for smoothening. Sanding sealer was then applied on the carvings and then sanded again with the grade 120 sandpaper.



Plate 3.43 Student Sanding the Carved Gye Nyame Symbol



Plate 3.44 Students Sanding the Tulip Carving



Plate 3.45 Students Sanding the 'Art Education' Intaglio Carving

Afterwards the students stained the carvings with black acrylic paint to show contrast and also project certain parts of the works (see Plates 3.46 and 3.47) and allowed them to dry. The works were sanded again to remove the spilled paint.



Plate 3.46 Mask Stained with Acrylic Paint



Plate 3.47 'Art Education' Stained with Acrylic Paint

The tulip flower (Plate 3.48) was sprayed with imitation gold spray and the background stained with acrylic paint.



Plate 3.48 Tulip Sprayed with Imitation Gold; Background Stained with Acrylic

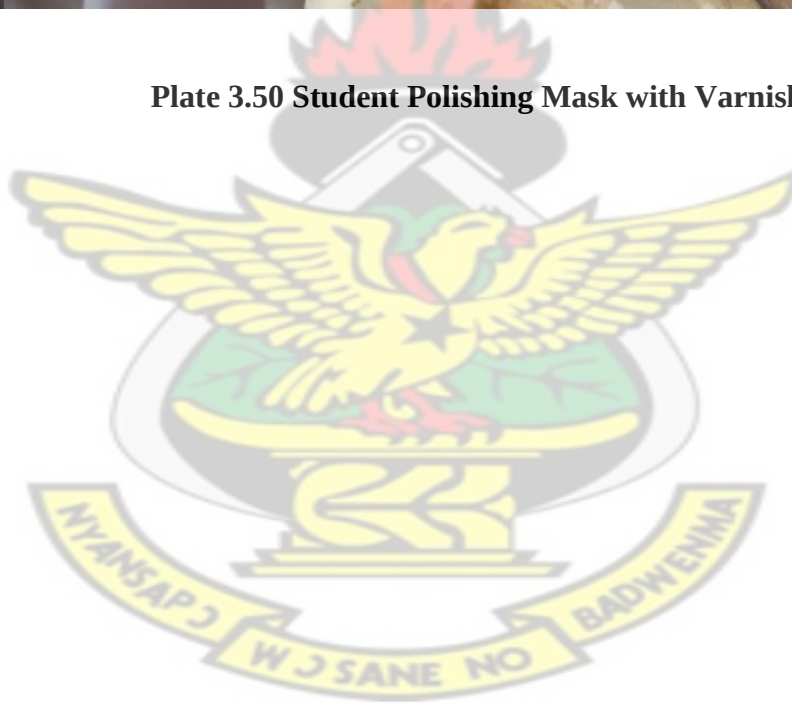
Following the staining, the students polished the works with varnish to obtain a glossy finish (Plates 3.49 and 3.50).



Plate 3.49 Student Applying Varnish on ‘Art Education’



Plate 3.50 Student Polishing Mask with Varnish



CHAPTER FOUR

PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Overview

As a result of the over reliance on utilization of traditional wood species without adequate provision for resource renewal, the wood industry in Ghana now faces scarcity and high cost of conventional wood, especially for Senior High School students offering sculpture. There is the need to look for lesser known wood material that can be used as substitute material for commercially known wood species to overcome the problem of inadequate supply of carving material and at the same time to help preserve the depleting forests of Ghana. This research therefore sought to use coconut tree as an alternative material for carving.

This chapter therefore discusses and presents the findings on the use of coconut tree as an alternative material for wood carving. The data were gathered through interview and observation as have been described in the following sections.

4.2 Discussion of Findings

Objective One: To identify, describe and document the properties of coconut tree which make it possible for carving.

The study found that twenty-five (25) year old hybrid and thirty (30) year old tall varieties of coconut wood as were used for this project had different characteristics. It was observed that the hybrid variety had a smaller stem than the tall variety and because of that the sizes of the boards obtained from the hybrid variety were smaller in width than those of the tall variety. It was discovered that the outer portion of the coconut wood was harder, with the grains which looked like strands closely packed, than the mid portion which was softer, with the grains loosely packed. The finger

nail could make an impression in the mid portion. This tallies with Arancon's (2009) finding as cited in the review of related literature.

As observed and gathered from the interviews held with the students and carvers, carving the outer peripheral of the coconut wood was more difficult and needed more pressure and energy because it was harder while the inner portion, which was softer, could be carved more easily with a little pressure such that when one is not careful, the chisel could cut more than what was intended to be chipped away. The carvers said the inner portion would be best for mouldings which need little or no carving.

It was also observed that the grains of the coconut wood were spiky and easily pierced the skin on contact if care was not taken. The spiky nature of the grains made carving difficult and uncomfortable. Care had to be taken by protecting the hands with gloves and goggles for the eyes from flying split pieces. The coconut wood was brittle and because of that carving small and tiny details and objects would be difficult and would not be advisable to use for such works as A. Adu and E. G. O. Appea indicated (personal communication, February 18, 2012). The nature of the coconut wood could be compared to bamboo (A. Adu, personal communication, February 18, 2012) which also confirms Arancon's (1997, p 1) finding that "coconut wood is comparable to Philippine hardwood/ softwood and bamboo as far as holocellulose, lignin and pentosan are concerned". These challenges notwithstanding, it was observed that coconut wood is suitable for wood carving.

Objective Two: To process coconut tree for carving.

It was observed that the processes, tools and equipment used for the project are the same ones used for woodworking, as stated by Bailleres et al. (2010) in the review

of related literature. The circular saw (Plate 3.17) which was used in cutting the logs into boards had to be sharpened after cutting before it was able to saw again because of the hardness of the outer peripheral. This confirmed what Ohler (1999) and Killmann and Fink (1996) had documented, as stated in the review of related literature.

During the seasoning process, it was observed that the softer portions of the coconut boards were attacked by termites (Plate 4.1) and wood borers (Plates 4.2). This confirmed that the mid portion of the coconut wood is susceptible to insect attack when left in the open, as affirmed by Arancon (1997; 2009), Killmann and Fink (1996) and Ohler (1999) and cited in the review of related literature.

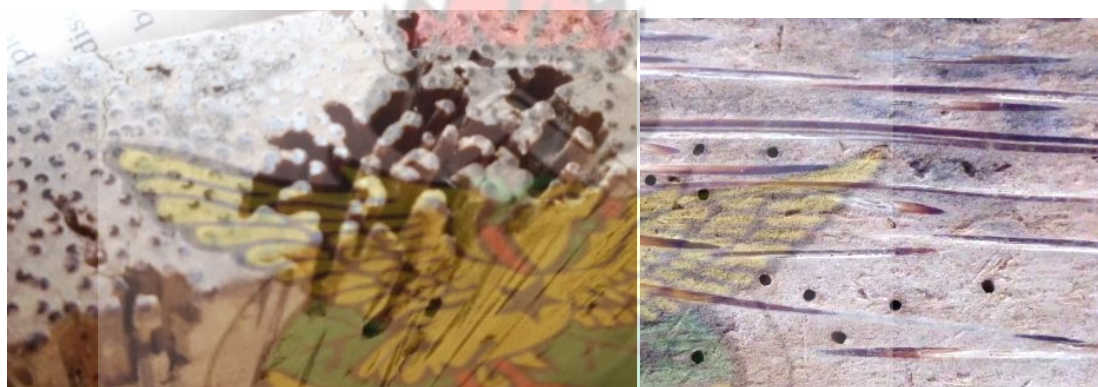


Plate 4.1 Termite Attack on Softer Portions of the Coconut wood

Plate 4.2 Wood Borers Attack on Softer Portions of the Coconut

Source: Fieldwork

Objective Three: To introduce the processed tree to Senior High School sculpture students and wood carvers to produce sample artefacts.

Carvers at the Centre for National Culture, Kumasi

From the interviews conducted and observation made, the chisels and gouges used for the main carving had to be sharpened at regular intervals when carving the outer peripheral because the tools easily got blunt and at some point the tip of some of the

chisels got broken; as stated by Ohler (1999) and cited in the review of related literature.

It was found that sanding of the works is not different from sanding conventional wood works. Sanding was done across and along the grain to achieve a very smooth surface. This demonstrated what Killmann and Fink (1996) observed and was cited in the review of related literature. There is the need to protect the nose with nose mask to prevent the dust from entering the nose as it is done when sanding conventional wood. The various grades of sandpaper (Plate 3.9) used in sanding conventional wood works to smoothen the surface (e.g. 60, 80, 120 and 320) and the sander (Plate 3.17) were used in sanding the carvings and the result was not different from that of conventional wood. The spiky grains pierced the skin in the process of sanding with the sandpapers; protective gloves should be worn to protect the hands from being pierced.

It was also observed that the carvers used potassium permanganate in staining parts of the works to show contrast, darken and project some areas on the carvings. They mentioned that potassium permanganate was mostly used when staining was needed in carvings produced because it dried quickly and spread to all corners without leaving traces of unstained corners.

Finishes such as sanding sealer, varnish, spray and wax work well with the coconut wood, just like conventional wood except that the mid portion which was softer absorbed more material, so there was the need to apply two to three coats before it looked glossy as proven by Arancon (2009) and cited in the review of related literature.

In the interviews, the carvers mentioned that it would be difficult for insects to attack the outer portion of the coconut, it was also not likely to warp because of the

nature of the grains and works produced with the outer portions, which they said would last longer than conventional wood because coconut logs had been used as pillars for a building for more than 30 years and it was not rotten.

One carver also mentioned that matured odum tree has almost the same colour as the coconut. Conventional wood species like mahogany, ebony, cedar and odum are heavier than the coconut wood. Quality of work produced was like that of conventional wood species and the finished work looked like kyenkyen (A. Adu, personal communication, March 26, 2012).

The carvers were aware that the coconut wood could be carved but had not worked with it before since the material was not easily accessible in the Ashanti Region and if it had to be brought from the coast, the cost of transportation would affect the production cost which would make the products expensive. They also mentioned that someone gave them oil palm wood to make some carvings for him. The carvers were impressed and excited about the carvings from the coconut tree.

Form Three sculpture students at Toase Senior High School

Five pieces of cocoboards-three rectangular, one circular board and one cut to the shape of a map of Ghana-were given to the students to work with. One of the students was asked to use the one shaped into the Ghana map to make a clock and another to use one of the rectangular boards to carve 'Art Education'. The remaining three carved anything of their choice and they produced an African mask, Tulip flower and the *Gye Nyame* symbol.

After the students had been given the coconut wood, they made their sketches and transferred them onto the boards. Their sculpture teacher showed them how to handle the tools for carving and how to sharpen the tools.

The students were happy about the works produced but said that they would not like to work with the coconut wood again because the grains pierced their palms and also the harder portions were difficult to carve. Additionally, tools had to be re-sharpened regularly and that made the carving tiresome and slow.

The students were surprised to see boards sawn from coconut tree because they had never heard or seen of any before. They said that they thought coconut tree was made up of only fibres that were not bound together and that it disintegrated when felled. This observation confirmed what Shmulsky and Jones (2011) and Walker (2006) had earlier observed, as cited in the review of related literature.

It was observed that sanding of the works by hand was difficult, because the grains pierced the palms in the process and it took a lot of time to achieve a smooth surface. The sander (Plate 3.17) made things easier. The students used black acrylic paint to stain parts of the carvings to project the designs carved on the cocoboards. The students also used varnish to finish the works. The tulip flower was sprayed with imitation gold before applying the varnish finish.

It was difficult getting the students to work with. The first batch of students abandoned the work after listening to the explanations. Two students in the second batch too left and other students were brought in to replace them.

Also because of their class schedules, the researcher had to meet them after school hours and weekends. Sometimes the researcher had to go and wait for them for some time before they came and at other times they did not come at all. This delayed the project a little. The researcher had to stimulate and motivate the students by giving them gifts before they committed themselves to the research.

4.3 Appreciation and Discussion of Works

Appreciation is discussion about nature and works of art based on acquired perception that requires deep thinking, practice and the right vocabulary to appraise nature and works of art without passing judgement on them.

Project 1: Mask



Plate 4.3 Mask

Dimension: 17.5inches × 9inches × 1.5inches
Year: 2012

Description

The mask made by one of the students was made from cocowood, stained with acrylic and polished with varnish. The work was made from the mid portion of the cocowood which is softer with a small portion of the hard wood around the ear and horn of the mask. This piece of cocowood was obtained from the "local" or tall variety. The mask has two horns. The area between the horns is stained with acrylic. The two ears with the holes in the ears are also stained. The irregular markings on the forehead also stained. The area in between the eyes is not stained. The nose is long; the portions under the eyes and around the nose are raised. The mouth is round and hollow. The cheek is rounded; the mask has a beard that is parted in the middle and the middle part of the chin stained with acrylic.

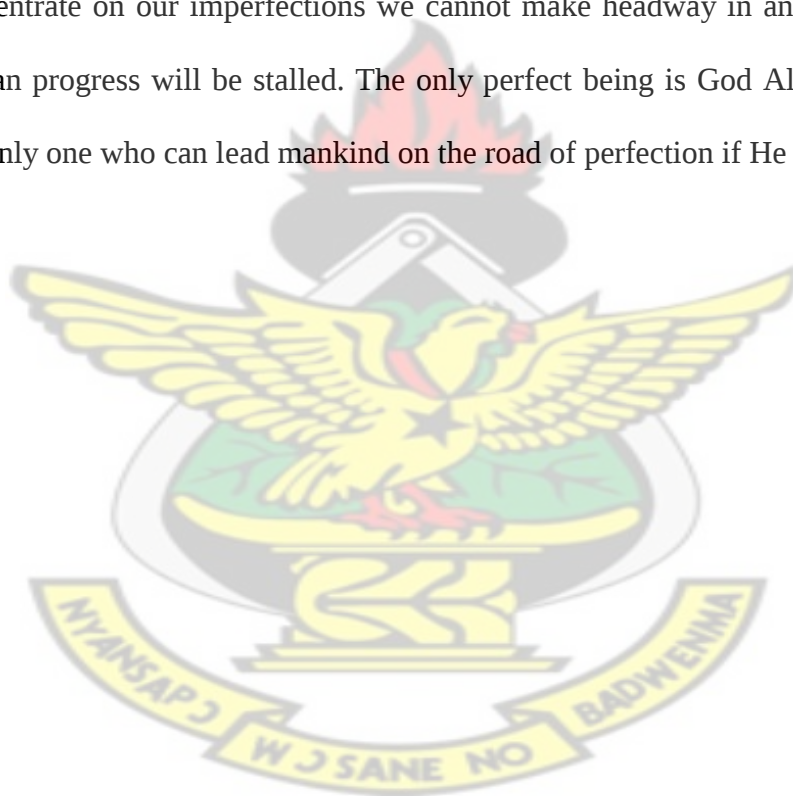
Analysis

The student employed both high and sunken (intaglio) relief forms of carving. The work is balanced asymmetrically. The stain used looks thick and solid contrasting with the lighter and darker shades of the natural colour of the cocowood. Three tones are showing in the mask: the light tone is on the nose, the eyes and forehead moving towards the middle tone seen besides the eyes, the ears, the horns and the left and right side of the thick curve above the forehead. The mouth and the beard are also part of the middle tone. The stained areas form the dark tone. Variety is created in the shapes and lines used. Colour, lines and shapes have been united and harmonised to create a masculine and robust mask.

Interpretation of the Work

The work was inspired by the known African masks. The mask is asymmetrically balanced. The ear on the right side is longer than the one on the left side. There are

four different sizes of marking on the forehead on the right side and tree different sizes on the left. Also the space between the right eye and the nose is bigger than that on the left. The raised portions under the eyes and beside the nose are not equal in size and shape. The left cheek is more rounded than the right one. The middle part of the parted beard is the smallest followed by the left side and then the right side. This relates to the fact that humans are not perfect and everything humans do is not perfect. In life one must accept his / her imperfection and that of the neighbour's imperfection in order to be able to live harmoniously with each other. If we concentrate on our imperfections we cannot make headway in anything in life and human progress will be stalled. The only perfect being is God Almighty and He is the only one who can lead mankind on the road of perfection if He is trusted.



Project 2: Issues of Life



Plate 4.4 Issues of Life

Dimension: 27.4inches × 6.5inches × 1.4inches

Year: 2012

Description

This work is made on cocowood obtained from the hybrid variety of the coconut, stained with potassium permanganate and finished with varnish. The carving is in abstract form with the uppermost figure depicting someone with the hands in between the thighs and the head looking down. The second figure represents a woman with a pot turned upside down in front of her. The third figure shows someone supporting his or her head with the hand; and the fourth motif is a couple

having a chat and the last and lowermost figures are a woman and a man hugging. The letters in the word issues have been arranged beside the figures as part of the composition.

Analysis

The carver used the low relief method of carving to execute the work. The work is asymmetrically balanced. The stain on the background contrasts with the colour of the wood and give the images a high projection. The thick lines in the form of borders on both sides of the images create the feeling of a safe and stable atmosphere in the work. It also contrasts with the curved lines forming the images. The curved lines have been repeated and varied. Thin lines are used to separate the images and the various parts of the images. The shapes depicting the female figures look more rounded and those of the male figures look angular, though rounded too. The shapes are repeated and varied to create the images. The arrangement of the letters beside the figures creates harmony, unity and movement in the work.

Interpretation of Work

Different human activities go on at the same time. While someone is chasing vehicles to sell items to make money, another person is also begging for money. Another person is mourning the death of a loved one and at the same time somewhere someone is also jubilating the birth of a new baby. One couple is giving finishing touches to their wedding plans and another is either chasing a lawyer to help with a divorce case or seated with family members trying to solve problems. Another person is trying to locate funds to start a business and the other is sitting comfortably in his/her office counting the number of businesses owned and profits gained and expected. Someone has to walk miles to fetch water from the stream to

drink and the other person wakes up turns a knob and water starts flowing. Such is life. As we move around in our daily lives, we come in contact with all these experiences and more and more questions are raised in our minds. Upon all these we are encouraged in the Holy Scriptures in Philippians 4:6, 8 (New International Version) "Do not be anxious about anything, but in everything, by prayer and petition, with thanksgiving, present your request to God.... Whatever is true, whatever is noble, whatever is right, whatever is pure, whatever is lovely, whatever is admirable – if anything is excellent or praiseworthy – think about such things."



Project 3: The Drummers



Plate 4.5 The Drummers

Dimension: 44inches × 8inches × 1.2inches

Year: 2012

Description

The drummers done by the carvers at the Centre for National Culture is carved from cocowood obtained from the "local" or tall variety of the coconut tree and polished with varnish. There are three drummers; the first one's head is in profile wearing a hat and a smock with the drum under the armpit using the hand to play. The second drummer is also wearing a hat and a smock with a drum under the armpit playing the drum with a drum stick. The head is also in profile. The third drummer is in frontal view, wearing a hat, a smock, with the drum on the right side of the lower part of his body using both hands to play. The shape of the mouth signifies that the drummer is singing.

Analysis

The work is cut in medium relief (mezzo rilievo). The cocowood has been shaped to move with the shape of the drummers to create the feeling of unity. Lines have been varied and repeated on the hats, edges of their sleeves and on the smock of the last drummer to create contrast. Variety and repetition of shapes is also seen in the drums, the hats, their heads and hands. The positions of the heads create movement and variety. The movement of the lines in the hats corresponds to the position of their heads.

Interpretation of Work

This work is inspired by the people of the Northern Region of Ghana. The drummers are in a festive mood. This also depicts some part of the culture of the people of Northern Ghana, portraying the cultural diversity of the country.

Students' works are influenced by foreign ideas due to on-going foreign influences on the minds of Ghanaian scholars, in the classroom, the Internet, foreign television

programmes and some programmes aired on the local television stations. At other times, they find it difficult coming out with original designs for their works. This carving shows that ideas can be generated from the cultural background of our country with some additions and subtractions.

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CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Wood carving has been practised by Ghanaians for a long time and it is also a subject of study in some second cycle institutions in Ghana. Conventional wood species such as odum, mahogany, ebony and others are, hitherto, the medium of expression. As a result of the over reliance on the utilization of traditional wood species without adequate provision for resource renewal, the wood industry now faces scarcity and high cost of conventional wood. This research has demonstrated that it is possible to use lesser known wood like cocowood for carving and obtain results that are equally good or better than results obtained in the traditional wood species. For this reason the researcher adopted the following objectives:

1. To identify, describe and document the properties of coconut tree which make it possible for carving
2. To process coconut tree for carving
3. To introduce the processed tree to Senior High School sculpture students and wood carvers to produce sample artefacts.

To achieve these objectives, the researcher located some of the coconut tree suitable for the project, reviewed related literature and observed the processing of the coconut logs into boards and wood carvers and students at work. The wood carvers and students were also interviewed. Quasi-experimental, descriptive and action methods of research were used for this project. The outcome of the project and the carved works indicates that the objectives and research questions set have been achieved.

Summary of Major Findings

- Processes, tools and equipment used for traditional woodworking are the same used for processing the coconut logs.
- The hybrid variety has a smaller stem than the tall variety and because of that the size of boards from the hybrid were smaller in width than that of the tall variety.
- The outer portion of the cocowood is hard with the grains which look like strands closely packed and the mid portion is soft with the grains loosely packed. The finger nail can make an impression in the mid portion.
- Carving the outer peripheral portions of cocowood is difficult and needs more pressure and energy because it is harder.
- The tools easily got blunt and at some point the tip of some of the chisels got broken when carving the outer portion of the cocowood.
- Cocowood has adequate resistance to insect borers. It is difficult for insects to attack the outer portion of the coconut. However, when exposed to the weather, cocowood is not naturally durable it is attacked by fungi decay, wood boring insects and termites. The mid portion of the cocowood is susceptible to insect attack when left in the open.
- The inner portion of cocowood is best for mouldings which need little or no carving.
- The grains of the cocowood are spiky and easily pierce the skin. This makes carving difficult and hazardous without protecting the hands with gloves and goggles for the eyes from flying splinters.
- The cocowood is brittle and because of that carving small and tiny details and objects would be difficult and uncomfortable.

- The nature of the cocowood can be compared to bamboo as a carving material.
- Sanding the cocowood with sander and sandpaper manually across and along the grain to help to achieve a very smooth surface. This combination of sanding across and along the grain is good for achieving high-quality surfaces.
- Stains such as potassium permanganate and acrylic paint used for conventional wood species are the same used for the cocowood.
- Finishes such as sanding sealer, varnish, spray and wax work well with the cocowood just like conventional wood except that the mid portion which is softer absorbs more so there is the need to apply two to three coats before it achieves the glossy look.
- Quality of work produced with cocowood is like that of conventional wood species.
- Cocowood can be carved but the respondent carvers had not worked with it before since the material is not easily accessible in the Ashanti Region.

5.2 Conclusions

Based on the findings of the project the following conclusions were drawn:

Tools, equipment and materials needed for processing traditional wood species for carving work well when using them for processing cocowood.

The various processes such as logging, sawmilling, grading, and machining that traditional wood species are taken through to get them into boards are the same that coconut tree is taken through to get them into boards.

As every tree species has its own unique structure, the cocowood has its unique structure which compares favourably with bamboo and Philippine hardwood/softwood therefore similar products can be made from coconut timber.

The traditional wood carvers the researcher worked with were aware that the cocowood is a carvable material, but because the material is not easily accessible in the Ashanti Region and that if it has to be brought in from the coast, where it abounds, the cost of transportation would increase and affect the production cost, which would increase the price of the handicrafts produced from them. It would be cost effective if it is patronised by wood carvers in the coastal regions where senile coconut palms are abundant.

5.3 Recommendations

The researcher therefore recommends that:

- The Ghana Education Service (GES) should adopt this project and make copies available to libraries to serve as an educational resource material for educational institutions offering wood sculpture as a subject of study.
- The Ghana Education Service (GES) should encourage schools in the coastal towns of Ghana to harvest, process and use the senile coconut trees standing in plantations for woodworking, as demonstrated in this report.
- The Ministry of Tourism, Culture and Creative Arts and other stakeholders should encourage the nation's wood carvers in the coastal towns to harvest, process and use the over-aged coconut trees for wood carving and other related use, as demonstrated in this report.

Further research should be conducted on senile coconut trees and the relevant techniques that can be applied in carving them into functional and decorative sculpture.

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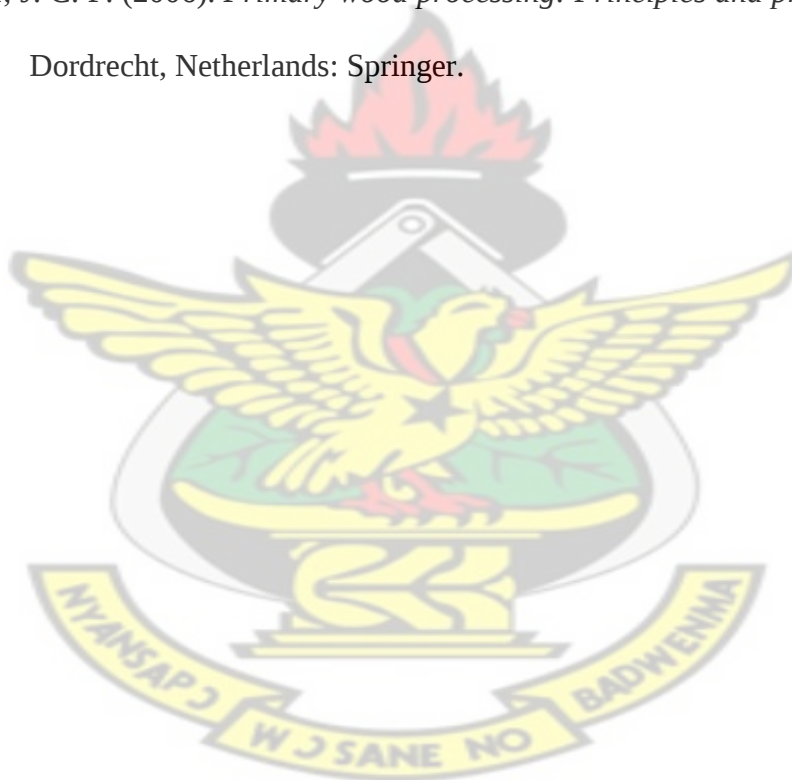
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APPENDIX

Interview Guide

- Differences and similarities between carving coconut wood and conventional wood.
- Is there the need for specialised tools?
- Does change in weather conditions have any significant impact on the coconut wood?
- Does the weight of the coconut wood affect the carving process?
- Sanding
- What is the reaction of finishes on the coconut wood?
- What are some of the challenges faced?
- General view of the finished coconut wood carving as compared to conventional wood carving

