NATIONAL LUMBERING AND WOOD RESEARCH CENTRE SAPELE

M- TECH THESIS (ARCHITECTURE)

BY

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CERTIFICATION

This to certify that this project, National lumbering and wood research centre Sapele is a product of research work carried out by Anza Ordughga Mark of the department of Architecture Federal university of technology Minna and meets the requirement for the award of a masters degree in Architecture and is approved for it's contribution to knowledge.

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DEDICATION

TO GOD ALMIGHTY.

AKCNOWLEDGMENT

To some people the way they go about their daily life is just normal even though they affect other peoples lives in incredibly positive ways with out even knowing it. This is case with the under listed people and many more I cant list in a whole booklet not to mention just this page.

- my parents Mr and Mrs E. T. Anza for their unending love, patience, encouragement and support.
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- Choji, Bobo, Vic, Valerie, Ngamdai, Marngai, Maya, Hyrawa. For your prompt advises

ABSTRACT

Human activities have severely disrupted the jungles of the world. Between 19 and 50 million acres (7 and 20 million hectares) are lost each year to farming, logging, mining, and other human endeavours. The largest continuos rain forest area, the amazon, is also the largest trace of unexploited, natural jungle. Most of the south American countries have some undisturbed forest left , and some have made concerted efforts to protect part or all of what remains . in central America, cattle ranching and cultivation have wiped out an estimated two thirds of the regions rain forests

Even as the deforestation deepens, in the name of logging, the end result of timber is highly below the required sectional standard and quality for building construction and furniture work . some of them come with wood boring insects and bugs and or destructive fungus. This project looks into all this problems and provides the required environment to produce standard timber, furniture, and development of environmentally friendlier ideas , methods and techniques for logging and conversion of wood.

MOTIVATION

Much of the vast jungle region in Africa has being destroyed and slash and burn agriculture. Slash and burn agriculture consists of cutting away other trees and other vegetation , burning what is left , and then planting crops . because of poor soil, many such soil can support only two or three such planting before the amount of nutrients is exhausted and the land is abandoned . timbering and crop clearing may eliminate the jungle forests of most of Africa soon.

Most of the timbering and clearing of the jungle habitat through out the world has occurred within the last century. These activities have caused unusual breaks in the ecological balance of the jungle communities. Although some developing countries like Nigeria and Kenya, have attempted reforestation , the damage is progressing at a pace such that the final effect on the ecosystem cannot be estimated

a tropical jungle is a delicate biological network comprised of numerous fragile interrelationships. The disruption of a key species in one part of the system can create an inbalance in the jungle ecosystems. These same species dependencies, however , can also work together in such a way that, if

left to themselves, they could in time recover to become once again a highly divers jungle habitat.

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CHAPTER I

1.0 INTRCDUCTION

It is hard to imagine a resource that provides more benefits for humans than do forests. Food, shelter, tools, and fuels are all products of this natural treasury. The forest is also home to many animals and plants. Its trees help clear the air of pollution while enriching it with oxygen and slow down the sometimes destructive forces of wind and water. Forests are one of the major resources that can be renewed and improved.

Long before the dawn of recorded history wood was an essential raw material. It was burned to provide heat and manipulated to provide shelter. Today in addition to its use as a fuel and as a building material, wood is used in many other ways.

Wood is the hard, fibrous substance found beneath bark in the stems and branches of trees and shrubs. Practically all commercial wood, however, comes from trees. It is plentiful and replaceable. Since a new tree can be grown where one has been cut, wood has been called the world's only renewable natural resource.

Although stronger and stiffer materials have been developed over the years, wood is still in great demand. Steel and concrete are the predominant materials used to construct high buildings and long-span bridges, but wood is a major material in houses, low buildings, and short-span bridges. Wood is also widely used in utility poles, railway ties, fence posts, ax and hammer handles, flooring, and paneling. It is also a raw material for pulp-based products such as paper and some plastics, and for turpentine and rosin .

A general, commonly used term for the dense rain forests of tropical regions of the world is "jungle." Certain forests of broad-leaved evergreen trees in subtropical or even warm temperate regions are also called jungles. An older, more precise definition of jungle is an area of thick, tangled plant growth at ground level.

In this strict definition, jungle occurs in tropical or subtropical rain forests where a significant amount of light can promote the characteristic dense growth of vines, small trees, and other plants. This occurs in areas where forests have been cleared of trees by humans, under natural situations where tall trees have fallen, or along the margins of large water courses. In true rain forests, however, sunlight hardly penetrates the lush growth.

The lumber industry transforms the trees of the forests into the lumber from which other products are made. Its tasks include logging--cutting trees down, sawing them into logs, and carrying the logs to the sawmill to be sawed into boards and timbers, or lumber.

In Nigeria the lumber industry is unable to make use of more than 30 percent of most trees. Small and crooked logs, treetops, branches, limbs, and high stumps are left in the woods to rot. In the sawmill the first slices from logs and the trimmings from sawed planks are burned as fuel or as waste. The present-day lumber industry in advanced countries, however, converts almost 100 percent of each tree harvested into useful products. Better equipment and working conditions permits less wasteful cutting. Thinner saws, for example, reduce the amount of sawdust. Chips that were formerly burnt or thrown in flowing water bodies. Better provision of space to enhance production at every level from conversion to finishing have all greatly improved wood processing.

History records many instances of harmful harvesting of the forests, often to provide food, fuel, or lumber. The once mighty forests of cedar in Lebanon are no more. Vast forests in China were destroyed during and after World War II. Rain forests in the Amazon Basin are today being

cleared for croplands. Widespread gully erosion and flooding in southern and eastern Nigeria. Forests get devastated whenever people need open land for farming. New settlers cut trees, use what wood they need, and burn the rest.

Over many years nature improves forests by removing inferior trees, an example of natural selection through the survival of the fittest . But many natural events and human activities affect this process. Fires, floods, wind storms, and harvesting practices all affect the growth of the forest. In general it is fair to say that nature's events generally improve the forests over the years and the activities of human beings harm them.

Through forest management, human beings should do less harm, perhaps even help forests. In controlling the composition of the stand by planting species they prefer, human beings can improve the quality of the trees they plant. Much has been learned about the development of genetically improved strains of corn, wheat, and other food crops. This improvement can be accomplished quickly because these crops produce a new generation each year. Progress is slower with trees because they often take many years to produce seed.

When forest managers think of improving trees, they want trees with long, straight trunks that can be sawed into lumber or peeled for plywood more economically. They want trees with small crowns, or tops, so more trees can get sunlight and grow on each acre. They want trees that are insect and disease resistant so their chances of maturing are better. And they want trees that will grow to commercial size as rapidly as possible.

Forest scientists have accomplished all these goals with pines and with some hardwood species such as sycamore, cottonwood, and yellow poplar. They have even learned to clone a superior tree, a process that produces more trees exactly like it. This is done in the laboratory by forcing tiny cuttings from the tree to develop roots and leaves.

An example of what can be achieved is that improved species of pines produce much more usable wood in the same time as ordinary wild trees produce relatively little. Such improvements mean that more wood can be grown on less land in a shorter time. As the world population grows and requires more land for home sites and food production, this ability to maximize wood production on each acre will be vital to future generations.

The typical Nigeria sawmill and timber shed fall completely below standards in almost all aspects, the building and mechanical facilities required to produce standard sound timber are simply not in place, due to this it is not possible to obtain wood that conform to laid down British standards for wood. This work covers the practice of lumbering in Nigeria in comparison with other advanced countries and their benefits a case study of the united states of America. The write up also prescribes methods of improving these practices and architectural provisions to enhance forestry, lumbering, milling and carpentry research.

1.1 AIM AND OBJECTIVES

In advanced countries lumbering has become very advanced and at least seventy to one hundred percent of each harvested tree is put to use in one way or the other. The present-day lumber industry, however, converts almost 100 percent of each tree harvested into useful products. Better equipment permits less wasteful cutting. Thinner saws, for example, reduce the amount of sawdust. Chips that were formerly scrapped are now sold to paper mills. The availability of research facilities led to this; In the United States loggers once stripped forests with no regard for their future regrowth as is the practice here now in Nigeria, they would enter a

wooded area, cut down all the valuable trees, and then move on to repeat the performance elsewhere. Their methods were abandoned only when lumber companies came to realize that America's forests were not inexhaustible and that their industry would eventually run out of trees if the forests were not replanted. This led to the development of research in forestry necessitating the need for various forest and lumbering research centers and institutions.

AIM:

The aim of this project is to provide a research center to develop and provide facilities and methods to optimize the use of timber and control environmental degradation due to lumbering and conversion of wood.

OBJECTIVES:

- To research into by-products of the lumber/mill industry for possible lamination and integrated structural or architectural members
- To research into desirable species with much desirable qualities for example rate of growth and girth.
- To implement environmentally friendlier logging and conversion

- To research into other tree species with promising lumber potential (in Sapele alone there are about five hundred (500) different tree species out of which only sixty (60) are being explored.

- To design and produce furniture with stricter and smarter application or and adherence to architectural anthropometrics.
- To provide the design world with sound and standard seasoned wood.

1.2 RESEARCH METHODOLGY

The following research methods were employed in acquiring data information for this thesis;

- Literature review from publication extracts , books, magazines, journals, consultation of maps and some unpublished works.
- Visits to various timber sheds, in Benin,Sapele, Ondo, Enugu, Kaduna, Minna, and Makurdi
- Visits to various saw mills, in Benin,Sapele, Ondo, Enugu, Kaduna, Minna, and Makurdi
- Visits to various logging sit-in Benin,Sapele, Ondo, Enugu, Kaduna, Minna, and Makurdi.

-Visits to various offices related to the subject and personal interviews with personnel of such offices, forest guards and various members of logging, milling and wood related industries

-Visits to various wood and metal work shops

1.3 SCOPE AND LIMITATIONS OF WORK

1.3.1 SCOPE OF WORK

Research into lumbering, conversion, seasoning, wood and manufacture of building components from otherwise waste products of wood as they affect the environment is quite wide, as it covers all aspects of forestry and all forms of environmental degradation.

This project is restricted strictly to privation of spaces for the following activities:-

- Conversion of wood;

This is where logs floated or transported to the center is debarked, sawn and planed to standard sizes before seasoning.

- Both air and dry kiln seasoning;

Here timber is sorted out into its various species and quality sound ones are moved to either the dry kiln while others are moved and stacked in shades to be seasoned by air.

- Carpentry workshop and show room;

Here, wood is actually made into furniture after seasoning and displayed in the showroom for potential customers. Architects may also bring their furniture designs to be constructed here

- A laboratory and library;

for development of plant species, lumbering ideas and improved methods as well as ideas for possible recycling and utilization of mill and logging waste products for example saw dust, planning chipping, tree heads and branches. This also has a plant nursery for young plants that may be developed in the laboratory and certified for replanting or grafting as the case may be. These nurseries will also supply private loggers nurseries.

- A timber shade for sale of standard converted and seasoned timber
- to the public and other government agencies or parastatals that may require it.
- An administrative unit to coordinate the activities of the entire center.
- A small clinic to take care of accidents that may occur from handling machines or chemicals.

1.3.2 LIMITATIONS

The major problems I encountered during this research work was basically getting members of the lumbering and logging industry to talk as most of them were afraid to reveal what they consider as "trade secrets," Others were afraid of getting into trouble with government.

The next problematic area was handling the roughness of Benin and Sapele. Most, if not all the timber workers

were very rough and ready to fight at the slightest provocation.

Another problem was the weather. It was almost always raining, this made field trips very difficult.

1.4 IMPORTANCE OF STUDY

Ecology emphasizes the dependence of every form of life on other living things and on the natural resources in its environment, such as air, soil, and water. Before there was a science of ecology, the great English biologist Charles Darwin noted this interdependence when he wrote:

"It is interesting to contemplate a tangled bank, clothed with plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and so dependent upon each other in so complex a manner, have all been produced by laws acting around us."

Ecology shows that people cannot regard nature as separate and detached--something to look at on a visit to a forest preserve or a drive through the country. Any changes made in the environment affect all the organisms in it. When vehicles and factories hurl pollutants into the air, animals and plants as well as humans themselves are harmed. The water they foul with wastes and silt threatens remote streams and lakes. Even ocean fisheries may experience reduced catches because of pollution.

The branch of science that deals with how living things, including humans, are related to their surroundings is called ecology. The earth supports some 5 million species of plants, animals, and microorganisms. These interact and influence their surroundings, forming a vast network of interrelated environmental systems called ecosystems. If left undisturbed,

natural environmental systems tend to achieve balance or stability among the various species of plants and animals. Complex ecosystems are able to compensate for changes caused by weather or intrusions from migrating animals and are therefore usually said to be more stable than simple ecosystems. A field of corn has only one dominant species, the corn plant, and is a very simple ecosystem. It is easily destroyed by drought, insects, disease, or overuse. A forest may remain relatively unchanged by weather that would destroy a nearby field of corn, because the forest is characterized by greater diversity of plants and animals. Its complexity gives it stability.

Every environmental system has a carrying capacity for an optimum, or most desirable, population of any particular species within it. Sudden changes in the relative population of a particular species can begin a kind of chain reaction among other elements of the ecosystem. For example, eliminating a species of insect by using massive quantities of a chemical pesticide also may eliminate a bird species that depends upon the insect as a source of food. Also eliminating a tree specie by lumbering activities may eliminate a specie of insects that depend on it for food thus eliminating species of birds that depend on it for food then other predators, the chain can get to the human beings within that ecosystem.

Such human activities have caused the extinction of a number of plant and animal species. For example, overhunting caused the extinction of the passenger pigeon . The last known survivor of the species died at the Cincinnati Zoo in 1914. Less than a century earlier, the passenger pigeon population had totaled at least 3 billion. Excessive hunting or infringement upon natural habitats is endangering many other species.

The reduction of the earth's resources has been closely linked to the rise in human population. For many thousands of years people lived in relative harmony with their surroundings. Population sizes were small, and life-supporting tools were simple. Most of the energy needed for work was provided by the worker and animals. Since about 1650, however, the human population has increased dramatically. The problems of overcrowding multiply as an ever-increasing number of people are added to the world's population each year.

The rate of growth of the world's population has finally begun to slow, after reaching an all-time high of about 2 percent in 1970. In 1987 there were 5 billion people on the planet. The United Nations predicted that

population growth rate will decline to 1.5 percent by the year 2000. Even so, there will be 6.1 billion people living on earth at the beginning of the 21st century--twice the number of people living on earth in 1960.

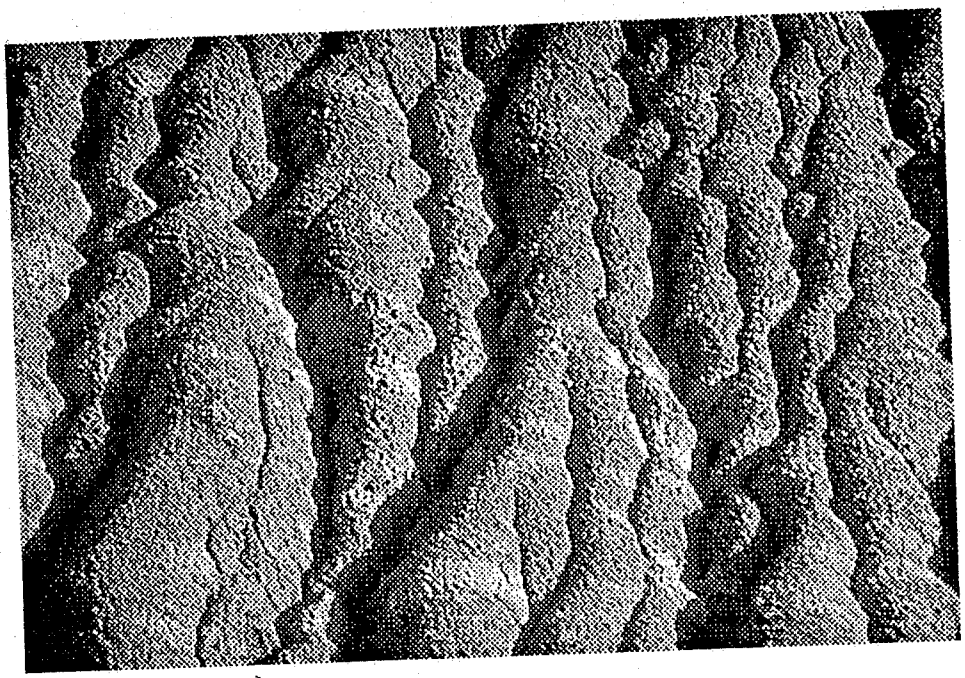
The booming human population is concentrated more and more in large urban areas. Many cities now have millions of inhabitants. In less developed countries of Asia, Africa, and Latin America, many of these cities are overpopulated because of an influx of people who have left rural homes in search of food, shelter, and employment. Some farmers have been forced off their land by drought, famine, flood or erosion which can be as a result of improper lumbering activities following a rise in demand due to the rise in population.

Natural resources are sometimes classified as renewable or nonrenewable. Forests, grasslands, wildlife, and soil are examples of renewable resources. They can be regenerated, and prudent management can maintain them at steady levels. Such resources as coal, petroleum, and iron ore are nonrenewable. Consumption, wasteful or not, of their limited supply speeds the rate at which they are depleted.

Natural resources are a vital part of sustaining human life, and conservation measures are designed to control, manage, and preserve them so that they can be used and appreciated to the fullest. Freshwater habitats must be kept clean for drinking and for recreational activities. Soils must be kept fertile, without the accumulation of toxic chemicals from pesticides or herbicides, to provide fruits and vegetables. Forests must be managed in a manner that can provide not only lumber and pulpwood for paper products but also homes for native wildlife. The use of oil, coal, and minerals important for an industrial society must be carefully monitored to be certain that the supply does not dwindle too rapidly. The proper conservation of these natural resources is of key concern in maintaining the balance of nature in a world with a large human population

Whenever land is stripped of its plant cover, soil is inevitably lost by erosion, the so-called silent thief. A single rainstorm can wash away centuries-old accumulations of soil from neglected or badly managed fields . Topsoil is an extremely valuable natural resource. Under this thin blanket of rich dirt and humus, in which plants grow best, is a less fertile material called subsoil. If the surface layer of topsoil is blown or washed away, the remaining subsoil cannot support plant life. The submarginal farms must

eventually be abandoned probably and most likely for fresh land - "fresh forests" and the degradation goes on, lumber is reduced.

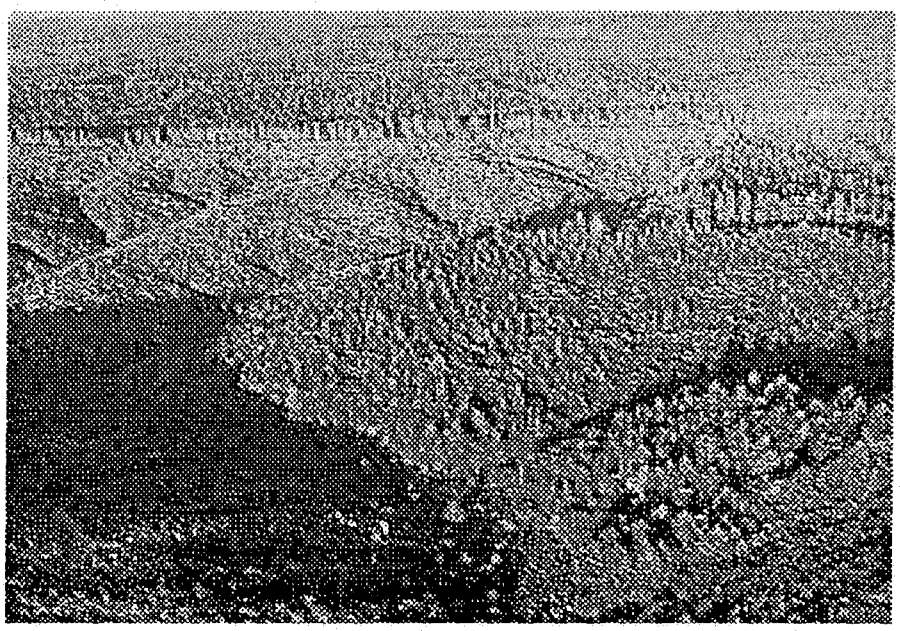


Erosion resulting from a lack of soil binding plants

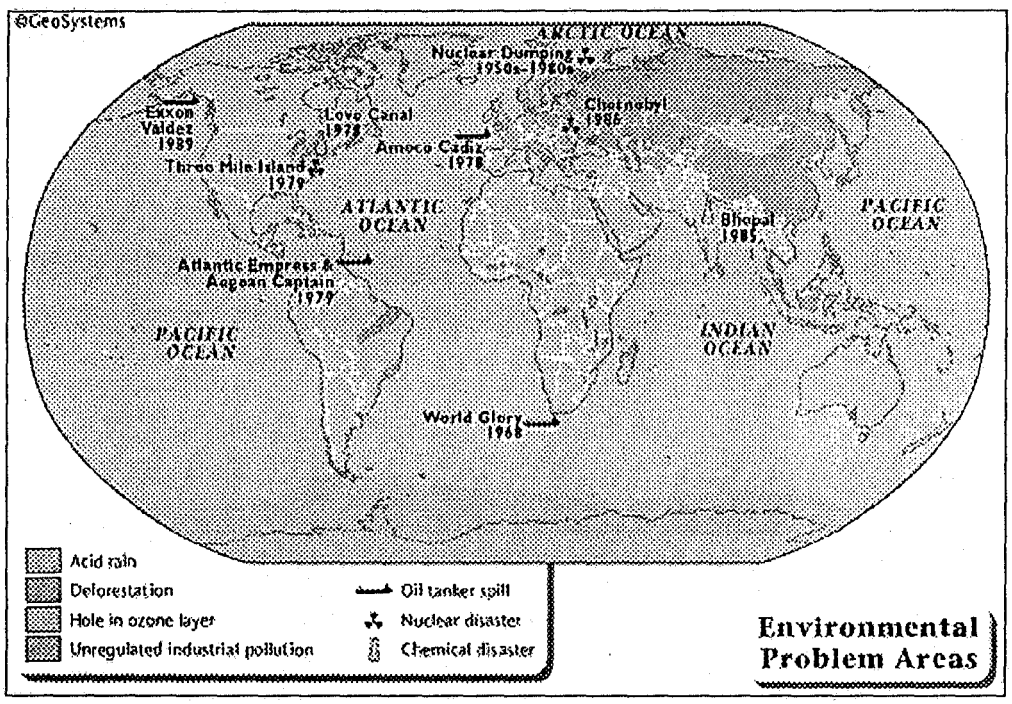
Among the most valuable of nature's resources are forests. They play a key role in the maintenance of the watersheds that are essential to water and soil conservation. They shelter many forms of wildlife. They supply lumber for construction, cordwood for fuel, and pulp for paper. Forests also provide the raw materials used in many synthetic products considered essential for modern life, including fibers, plastics, and medicines.

Insect infestation can also threaten the life of a forest. The Forest Pest Control Act of 1947 authorized surveys of public and private forests so that insect-borne diseases of trees could be detected and suppressed before they became epidemic.

A more serious threat than fire or insects is indiscriminate logging. When every tree of a stand is cut without any provision for natural reseeding or manual replanting, no canopy is left to protect the soil against the splash erosion of rainfall. The loose soil soon becomes deposited as silt in nearby streams. Timber must be treated as a renewable crop, carefully harvested to ensure a sustained yield of trees. In this way, a balance is struck between the cutting of mature trees and the growth of saplings.



Erosion on the hill side after indiscriminate logging



Nigeria shown in the above map as one of the countries threatened by deforestation

Even as Nigeria features prominently as one of the countries threatened by deforestation, the benefits of yet to be seen as the numerous timber sheds and yards are filled with timber that falls way below the required standards in section dryness and strength. Strength for timber is biological but when the timber in question is infected with insects molds or both, the strength of the timber is greatly reduced.

The national lumbering and wood research center sapele will have facilities to take care of all the problems listed above

1.5 DEFINITION OF TERMS

1.5.1 lumbering.

the work or business of cutting down trees and preparing lumber

1.5.2 lumber.

cut timber, logs, sawed timber, forest products, boards, hardwood, softwood, lumbering products

1.5.3 angiosperm

(anje o spurm) ***n.*** any of a division (Magnoliophyta) of flowering plants having seeds produced within a closed pod or ovary, including monocotyledons and dicotyledons: **an|gi-o-spermous** ***adj.***

1.5.4 gymnosperm

(jimno spurm, -n-) ***n.*** [[ModL *gymnospermus* < Gr *gymnospermos* :any of a large division (Pinophyta) of seed plants having the ovules borne on open scales, usually in cones, and usually lacking true vessels in the woody tissue, including seed ferns, cycads, conifers, and the ginkgo:

1.5.5 season

to make more suitable for use; improve the quality of, as by aging, drying, etc.; cure; mature *[*to *season* lumber*] b*)

1.5.6 Paleozoic

(pa|le o|zoik, -le -) ***adj.*** [[PALEO- + ZO- + -IC]] designating or of the geologic era between the Precambrian and the Mesozoic: it covered the period between *c.* 570,000,000 and 225,000,000 years ago and was characterized by the development of the first fishes, amphibians, reptiles, and land plants

1.5.7 century plant

a tropical American desert agave (*Agave americana*) having fleshy leaves and a tall stalk that bears greenish flowers only once after 10 to 30 years and then dies: mistakenly thought to bloom only once a century [1]

1.5.8 cordite

(-it) ***n.*** [[CORD + -ITE[1]: so called from its stringy appearance]]

1.5.9 quercitron

(kwursi trn, -si|trn; kwr sitrn) ***n.*** [[< ModL *quercus* < L, oak the inner part of the bark of a North American black oak (*Quercus velutina*), containing tannin and used in tanning and dyeing **2** a yellow dye made from this bark

1.5.10 monocotyledon

(man|o kat'l ed'n, man|-) ***n.*** *Bot.* any of a class (Liliopsida) of angiosperms having an embryo containing only one cotyledon, and usually having parallel-veined leaves, flower parts in multiples of three, and no secondary growth in stems and roots, as lilies, orchids, and grasses:

1.5.11 dicotyledon

(di|kat led'n) ***n.*** a flowering plant with two seed leaves (cotyledons); specif., any plant belonging to a class (Magnoliopsida) of angiosperms which is characterized by embryos with two cotyledons, net-veined leaves, flower parts in fours or fives, and the presence of cambium

1.5.12 areca

(ari k, er-; rek) ***n.*** [[ModL < Port; prob. < Malayalam *adekka*]] any of a genus (*Areca*) of palm trees, native to Asia and Australia, with a smooth, slender trunk and feathery compound leaves; esp., the betel palm

1.5.13 phellogen

(felo jen, -jn; fel-) ***n.*** [[< Gr *phellos* (see prec.) + -GEN]] CORK CAMBIUM --**phello-ge-netic** (-j netik) or **phello-genic** (-jenik) ***adj.***

1.5.14 dendrochronology

(-kr nal je) ***n.*** the science of dating past events or climatic changes by a comparative study of growth rings in tree trunks --**den|dro-chrono-logi-cal** (-kran| laji kl) ***adj***

1.5.15 photosynthesis

(fot|o sin sis, fot|-) ***n.*** the biological synthesis of chemical compounds in the presence of light **2** the production of organic substances, chiefly sugars, from carbon dioxide and water occurring in green plant cells supplied with enough light to allow chlorophyll to aid in the transformation of the radiant energy into a chemical form --**photo-syn-thetic** (-sin etik) ***adj.*** --**photo-syn-theti-cal-ly** ***adv.***

CHAPTER II

2.0 LITERATURE REVIEW

2.1 LUMBER

Wood is used to make many things--from homes to furniture to toothpicks. The lumber industry transforms the trees of the forests into the lumber from which other products are made. Its tasks include logging which is cutting trees down, sawing them into logs, and carrying the logs to the sawmill to be sawed into boards and timbers, or lumber.

The Nigeria lumber industry is unable to make use of more than 30 percent of most trees. Small and crooked logs, treetops, branches, limbs, and high stumps are left in the woods to rot. In the sawmill the first slices from logs and the trimmings from sawed planks are burned as fuel or as waste. The present-day lumber industry, however, should be able to converts almost 100 percent of each tree harvested into useful products. Better equipment and planed working spaces permits very little wasteful cutting.

Modern forest management employs the sustained-yield system. Under this system certain valuable trees are chosen for harvest. The forester must plant trees of all ages to ensure continuous harvesting on a rotation basis.

Enough valuable trees must remain to reseed the forest so that the forest is never completely destroyed. It continues to be used for recreation. Wild animals continue to find shelter in it. The roots of the remaining trees continue to retain water and prevent erosion. The management of forests to serve all of these purposes is called the multiple-use system. In the 1940s the wood-using industries started the American Tree Farm System, a voluntary program which encourages private owners to use a multiple-use system. Silviculture is another system of forest management that controls forest establishment, composition, and growth.

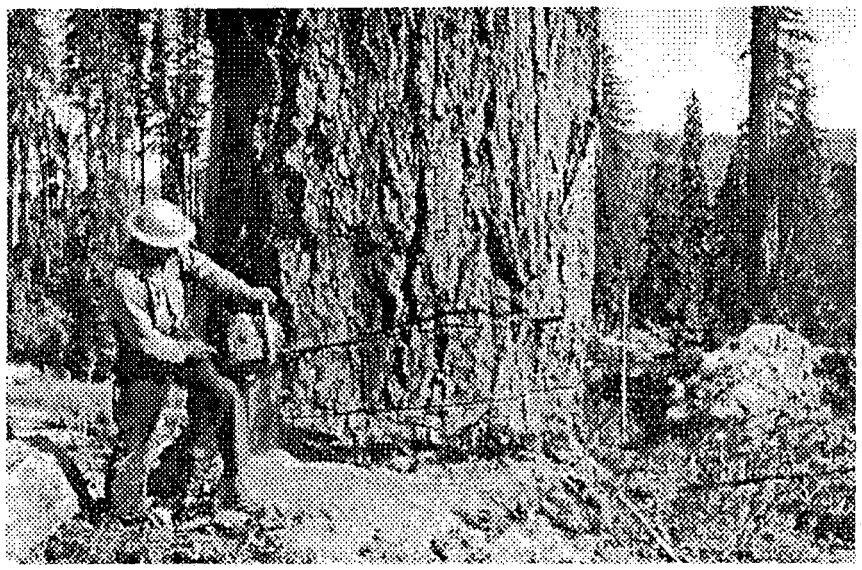
2.2 LOGGING

Before a tree can be sawed or chopped into useful wood, loggers must cut it down and transport it to the sawmill. Logging is still rugged work, though power tools and power-driven lifting equipment have eliminated much of the drudgery. This though, follows the process of marking by foresters.

2.3 FELLING A TREE

Once a tree has been marked for cutting, logging can begin. The person who cuts the tree down is the faller. First he decides the direction in which the tree should fall. He makes sure that other trees will not be damaged

when it falls and that it will be easy to move the fallen tree to the loading



area.

Having decided the direction of the fall, the faller cuts a large notch, or undercut, on that side of the tree. The undercut is located opposite and below the point where he plans to make the main cut. The exact position of the undercut and the depth to which it is made depend upon the size and the shape of the tree, wind conditions, and other factors. Planning the undercut takes great skill and experience.

When the undercut has been made, the faller makes the main cut on the opposite side. As the saw bites deeper into the trunk, wedges may be driven into the cut behind the saw. The wedges keep the tree from squeezing down on the saw.

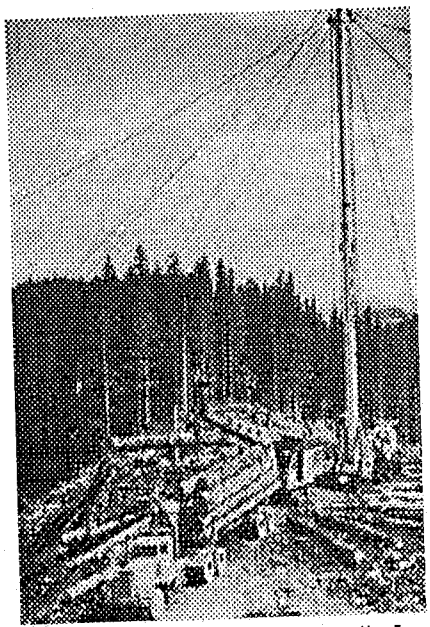
Today's loggers use engine-driven chain saws that can be carried by hand. These saws have taken much of the hard labor out of felling. They have helped make the work safer both by reducing fatigue and because they are equipped with protective devices.

2.4 SAWING AND ASSEMBLING THE LOGS

After a tree is down, the limbs must be removed. A chain saw is generally used to cut off the big limbs. The practice of chopping off smaller limbs with an ax is dying out. The next step is bucking, or cutting the tree into shorter logs. The length of these logs depends upon the use that will be made of the wood and upon the capability of the equipment that will carry the logs to the sawmill. Ordinarily, small trees are not cut into logs. Only the top is cut off, at the point where the diameter grows too small to be usable.

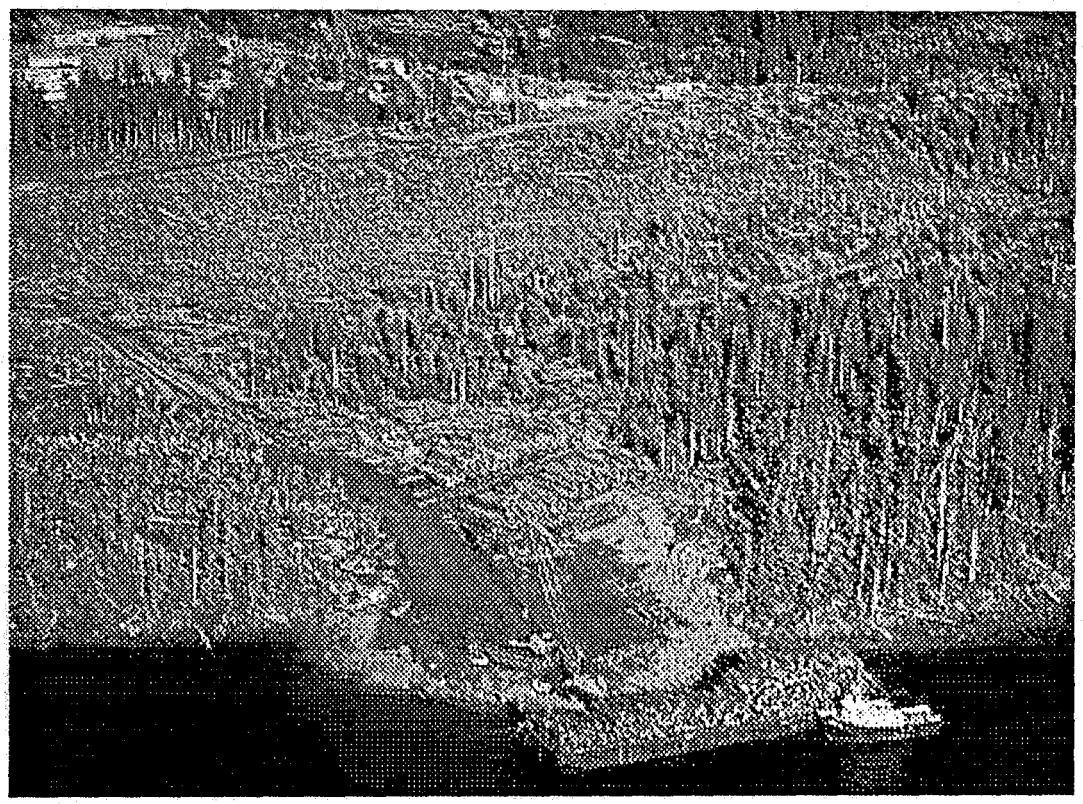
Whatever their length, the logs must be yarded, or moved to a central collection point called the landing. Yarding is done either with cables that lead from the landing or with tractor-type vehicles. Factors that determine which method is used include the size of the timber, the steepness of the terrain, and the need to protect soil, streams, and younger trees.

One frequent cable arrangement is the high-lead system. A tall spar pole is erected at the landing. Cables lead from the pole to the felling areas. Logs are attached to the cables, and an engine reels the cables in. The spar poles are now often made of steel, but very tall trees still serve this purpose.



Photo, American Forest Institute

Helium balloons have been used experimentally to replace the spar pole. They lift the logs completely off the ground and carry them to the landing. Tractors are the most common method of yarding . Crawler treads or large tires enable them to operate in rugged logging terrain. They drag, or skid, the logs to the landing.



Logs are assembled after sawing

2.5 Moving the Logs to the Sawmill

The landing is the center of logging activity. It receives logs from many directions. The logs are then transported from the landing to the sawmill. Formerly, logs were brought to the mill by railway or were floated downstream in river drives. Today most logs are transported by large trucks, though the other methods are still used. Mechanical loaders at the landing lift the logs onto the trucks.

Road building has become an important task of the lumber industry. The industry constructs its own roads from the forest logging areas to sawmills or public highways. These roads must be able to support heavy cargoes. They may be relatively simple to build in level country. In rough terrain, however, their construction is very difficult, since steep grades, sharp curves, and narrow roadbeds must be avoided.

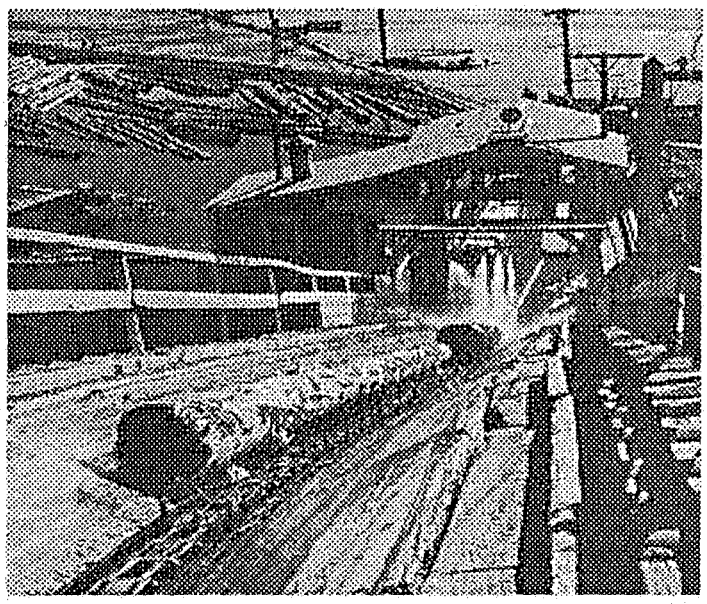
Photo, American Forest Institute

After the trip over the forest road, the trucks may still travel many miles by public highway. Sometimes, however, the forest road leads directly to the sawmill. In such cases, vehicles that are too large for public highways can be used to haul the logs.

2.6 MILLING

Logs are usually stored at the mill for some time before being sawed up. Often they are sorted by size or species. Some storage areas are on dry

land, but frequently the logs are left in ponds. Specialized equipment may be used to unload the trucks and stack the logs. Logs stored in a pond may be moved about by a special boom boat.

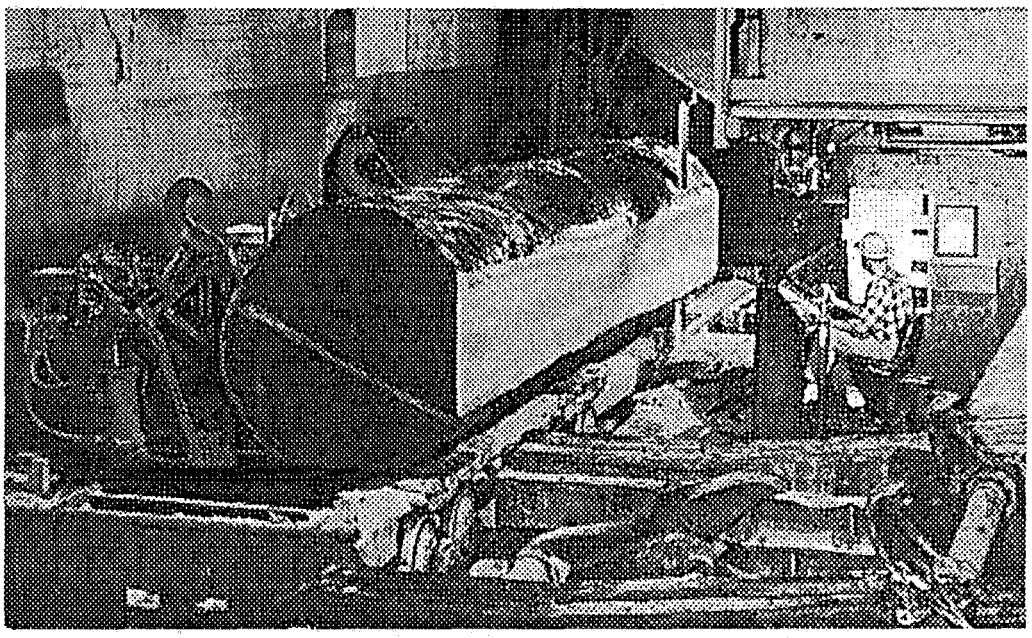


2.7 SAWING THE LOGS

When a log is selected for sawing, an endless conveyor, called a bull chain or jack ladder, carries it from the water to the upper levels of the sawmill. The log may be washed clean on the jack ladder, or the bark may be entirely removed before sawing. One type of debarking equipment works something like a pencil sharpener. It follows the configuration of the log and does not cut deeper than the thickness of the bark. In another debarking method, water jets under extreme pressure blast the bark from the log. Debarking protects the sawing equipment by removing grit and other foreign objects that might damage the saw teeth or cause excessive

wear. When the log is sawed into boards, debarked outer pieces can be chopped up into small, clean chips, which are sold to pulp and paper mills. Previously, the outer pieces were burned as fuel or as waste.

After washing or debarking, the log is rolled onto the carriage, a special wheeled platform that rolls on tracks. The carriage has a framework that holds the log securely. The head sawyer controls the carriage. He maneuvers it to the head saw, a high-speed saw that slices the log from end to end. Small mills usually have a circular head saw. Most large mills, however, use an enormous band saw. The blade may extend from floor to ceiling. The first pass of the saw through the length of the log removes a slab which is flat on one side and round from the curvature of the log on the other. Succeeding passes produce rough-edged boards, some of them enormous because the log is so thick. After each pass, the head sawyer manipulates the controls that move the log into position for the next cut.



Photo, American Forest Institute

2.8 HANDLING THE BOARDS

When the log has been reduced to boards and other wood products, the boards travel to the edger, whose parallel saws remove any irregular shapes and square the edges. Trimmer saws then cut each board to its proper length and square the ends.

The boards then move to the green chain, a conveyor which passes in front of men who grade each piece of lumber. "Green" refers to the moisture in the freshly cut lumber, not to the conveyor color.

The pieces are sorted by grade and by species. Most of them are then dried, or seasoned. Some are stacked in the yard for air-drying. Others are

placed in oven-type structures called dry kilns. The heat and humidity control in these kilns permits faster and more precise drying. Many of the larger sawmills have additional equipment, such as the planers which are used to smooth the surface of boards.

Some sawmills have equipment for re-manufacturing, converting, or reshaping wood into a variety of forms. Typical products of re-manufacturing include furniture frames, tool handles, wooden dishes, and baseball bats.

2.9 LAMINATED WOODS AND PLYWOODS

Logs are sometimes cut into thin sheets of wood. A decorative veneer is a sheet that comes from a valuable wood and is used as the surface of a wood product because of its attractiveness. Other woods are also cut into thin layers. A log may be sliced or sawed into sheets, or sheets may be obtained by a process called rotary cutting. In rotary cutting the log is turned on a lathe against a long, stationary knife. The sheets are usually glued together to make laminated wood or plywood. Laminated wood consists of thin sheets of wood whose grains run roughly parallel. It can be constructed from lower grades of lumber with a surface layer of decorative

veneer. Laminated wood can be made in any size or shape. Its component sheets can be impregnated with a fire retardant and a decay preventive.

The wood in plywood is usually rotary cut. Thin sheets of this wood are glued together at right angles to each other. Plywood does not split and is very strong.

2.10 USERS

Rough lumber may be shipped from the sawmill to mills that finish and shape the boards and make other lumber products. Wholesalers purchase lumber to sell to large users or to retail lumber yards from which individuals buy it in smaller amounts.

The building construction industry consumes about three fourths of the lumber produced in the United States. The shipping-container industry uses about one tenth of the lumber produced. Shipping containers are boxes in which merchandise is shipped or stored. The shipping-container industry also makes pallets, the wooden platforms used to carry materials or merchandise, particularly in the food industry. Somewhat more than one

twentieth of United States lumber production goes to the furniture industry, the third largest consumer.

2.11 INDUSTRY

Lumber Output is measured in board feet. One board foot is represented by a board one foot long, one foot wide, and one inch thick. In some parts of the world, production is measured in cubic meters--1,000 board feet equal 2.36 cubic meters. The peak year for lumber production in the United States was 1909, when about 45 billion board feet were produced. The demand for lumber lessened when the construction industry began to substitute steel, brick, and concrete for wood and as improved preservatives lengthened the life of wood products. Annual lumber production now hovers at about 37 billion board feet.

The nation's lumber production comes from its commercial forestland. This is land that can grow trees of marketable quality that are available to the lumber industry. Noncommercial forestland includes land too poor to grow good timber, land with too few trees for lumbering to be profitable, and land that has been withdrawn from commercial use to be used for parks, wildlife refuges, and wilderness areas.

The half-billion acres of commercial forestland in the United States provide more than nine tenths of the nation's lumber needs. About three fourths of the domestic output is harvested from land owned by private concerns and individuals.

National forests are managed under the multiple-use system to provide watershed protection, lands for recreation, food and shelter for wildlife, and a supply of timber. Private companies bid competitively for timber on government lands. Logging is done under the supervision of government foresters.

2.12 FOREST AND FORESTRY.

It is hard to imagine a resource that provides more benefits for humans than do forests. Food, shelter, tools, and fuels are all products of this natural treasury. The forest is also home to many animals and plants. Its trees help clear the air of pollution while enriching it with oxygen and slow down the sometimes destructive forces of wind and water. Forests are one of the major resources that can be renewed and improved. The science of managing forests is called forestry.

2.13 TYPES OF FORESTS

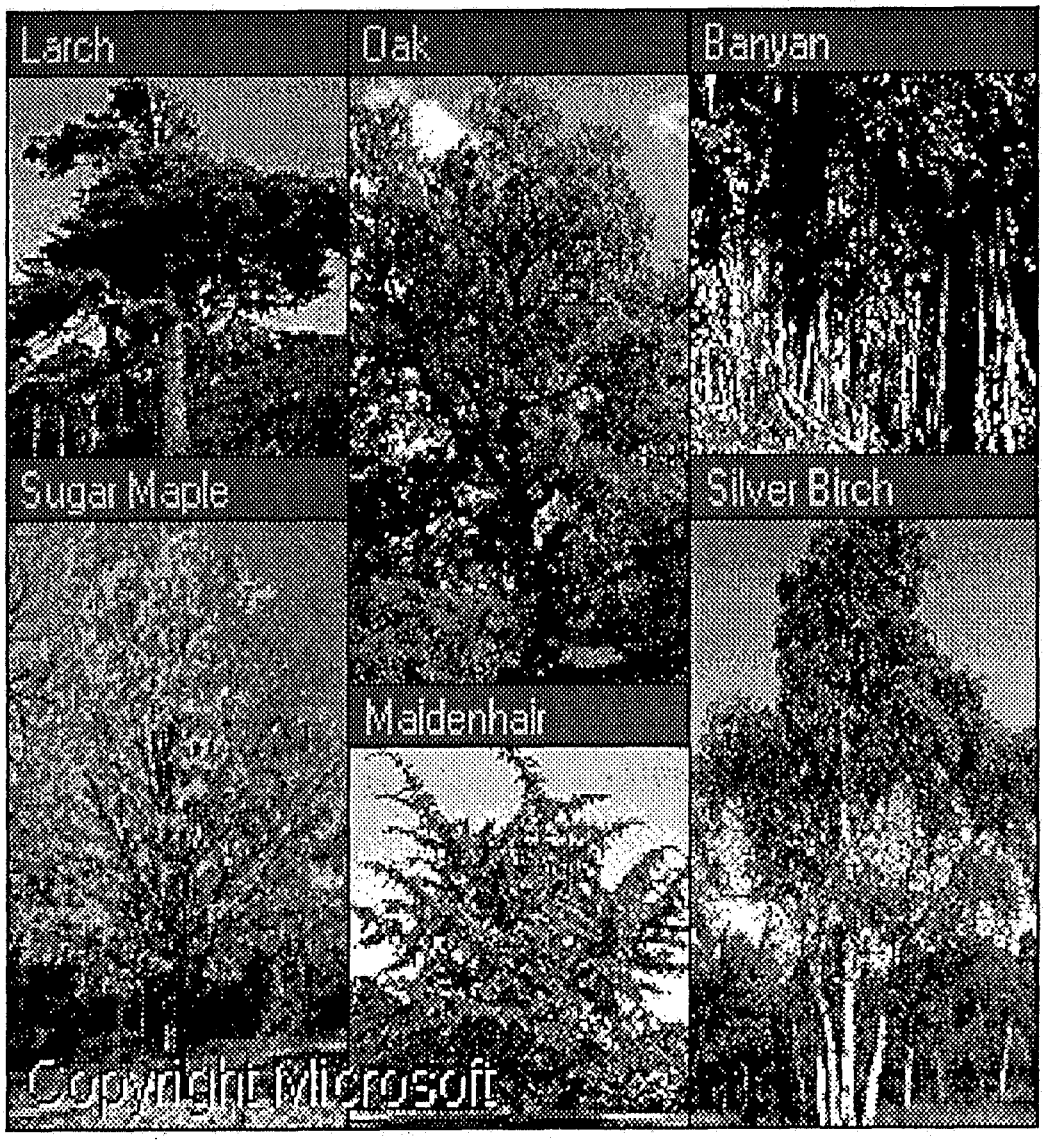
Forests are found in almost every part of the world. Only the north and south poles, the tops of some mountains, the deserts, and some prairies are bare of forests. Forests can be grouped by location, climate, or the types of trees common to them. Forests can also be described in terms of the uses made of them. Commercial forests, for example, are lands used for growing successive crops of trees for products. Wilderness preserves, on the other hand, are areas where no harvesting is allowed.

Trees in the forest are of two basic kinds. Hardwoods have broad leaves and bear their seeds in dry clusters or in fruits; examples are oak, maple, hickory, and apple. Most hardwoods are deciduous, which means they lose their leaves each dry season. Softwoods have needle-shaped leaves and bear their seeds in cones, for which reason they are often called conifers; examples are pine, spruce, fir, and larch. Most softwoods are evergreen, which means they lose only some of their needles each year, and so remain green year-round. This description can be misleading, however, because several hardwoods are also evergreen.

2.14 Hardwood Forests

One major type of hardwood forest is the steamy, tropical rain forest that grows in the tropics and subtropics. These forests are typically composed of big, old evergreen hardwood trees that grow in several layers, or groups according to height. The tallest layer may reach heights of 150 feet (45 meters) or more. Other layers, composed of shade-tolerant trees, reach to about 100 feet (30 meters). Smaller trees and vines cover the ground in the shade in a dense tropical rain forest. These forests are often called jungles, though true jungles are dense thickets of brush and vines that may not have any tall trees.

Beautiful woods such as rosewood, mahogany, ebony, and teak are commercially important products of these forests. They are prized for fine furniture, cabinetry, and artistic uses.



DECIDUOUS TREES

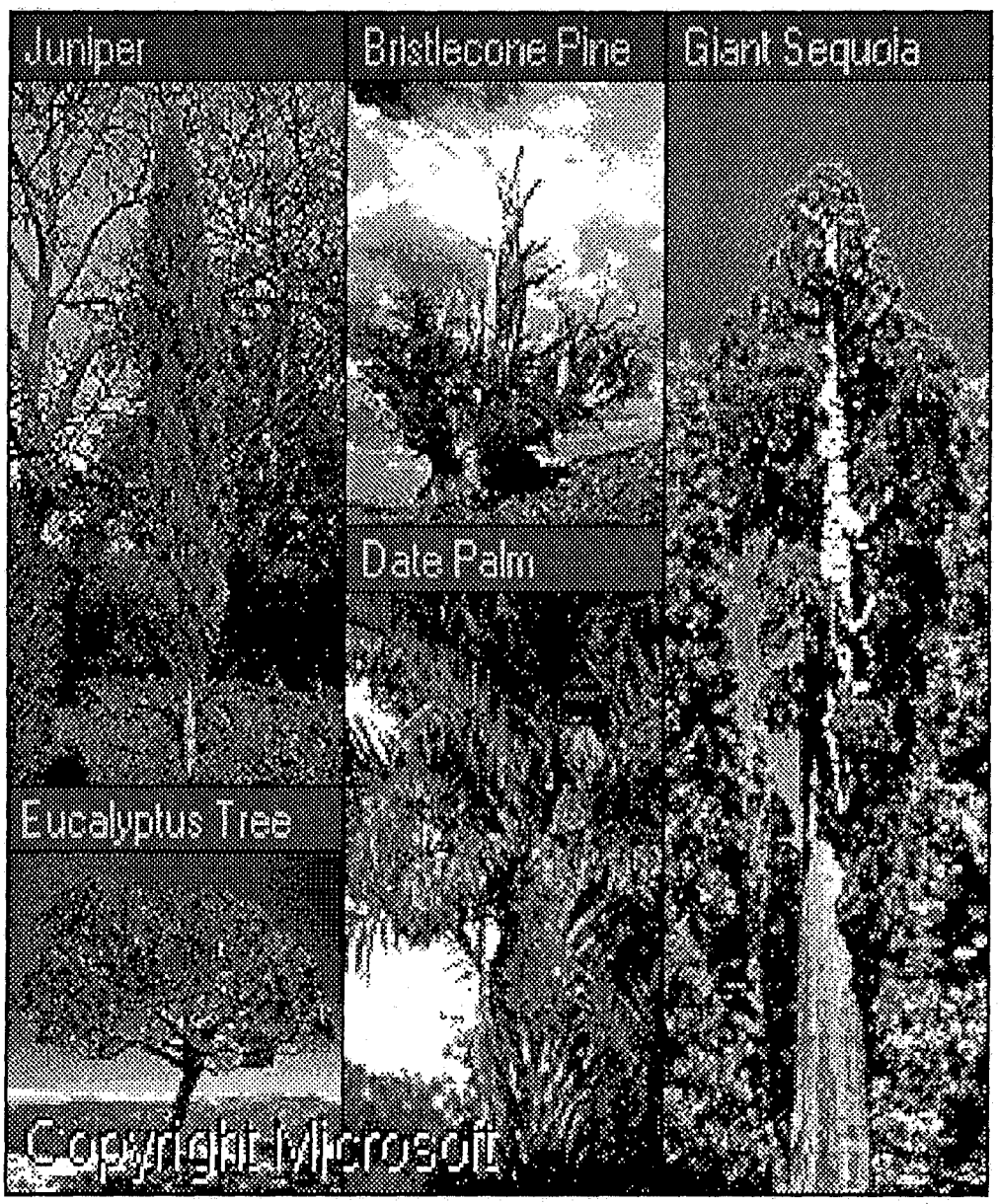
2.15 SOFTWOOD FORESTS

The Forest is composed of softwood trees such as white pine, hemlock, and red spruce. White wood, Several hardwood trees, such as oak, maple, birch, and basswood, are also present. Trees in this forest tend to be smaller and more slow-growing than those in warmer areas with longer growing seasons.

The softwood forests are sources of lumber, plywood, and paper pulp. The more important southern, or yellow, pines are the loblolly, longleaf, shortleaf, and slash. The bald cypress grows in southern swamps.

Hardwoods such as the red oak, white oak, hickory, gum, ash, pecan, and live oak are found along southern rivers. They are a significant part of the forest economy in the South.

A SOFT WOOD FOREST



EVERGRREN TREES

2.16 MANAGING THE FOREST

The most modern aspects of the science of forestry are collectively called forest management. These aspects of forestry involve much more than just using the trees nature provides. Forest management is concerned with the complete life cycle of the trees and the forest, from getting trees

off to a better start to making sure trees are harvested in a way that protects the future of the forest.

Forest management usually involves doing the same sorts of things nature does, but in a more planned and organized fashion. Nature plants trees, thins forest stands, and kills trees, but nature's efforts sometimes seem haphazard. Forest managers do these same things with a plan that benefits the forest stand and people, too. Nature lets trees burn or rot. Forest managers prefer to use the wood.

2.17 The Natural Forest Cycle

When a mature hardwood forest is harvested or killed by nature, it is not long before a new forest takes its place. There are seeds in the ground already, dropped there by the trees of the past. There are usually young trees on the ground--unless the stand was killed by fire or some other general catastrophe.

When nature renews a forest, it is often quite different from the original forest. A mature stand in the Central Hardwood Forest, for example, is usually composed of oaks and hickories and other species referred to as climax types. They are species that grow well in bright sunlight or in

partial shade. They have long life spans and compete well for the moisture and the space available.

When these trees are removed or destroyed, however, other trees have a chance to get started. Seeds from pines or other trees in the vicinity blow onto the ground. Sometimes seeds sprout after being in the ground for many years. The new forest is composed mostly of trees referred to as early succession species. Usually some seeds of the climax types also survive. And some trees resprout from the root systems of trees that have been killed. But it is only after many years that the climax types will dominate the forest once again. This same succession takes place when farms and pastures are allowed to lie idle, allowing forests to develop.

2.18 RENEWING THE FOREST

Foresters and landowners often plant seeds or seedlings of a particular kind of tree. The seedlings are usually grown in large nurseries, much as ornamental plants are grown for landscaping, and transplanted when they are older and better able to survive.

When companies first began to replant harvested forests, all of the planting was done by hand. Since the 1940s more and more trees have been planted by machine. The tree planter is pulled by a tractor. A plowlike blade opens a furrow, an opening in the ground, so a worker can plant a seedling. Packing wheels on the planter then close the furrow around the tiny tree. A crew with a tree planter can plant thousands of seedlings in one day.

In forests where the ground is too rough to allow the use of such machines, planting is still done by hand. Sometimes seeds are spread over the ground by airplane or helicopter.

A REPLNTED FOREST

2.19 HARVESTING THE FOREST

History records many instances of harmful harvesting of the forests, often to provide food or fuel. The once mighty forests of cedar in Lebanon are no more. Vast forests in China were destroyed during and after World War II. Rain forests in the Amazon Basin are today being cleared for croplands. In southern Nigeria tropical rain forests are being abused.

Forests have been devastated whenever people needed open land for farming. Most of the east coast of North America was once covered with dense forests. The new settlers cut the trees, used what wood they needed, and burned the rest.

Individuals and companies have learned to practice better harvesting techniques. The long-accepted practice of cutting only a few trees at a time from a particular stand is being challenged by foresters. They point out that the practice almost always resulted in taking the best trees and leaving inferior specimens to take over the forest. They prescribe following nature's approach of harvesting all the trees in an area at one time and encouraging seeds from the best trees available to reforest the land.

2.20 IMPROVING THE FOREST

Over many years nature improves forests by removing inferior trees, an example of natural selection through the survival of the fittest. But many natural events and human activities affect this process. Fires, floods, wind and ice storms, and harvesting practices all affect the growth of the forest. In general it is fair to say that nature's events generally improve the forests over the years and the activities of human beings in the past have harmed them.

Recently, through forest management, human beings have begun to do less harm, perhaps even help forests. In controlling the composition of the stand by planting species they prefer, human beings can improve the quality of the trees they plant. Much has been learned about the development of genetically improved strains of corn, wheat, and other food crops. This improvement can be accomplished quickly because these crops produce a new generation each year. Progress is slower with trees because they often take many years to produce seed.

When forest managers think of improving trees, they want trees with long, straight trunks that can be sawed into lumber or peeled for plywood more economically They want trees with small crowns, or tops, so more trees can get sunlight and grow on each acre. They want trees that are insect and

disease resistant so their chances of maturing are better. And they want trees that will grow to commercial size as rapidly as possible.

Forest scientists have accomplished all these goals with pines and with some hardwood species such as sycamore, cottonwood, and yellow poplar. They have even learned to clone a superior tree, a process that produces more trees exactly like it. This is done in the laboratory by forcing tiny cuttings from the tree to develop roots and leaves.

The most commonly used method of tree improvement involves first locating superior specimens of the species. Branches are collected from their crowns, often by shooting them off with guns.

The branches are grafted, or joined, onto rootstocks in special nurseries where they grow until they are old enough to bear seed. A great advantage of this method is that tree branches that come from mature trees bear seed much sooner than do trees that are grown from seed. The flowers on the selected branches are carefully pollinated with pollen from other superior trees. Thousands of combinations of pollen trees and branch trees are tested. The resulting seed is then planted. Many of the trees that grow from the seed have all the bad characteristics of their parents. But some have all

the good characteristics. Forest scientists try to produce and plant as many seeds having the good combinations as they can.

An example of what can be achieved is that improved species of pines produce much more usable wood in the same time as ordinary wild trees produce relatively little. Such improvements mean that more wood can be grown on less land in a shorter time. As the world population grows and requires more land for homesites and food production, this ability to maximize wood production on each acre will be vital to future generations.

2.21 PROTECTING THE FOREST

Once the forest is started, protection is a major concern for forest managers. Fire is one of the most dramatic enemies, especially for hardwood species. But insects and diseases, while not so obvious as fire, destroy far more trees each year than are lost to fire and other natural disasters.

2.22 INSECT AND DISEASE PROBLEMS

Insect pests such as the gypsy moth, spruce budworm, southern pine beetle, and Douglas fir tussock moth destroy thousands of trees each year. In the 1930s the American chestnut, once one of the most attractive and

commercially important trees in the United States, was virtually eradicated by the chestnut blight. The American elm has suffered much the same fate because of the Dutch elm disease.

As a rule, older, slower-growing trees that have lost their vigor, and trees that have been damaged by fire or drought, are most vulnerable to attack by insects and disease. Often, however, insect and disease infestations grow to epidemic proportions in weak stands and then the pests attack nearby healthier stands.

Forest scientists continually search for ways to control enemies of the productive forest. They have created many special chemicals to help control forest pests and diseases. Much ecological research is being done to encourage natural enemies of insect pests in order to control destructive populations.

2.23 The Control of Fire

Protection against forest fires is often a matter of education. Many fires started by people to burn trash or leaves or dead grass get out of control and burn forests as well. Sometimes campfires or cigarettes cause fires. Arson is another common cause of fires in some areas.

Most forests are watched during the spring and fall fire seasons to detect fires as early as possible. Fire damage can be held to a minimum by quick action. Fire roads are cut through forests to allow firefighters to quench blazes before they get hot enough to reach the tops of trees. Ground fires may damage hardwood trees, but they rarely do severe damage to mature pines. Crown fires, on the other hand, kill all trees.

Lightning is still a common cause of fires. If these fires are in remote areas, they can damage large parts of a forest before they are discovered and controlled. Firefighters sometimes have to be flown to the fire in helicopters. Sometimes firefighters called smoke jumpers parachute into battle against forest fires.

Once a stand has been damaged or killed by fire, useable wood is removed quickly to prevent the buildup of destructive insect populations and to prepare for the reforestation of the area. As destructive as fire can be, foresters have learned to set fires that imitate nature to benefit the forest. Fires set by lightning destroy climax forests and allow a new succession of tree species, starting with softwoods, to begin. Natural fires also serve to reduce competition in softwood forests. Forest managers sometimes use controlled fire to control unwanted hardwood growth in pine stands. This

leaves more moisture and nutrients for the pines. It also reduces the ground litter of leaves and branches that might fuel a hotter fire, and it exposes the soil, allowing grasses and brush to grow and feed wildlife.

2.24 WATER AND WIND CONTROL

When land is bare, it is subject to erosion by wind and water. When it is covered with plants, however, it is protected against erosion.

The canopy of trees slows the wind, lessens its severity, and becalms the forest. It also slows the fall of raindrops. The leaves on the forest floor and the root systems of the trees slow the movement of rainfall so that the water soaks into the ground rather than running off..

Forest managers can increase water flow for various reasons (to fill a lake, for example) by harvesting trees in the watershed. The watershed consists of all the highland areas with sources of the water such as and small streams. If flooding is a problem on bare ground areas, planting trees can be part of the solution. If the water table, the level of underground water, is too high, planting water-tolerant trees can help to use up more water and lower the water table. Many cities own and manage large forest tracts to protect their water supplies.

2.25 REGULATION OF FORESTS

In many parts of the world forestland is regulated by government agencies as a national resource. Some famous forests, like the Black Forest in Germany, are very thoroughly managed.

In the United States a large part of the forestland belongs to the federal government. Most of this is managed by the Forest Service, a branch of the Department of Agriculture, to perpetuate the forest and provide all the benefits of timber supply, wildlife management, watershed management, and recreation. The Forest Service protects the trees from natural enemies and manages their harvests.

Many state governments own forests. These are managed by forestry agencies that also help private landowners develop the forests on their lands.

Forest industry companies practice good forest management and encourage their neighbors to do the same. In the United States the industry established the American Tree Farm System in 1941 to do just that. Company and state foresters seek landowners doing a good job of

planning, protecting, and harvesting their forests and certify them as members of the system. The foresters also work with people who want to improve their management, helping them with tree planting and fire and insect control.

These three groups of landowners, working in harmony and taking advantage of modern forestry developments, assure that the forests continue to provide wood products and all the other benefits of well-managed stands

2.26 CAREERS IN FORESTRY

When forestry was in its infancy, it was a career for hardy men who loved the outdoors. Most of the foresters worked for the government and spent their time protecting the forests against fires and illegal woodcutters.

In recent years foresters have become much more professional. Now a man or woman who wants to practice forestry is expected to have a college degree in forest sciences. Many professional foresters work for the government, but their work is different from that of their predecessors. Professional foresters are usually called on to be forest managers, directing

other people in the tree planting, tree improvement, and protection activities they prescribe.

The Forest Service is a major employer of foresters. State agencies, forest industries, and teaching in colleges or technical schools are other career fields. Individuals who prefer to be self-employed may become consultant foresters, selling their services to companies and private landowners.

Many foresters find careers in research, working in such areas as tree improvement or insect control. Some researchers work for government agencies, but industry also employs forest scientists. People with less formal training may still find careers as forest rangers, protecting the forests, or in related activities such as harvesting and tree planting.

2.27 GEOLOGICAL HISTORY

Warm, perpetually humid climatic conditions suitable for tropical and subtropical rain forests, which are most commonly called jungles, have existed on Earth since at least the middle of the Carboniferous period (approximately 300 million years ago). Authorities disagree on the extent and distribution of such areas during different geologic periods. Most agree that much of the equatorial region remained as a high-temperature,

high-rainfall area during the Triassic period (from 225 to 190 million years ago). Studies suggest that the Ice Ages (about 1 million years ago) during the Pleistocene epoch and perhaps similar conditions in earlier times, resulted in worldwide conditions of decreased temperatures and increased dryness. According to these accounts some of the equatorial rain forests of that time became deserts.

2.28 CLIMATIC CONDITIONS

The jungle environment is characterized by high, constant temperatures and abundant rainfall. The amount of sunlight penetration is determined by the density of canopy vegetation, sometimes resulting in daytime semidarkness at the ground level. The permanently wet conditions, coupled with the warm stable temperatures, have fostered some of the most magnificent plant and animal communities in the world.

Rainfall in a jungle is more than 60 inches (150 centimeters) a year and may be as high as 400 inches (1,000 centimeters). The relative humidity in a tropical jungle environment is normally from 75 to 100 percent. Near the equator the rainfall may be continual throughout the year with little variation in the amount from month to month. In subtropical regions, where slight seasonal changes are apparent, rainfall may be consistently

higher at certain times of the year than at others. Even in areas where such wet-dry cycles occur, some rainfall occurs during the so-called dry season so that a high humidity is maintained.

Temperatures in the jungle are always warm, never as hot as those of the desert. Although temperatures may vary a few degrees during the day, the average temperature in a jungle from one month to the next may vary by only one or two degrees. Temperatures in tropical rain forests range from about 68o F (20o C) to above 90o F (32o C). Extreme weather conditions such as high winds, sudden drops in temperature, or prolonged drought are rare occurrences.

2.29 SOILS AND HYDROLOGY

No single type of soil or topographic situation is characteristic of tropical or subtropical rain forests, but all are affected by the constant wetness. As water drains through the soil, a process known as leaching occurs in which certain minerals and nutrients are drained away. Soil weathering and erosion processes are highly complex in tropical rain forests and are not totally understood. Despite the wealth of vegetation in a jungle, the soils themselves are nutrient-poor. Rooted plants of a tropical jungle are dependent on decaying ground debris for most of their nutrients, which are

richest in the upper few inches of the soil and in the rich layer that is formed from falling, decaying vegetation. Most nutrient and mineral exchange in a rain forest occurs within these thin layers. The myriad microscopic organisms inhabiting the forest floor decompose vegetation. Resulting nutrients are recycled back into the trees and other plants of the community through their shallow root systems.

The constant passage of water through the upper soil layer results in the selective removal of certain elements. Calcium, magnesium, and silicon compounds are commonly leached out from highly drained tropical soils. Compounds of iron and aluminum often remain in the upper soil layers to form kaolinite, a type of clay. Many tropical soils with heavy concentrations of iron and aluminum compounds are called lateritic. Such soils may have distinct layers, including a surface layer of red loam.

2.30 HUMAN IMPACT

Human activities have severely disrupted the jungles of the world. Between 19 and 50 million acres (7 to 20 million hectares) are lost each year to farming, logging, mining, and other human endeavors. The largest continuous rain forest area, the Amazon, is also the largest tract of unexploited, natural jungle. Most of the South American countries have

some undisturbed rain forest left, and some have made efforts to protect part of what remains. In Central America, cattle ranching and cultivation have wiped out an estimated two thirds of the region's rain forests.

Much of the once vast jungle region in Africa has been destroyed by lumbering and slash-and-burn agriculture. Slash-and-burn agriculture consists of cutting away trees and other vegetation, burning what is left, and then planting crops. Because of poor soil, many such areas can support only two or three agricultural plantings before the small amount of nutrients is exhausted and the land is abandoned. Timbering and crop clearing may eliminate the jungle forests of most of Africa soon.

In Asia and Australia most of the natural rain forests have disappeared or are severely disrupted. Only a small proportion of the original jungle remains on the Indian subcontinent, and most of the rain forests of southern China are disturbed. Logging and clearing for rubber plantations and farming have eliminated two thirds of the forests in Malaysia, Borneo, and the Philippines.

Most of the timbering and clearing of jungle habitat throughout the world has occurred within the last century. These activities have caused

unnatural breaks in the ecological balance of the jungle communities. Although some developing countries, including Chile, China, and Kenya, have attempted reforestation, the damage is progressing at a rate such that the final effect on the ecosystem cannot be estimated.

A tropical jungle is a delicate biological network comprised of numerous fragile interrelationships. The disruption of a key species in one part of the system can affect other species and create an imbalance in jungle ecosystems. These same species dependencies, however, can also work together in such a way that, if left to themselves, they could in time recover to become once again a highly diverse jungle habitat.

2.31 SOME TREE SPECIES AVAILABLE IN SAPELE DELTA STATE;

There are an estimated five hundred species of trees with timber potential in sapele out of which only about 60 are currently being exploited.Some of these include:-

- Iroko
- Obeche
- Owewe
- Ekimi

- Walnut
- Black afara
- White afara
- Oka
- Akomo
- Astonia
- Mahogany
- Guaria
- Acodia
- Agboja
- Danta
- Utuero
- Teak

2.32 DEDUCTIONS

The level and practice of lumbering in Nigeria is highly below standard and this is reflected in the massive and continuous deforestation in not only the southern Nigeria but all over the country, unavailability of seasoned wood, mold and insect infested wood, low development of wood work, carpentry and joinery in the country

CHAPTER III

(AREA OF RESARCH)

3.0 REVIEW OF LUMBERING LAWS IN NIGERIA

3.1 LUMBERING LAWS IN NIGERIA

Nigeria happens to be one of those counties, blessed with vast forests reserve, this is evident in our coastal and riverine areas in the south. Unfortunately these forests are being striped away in the same manner as it was in the United States before they realized the gravity of the problems they were heading for. These are lessons we need not experience since so many other countries have already learnt these lessons for us. All we should do is learn from their own experiences and guard against the repercussions of poor management of forest resources.

Right now any person interested in logging within the boundaries of Nigeria has only to do the following:-

I - Register with the government

II- Pay for a measured piece of a forest of his interest.

III - pay an unfixed token to the locals of the area.(logging then commences)

IV- Have all the logs hammered (stamped) by the forestry department of the ministry of agriculture.

No consideration has been given to the state of trees to be harvested, replanting, form of harvest or saw mill standards

3.2 REGULATION OF FORESTS (AMENDMENTS)

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Many state governments own forests. These are managed by forestry agencies that also help private landowners develop the forests on their lands.

Forest industry companies practice good forest management and encourage their neighbors to do the same. In the United States the industry established the American Tree Farm System in 1941 to do just that. Company and state foresters seek landowners doing a good job of planning, protecting, and harvesting their forests and certify them as members of the system. The foresters also work with people who want to improve their management, helping them with tree planting and fire and insect control.

These three groups of landowners, working in harmony and taking advantage of modern forestry developments, assure that the forests of the United States continue to provide wood products and all the other benefits of well-managed stands. Similar groups are active in many of the developed countries. Nigeria should emulate this countries, and re-enforce replanting while making the following compulsory for all lumbering and milling firms in the country:-

I - All lumbering and or milling firms must be registered in the forestry department of the ministry of agriculture.

II - All intending milling firms must invite the forestry department to inspect their equipment to ensure that they meet with prior set standards to produce standard sound wood.

III - All lumbering firms must include at least one forest scientist in their team of foresters to take care of control the infection and spread of fungus, insects, replanting, and render professional advice when and where necessary.

IV- All lumbering firms must keep and maintain a plant nursery commensurate to the area of their plot(s) as the case may be.

IV (A) Firms must check with the research center or agric department for the latest advances in lumbering, milling and forestry for prompt application when and where necessary.

V - All lumbering firms must adhere to logging physical conditions for trees

V(A)Loggers must never fell trees whose girth falls below the standard specified for that particular specie

V(B)- Loggers must avoid sawing for commercial purpose, infected logs, they must invite their forest scientist to take proper action.

VI - Commercial logs must be certified by qualified government officials from the forest department of the ministry of agriculture before and the research center before conversion.

VII- Except on special request all logs must be sawn to standard dimensions for architectural and carpentry works.

VIII- Saw mills must ensure that commercial timber or lumber is free of all defects

IX- Timber must be properly seasoned before sale.

X- All lumbering, milling and paneling firms will be required to answer for any short comings discovered by government agencies on any surprise visit or otherwise.

XI- These laws are subject to changes or amendments when ever government deems it necessary with or without prior notice.

CHAPTER IV

4.0 CASE STUDIES

The lumbering and wood research centre sapele comprises of lumbering /logging activities, conversion, seasoning and carpentry activities so I carried out case studies of various saw mills and logging outfits, workshops, and research institutes, so as to be able to acquire information for all aspects the design.

4.1 BOPTRADE WORKSHOP ENUGU (CASE STUDY ONE)

4.1.1 INTRODUCTION

This is a specialised furniture workshop, where all sorts of upholstery and cabinet works are done.

4.1.2 PLANNING

It is comprised of two workshops, one for cabinetry and the other for upholstery works. There is provision for tool storage spaces for both workshops.

4.2.3 OBSERVATIONS

MERITS

- There is enough working space.
- upholstery space is separated from cabinetry space
- large doors for bringing in materials and taking out finished work
- good head room of about seven meters

DEMERITS

- Inadequate lighting

No office

- No parking space
- No defined timber yard
- No exhaust facilities to remove dust
- No show room

4.2 SUPER HIGH KLASS FURNITURES CASE STUDY TWO

4.2.1 INTRODUCTION

This is also a furniture and upholstery work shop located in high level Makurdi.

4.2.2 PLANNING

They also undertake all kinds of cabinetry upholstery and interior decoration works.

4.2.3 OBSERVATIONS

MERITS

- Presence of a show room
- Presence of a store
- Presence of an office
- The interior of the show room is well finished
- The store and office create a buffer between the workshop and show room
- Good parking space

DEMERITS

- The work shop is not enclosed

- finished furniture are moved round from the work shop into the showroom.
- the store is inadequate so some storage items are kept in the office.
- Inadequate lighting in the store

No defined timber yard

4.3 NEW BENIN ROAD SAW MILL, BENIN. (CASE STUDY THREE)

4.3.1 INRODUCTION

This is a saw mill that converts road transported logs into planks.

4.3.2 PLANNING

This saw mill is located along the new benin road, it is made up basically of a large roof of corrugated iron surported by timber columns.

4.3.3 OBSERVATIONS

MERITS

- The sawmill is located just by the road and not far away from a major timber shade
- The site is large enough to accommodate processed and unprocessed wood as well as waste
- The saw mill is within a region where logs are readily available.

DEMERITS

- Very local structure
- No milling pond (logs are exposed to splitting)
- No parking space.
- No defined office
- No defined entrance
- Because of continuous roofing the interior of the mill is dark.
- The saw mill has no walls, only wooden columns

4.4 OMO WOOD CENTRE ORE (CASE STUDY FOUR)

4.4.1 INTRODUCTION

Omo wood centre Ore is located in Ore, Ondo state by Benin road , on the outskirts of ondo town, they carry out milling and conversion of wood only.

4.4.2 PLANNING

This is also a large roof structure suspended on wooden columns with rough-sawn wooden walls in certain areas.

4.4.3 OBSERVATIONS

MERITS

- Good accessibility
- Enough parking space
- Presence of an office
- Good proximity to lumber
- Good location; lumber from out of town is taken straight into the saw mill with out passing through town.

DEMERITS

- The shade for the saw mill is an open structure
- There is no milling pond
- Unimpressive elevation
- Dark interior due to the long span and large spread of the roof
- No seasoning facilities
- No timber shade
- Disposal of waste is only by open incineration

4.5 OWO TIMBER SHADE IFE PARK ONDO STATE (CASE STUDY FIVE)

4.5.1 INTRODUCTION

This is a timber processing facility which is located in the middle of town beside Ife motor park. They carry out only resawing, planning and retail of timber.

4.5.2 ARCHITECTURE

The building and planning of this place is very much like the other case studies mentioned here already- Basic roof structure on timber columns.

4.5.3 OBSERVATIONS

MERITS

- Easy accessibility to carpenters and others with owo metropolis
- Availability of offices
- Good site layout

DEMERITS

- Undefined parking spaces
- Poor structures
- No central administration
- No seasoning facilities
- Disposal is only by open burning

4.6 GWAJA SAW MILLS SAPELE EDO STATE CASE STUDY SIX

4.6.1 INTRODUCTION

This is a continuous stretch of saw mills located on the bank of river ethiop. they carry out conversion of timber and sale of wood

4.6.2 PLANNING

There is no evidence of conscius professional planning.

4.6.3 OBSERVATIONS

MERITS

- Located beside a river
- Adequate set back
- Availability of mill pond
- Cheap transportation of logs through water
- Presence of a few offices
- Because there are many dealers and mills, there is competition
- Availability of timber sheds

DEMERITS

Poor parking arrangement

- No central administration

- No seasoning facilities
- Poor mill shades
- No incinerators
- No spatial planning
- No carpentry or cabinetry work shops
- Inadequate offices

4.7 DEDUCTIONS

- After careful consideration of the provision and short comings of all the case studies, I made the following observations and recommendations
- Standards are not set for saw mills, timber shades and logging industries such standards and regulations as the following should be set and enforced

- All proposed saw mills, like filling stations should be made to submit proper working drawing for approval and development before commencing logging operations

- Lumbering firms and forest owners do not employ foresters they simply pay for a forest plot or a compartment and then pay independent fellers or loggers to commence felling of trees.

- Government should also concentrate proper and other food based product companies with areas of measures logging the by products of trees like branches bark, saw dust and planing chips can be put to measure the percentage use of felled trees

CHAPTER V

5.0 DATA COLLECTION

5.1 CLIMATE

Nigeria is a physically diverse country divided by the Niger-Benue river system into three sections. The northern section which consists of gently rolling plains roughly 1,500 feet (460 meters) above sea level crossed by both permanent and seasonal rivers and streams and occasionally broken by large outcrops of granite.

The middle belt has a more varied relief and is marked by rugged volcanic highlands--the Jos Plateau.

The southern and coastal section consists primarily of low-lying plains and the southwestern uplands. The third section were my project is located (Sapele in delta state), It consists of mangroves, dense forests, and some of the richest petroleum deposits in Africa.

sapele's climate is shaped by the moist, unstable air as it is in the south. The northward movement of moist air from the Atlantic Ocean brings precipitation

humidity and temperatures are high year-round, and rainfall ranges from about 60 to 100 inches (150 to 250 centimeters) per year, distributed over

at least eight months. temperatures vary from a dry-season average of 86o F (30o C) to 77o F (25o C) in the wet season--May to November. . The dry season is between February and May. Since Sapele falls within the southern coastline of Nigeria, it has the characteristic tropical climate of hot wet conditions characterized by heavy rainfall and high temperatures for most of the year. the movement of the tropical convergence zone (ITCZ),north and south of the equator gives these characteristics hot and wet climatic conditions. When ITCZ is far south in the Atlantic ocean, there is the dominance of dry north easterly over the country including the coastal zone, hence the short dry season between November and February. However, when the ITCZ moves north of the equator, with the tropical maritime of south westerlies prevailing over most parts of Nigeria, the wet season sets in between March and September. the length of the wet season is known to extend as far as nine months particularly in the Niger delta and eastern coastlines where about 3050mm of rainfall a year has been recorded in the south .

5.2 GEOGRARHY

The geographic patterns of tropical vegetation and animal life correspond closely to the zones of rainfall distribution. In the south, year-round rainfall, high humidity, solar radiation, and generally equatorial conditions produce tropical rain forests. The dense forests are some of the oldest, most complex, and diverse habitats in the world. Human activities--particularly burning, agriculture, and logging have greatly reduced the area of natural rain forest. Such moisture-demanding crops as yams, cassava, and rice and such tropical tree crops as rubber and cacao thrive in the forest environments.

5.3 VEGETATION

The abundant rainfall in Sapele and the southern coastlines supports a dense and luxuriant vegetation . how ever, due to the influence of the Atlantic ocean, the mangrove forest is the main vegetation in parts of the coastlines close to the Atlantic shore line.

Inland beyond the coastline where there is saltwater mangrove swamp forest, are the fresh water forest of raffia , oil palm , bush and some rain forest trees like iroko .Further north is the tropical rain forest influenced by heavy rain fall and high temperatures . this is characterized by dense forest vegetation with trees of economic value like iroko mahogany walnut and

obeche. However due to population pressure , the rain forest has become degraded and replaced by farmlands and plantations now common in the eastern part of the southern coastlines.

5.4 RELIEF AND DRAINAGE

The southern coastlands have a low-lying gently undulating relief of less than 20m above sea level. This ecological zone is therefore liable to coastal flooding and erosion during the wet season. undulating upland terrain found immediately to the north of the coastlines has an average relative height of 30m above sea level.

The Niger delta probably has the lowest relief features. this is owing to the complicated system of braided water channels which have enhanced the flowing of river Niger into the Atlantic ocean. to the west of Niger delta, rivers, ogun, oshun, and yewa drain the southwestern Nigerian sedimentary basin. these have produced the deposition of vast amounts of alluvial materials, forming an intricate network of coastal creeks and lagoons the coastal lowlands are therefore very poorly drained, particularly when the area is flooded by overflow of coast bound rivers and creeks.

The higher relative relief in excess of 25m above sea level in the north of the coastal areas of Delta state reduces flood hazards and ensures a better drained area in warri and sapele environs.

5.5 PEOPLES OF THE SOUTHERN COASTLINES.

The economic and social life of the people of the southern coastlines of Nigeria is greatly influenced by the aquatic nature of their immediate environment. From west to east, the peoples of these coastlines include the Yoruba, Edo, Urhobo, Itshekiri, Ijo, Ika, Ibo, Efik and Ibibio. Population density of the southern coastlines.

The high population density of the southern coastline of Nigeria is greatly influenced by the terrain features of the coastal environment. That is, the proximity to the Atlantic ocean has led to the development of sea-ports in Lagos, Warri, Port Harcourt and Calabar, with these towns receiving a tremendous influx of people. These sea-port towns and cities have the highest population density, with Lagos being the most densely populated.

Away from the unfavorable terrain of the Niger Delta towards the east, Ibibio land has a population density of over 500 persons per square kilometer as at 1979, making it one of the most densely populated areas in the country and indeed Africa. The recent migration s from the formally high population density areas of southern parts of Bendel, Ondo and Ogun states to Lagos, due to proximity and economic considerations, have reduced population density in these areas while the population density o Lagos has increased.

5.6 The Edo, Urhobo and Itshekiri

These people constitute the majority population in sapele they are also spread in Edo and Delta states with the Urhobo and Itshekiri to the southern parts of Delta state near the Atlantic Ocean. They are still found towards the Niger Delta, east of Ondo State The Itshekiri are more related to the Yoruba than the Urhobo people who are closely linked to the Ijaw. The Itshekiri are found in Warri while the Urhobo occupy Sapele and Ughelli which are the major towns in the southern parts of the defunct Bendel State.

5.7 ECONOMY AND COMERCE

There is a museum, a crafts school in Benin city .modern large industrial and commercial concerns like saw-mill ,textile mills ,cement factories, carpet factories, motor assembly plant; furniture, printing and block - making industries exist . there are also breweries, bottling plants, toothbrush and pharmaceutical plant, bakeries, nail and glass factories

Delta state is Nigeria's prime producer of hardwood and about eighty percent of the country's rubber sheets and crepes. The principal cash crops are cocoa, rubber and palm oil . mechanisation of agriculture is gradually being introduced in the state . the agbede and warrake projects cover

nearly hectares of land . total hectarage of already mechanised farmlands stands at two hundred and sixty three thousand . livestock projects are being vigorously executed in the state in order to provide an adequate source of protein for all the people in the state . several poultries also thrive. There are large fishs farms in Sapele, ogba and other parts of the state and a fish processing laboratory in warri

LOGS FLOATING TO A SAW MILL IN SAPELE

5.8 CULTURE AND SOCIETY

Long before colonial conquest by Great Britain in 1903, the area that was to become Nigeria was a region of great cultural diversity and political complexity. Traditions of metalworking, technical innovation, and

elaborate city development existed within peoples in the southwest prior to the 15th century.

The vast majority of people in Delta state have common ancestry with almost identical customs, beliefs and culture, noticeable in their festivals, religious, matrimonial and other ceremonies. Tradition plays an important part in their lives `. traditional dances like the esakpaide, festivals like igue distinctive dresses, ornamental, precious coral beads and various styles of hair-do like the okuku underscore the people's penchant for traditional values.

5.9 TRANSPORTATION AND EDUCATION

By Nigerian standards Delta state has an excellent system of communications . The growth in oil revenues facilitated an expansion of the state road system, which now connects the entire state. an automatic telephone and telex service is operated by the government. There is a radio station and a national television network, more than a dozen national daily newspapers, and many national weeklies published in English or native languages.

Delta state tackles education seriously. It has about 1,548 primary schools, 162 secondary schools, several teacher and technical colleges and a state university. State and other libraries function in the state .

5.10 DEDUCTIONS

- Due to heavy torrential rainfall, roofs should be properly designed to avoid leakage's, pitched roofs should be made high to increase water drainage from the roofs

- Where roofs gutters are used, they must be large enough, their volume should be proportional to the area of the roof they are draining.
- Roof gutter must be properly finished with felt or other materials to avoid leakage's

Due to high temperatures , proper ventilation or air conditioning services should be provided.

- Condensation should be avoided since relative humidity in sapele and the south in general is high.

- Building orientation should be done to avoid direct sun rays to the advantage of prevailing wind . care should be taken to avoid glare

- Because of wind and rain storms and proper wind breakers should be provided.
- since this is an area of high rain fall, proper drainage system should be designed to avoid flooding and erosion especially if the building is located at the foot of a hill.
- Since the people around the area are already used to lumbering and timber processes, staff to run the centre will not will be readily available, the will in any case require training and orientation to the new environment and working environment.
- Sapele has already being recognised as one of Nigeria's highest wood processing regions, by locating the wood centre there, and producing quality wood and wood products more people and customers including importers will be easily attracted to it.

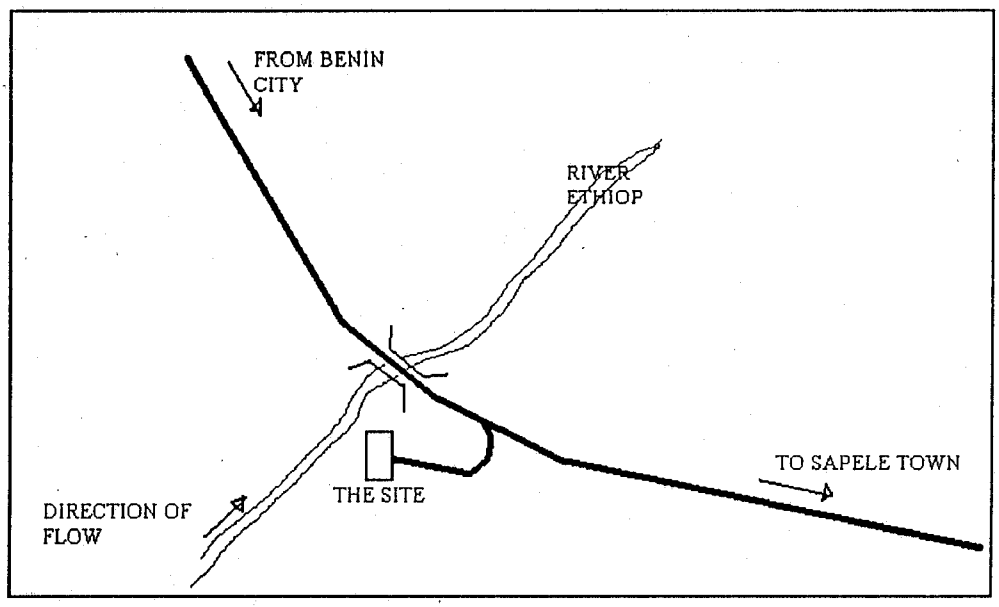
CHAPTER SIX

6.0 THE SITE

6.1 SITE LOCATION

The site for the national lumbering and wood research canter sapele is located in Jese area of sapele just after the bridge across river Ethiop when you are coming from benin and heading towards sapele. There is a good unrestricted view of the site from the bridge.

SITE LOCATION MAP



6.2 SITE SELECTION CRITERIA

In selecting a site for this project the following factors were put into consideration

- Proximity to raw materials
- Accessibility and location
- Soil bearing capacity
- The saw mill
- The seasoning plant
- Forestry and research suitability
- Accommodation
- Congestion

6.2.1 PROXIMITY TO RAW MATERIALS

Like any other firm or industry, the availability of raw materials is very important. It is very important to locate a saw mill close to the source of lumber to ease the problems associated with rood transport, problems like cost of fuel and vehicle maintenance, accident risk including production continuity are some of the reasons that influenced my decision to use this site. The river ethiop will sufficiently aid in the transportation of logs from the logging site to the conversion centre.

6.2.2 ACCESSIBILITY AND LOCATION

Accessibility of workers and visitors to the site is another important factor that influenced the choice of site. Prospective customers are expected from all over the country, most of which are not familiar with sapele and we do not want them missing their way. The site is easily accessible and located almost on the out skirts of the town so that in a situation where logs are to be brought by road, the delivery vehicle wouldn't have to pass through town before getting to the research or conversion center.

6.2.3 SOIL BEARING CAPACITY

This is really not a major criteria because this is not the only place within the rain forest region with adequate bearing capacity for this project but with all the other criteria it's good bearing capacity is an added advantage as almost all the buildings on this site are large.

6.2.4 CONGESTION

The other considerable sites in sapele are either congested with other saw mills or buildings other sites in Gwaja also by river ethiop were carried out

some case studies are quite congested and they all transport their logs by floating, Done in excess this can upset the ecological balance of the river and even lead to over flooding.

6.2.5 FORESTRY AND RESEARCH SUITABILIY

The research center requires a forestry and an environment suitable for research. This site located away from the rowdiness of sapele town and tucked away in the quietness of the serene jungle is just the right environment for this venture.

6.2.6 ACCOMODATION

Workers and staff of the lumbering and wood research center especially the low income earners who do not have cars but live in jesse can easily walk to their various duty posts.

6.3 SITE INVENTRY

The site which is located in jesse is not virgin, there is a small saw mill by the ethiop river that carries out logging in the ethiop jungle and floats them dawn to the mill.

There is a small clearing of about two thousand five hundred meters square (2,500 M2) in front of the mill and about one thousand meters square (1,000 M2) to the left hand side(south east)of the mill of the saw mill. The space in front is currently used for parking while the one on the left is for burning waste from the saw mill.

There is an existing road that branches off the Benin sapele road about two hundred and fifty meters from the bridge into the site and is currently being used as the only entrance into the existing saw mill.

The site is already connected to electricity and pipe borne water . The soil is loamy and well drained with a high percentage of silt and sand.

Apart from the little clearing that accommodates the existing saw mill, the entire site is covered with plants of various classes , from ground cover to trees of different genus and height

The site slopes gently towards the stream, in the event of rain , water drains naturally into the river ethiop which is on the site.

6.4 SITE PLANNING

Regarding the fact that the site s to be used for a saw mill, two entrances have been provided, one a neat and diplomatic entry and the other a services entry, also provided are parking spaces for all buildings and services for example, the timber shade has been provided with parking

spaces for potential customers, visitors, and all delivery vehicles. The road net work is such that these classes of traffic do not mix.

Since the site is located near or almost in an urban area most staff will stay within the town only to come to work every day, the office for the lowest class of workers is located in an easily accessible way so that they do not have to work too far before reaching there place of work.

Orientation of all offices and laboratory and library is in such a way to enhance cross ventilation and keep the windows from direct sun light. The timber shade is in such way that wind or air passes across or perpendicular to the stacked wood so as to enhance seasoning.

Sunrise and sunset has also been put into consideration so as to avoid excessive exposure of converted planks to sun rise because of defects such as cupping twisting bowing and splitting ,but that is the effect on wood , for people consideration has been made to prevent glare and heat by positioning the building in such a way to avoid all these.

Considering traffic flow the main access road remains while the existing road into the site is also retained to serve as the services route. The site

has being zoned into quiet semi-quiet and noisy areas to correspond with the research area, the administrative area and the production area respectively. A set back of 100 meters has been left from the bank of the river for all buildings except for the mill pond which is supposed to collect water from the river which is designed to a dept. of two thousand five hundred millimeters deep, one meter deeper than the river which happens to be one thousand three hundred and forty at that point .

7.0 CHAPTER SEVEN

7.1 DESIGN BRIEF

To function properly, the lumbering and wood research center requires the units and features;-

An unseasonal river that flows through the forest where logging is done. This provides a cheaper means of transporting the logs and keeps them from insect attack, splitting and the adverse effects of the weather like undue shrinkage it also forms the basis for a mill pond for keeping the logs until they are set for conversion. The only disadvantage of this means of transportation is delay when the tide is against the direction of flow. This happens once in a while and they have to wait for a maximum of six hours for the tide to return to normal. This however does not mean that production is stalled because logging is a continuous process and there is always enough wood in the milling pond. Apart from that, a services entrance has being provided for road supply of logs.

A SAW MILL.

This is the basis for availability of standard wood. With out a saw mill, no conversion can take place . the saw mill how ever makes provision for following facilities.

- A bull chain; To pull logs out of the milling pond
- A milling deck; To dispense logs for sawing
- A head saw; To saw logs into rough boards
- Re-sawing facilities; To saw the rough boards into neater planks
- Edgers; To remove the rough edges of the boards
- Trimmers; To trim the ends of the boards
- Seasoning facilities; To dry wood gradually under controlled temperature wind speed and pressure
- Planners; To plane the boards into smoother finish
- A timber shade; For air seasoning and sale of wood.

A RESEARCH CENTRE

Here forestry and lumber research is carried out for improved timber output while reducing degradation, The unit requires the following.

- A laboratory
- A library
- A plant nursery , experimental and commercial

A STAFF CANTEEN

This is to cater for the feeding of staff so that they do not have to leave their duty post for too long in the name of feeding. The restaurant is provided with storage facilities to reduce the frequency of heavy shopping.

A FURNITURE CENTRE

Some of the wood processed in the mill will be used to construct furniture in the workshop provided in this facility and displayed for sale to the public. Such furniture will be designed with strict and smart adherence to architectural antropometrics for enhanced comfort. Architect can also bring their furniture designs to the center for development

There is provision in this unit for the following spaces:-

- Timber stack
- wood work shop
- Tool store
- Material store
- furniture store
- show room
- offices

ADMINISTRATIVE BLOCK

A project of this magnitude requires coordination, the administrative block has spaces to accommodate all the departments and offices required to run this research centre

CLINIC

This is necessary to take care of emergencies. The conversion centre is a potential accident zone. Wood processing involves operating very sharp machinery, accidents have being recorded in these operations in the past so I have reconmended a clinic with in the site.

7.2 DES IGN PHILOSOPHY AND SPCIFICATION

This design is based on harmony, functionality, and promotion of natural environmental values safety therefore very little of the site is tampered with so as to retain the natural tropical look of the site. Materials for the construction especially finishes are as simple as they are safe. Non combustible materials are used for the fire prone areas, Folded plates for the roof of the saw mill ,metal roof members for and asbestos roofing sheets for the timber shed.

To avoid blowing of dust and leaves all over the place, adequate space has been provided and the walls are of fire tampered laminated glass, to assure strength and fire resistance.

SPACE REQUIRMENT FOR THE VARIOUS SPACES

SPACE	AREA (M 2)
Head Saw	30
Planing machine	16
Edger	30
Trimmer	30
Seasoning chamber	16
Re- Saw	30
Wood work shop	40

Show room	80
Waiting area	40
Card room	16
Records room	20
Study lab	64
Store (lab/ lib)	12
Offices	15
Library	96
Consultation room	25
Examination room	9

Pharmacy	30
Store (pharmacy)	12
Cashier office	9
Theatre	20
Nurses station	6
Offices (admin)	16
Conference room	128
WC	2
Ward (room)	9
Laundry	72
Tool store	15

Timber shade	1000

7.3 CONCEPTUAL ANALYSIS

Since this is basically about conversion and conversion entails sawing, my concept for the saw mill is a combination of a common carpentry hand saw with nails where the saw forms the building it self while the nails become columns.

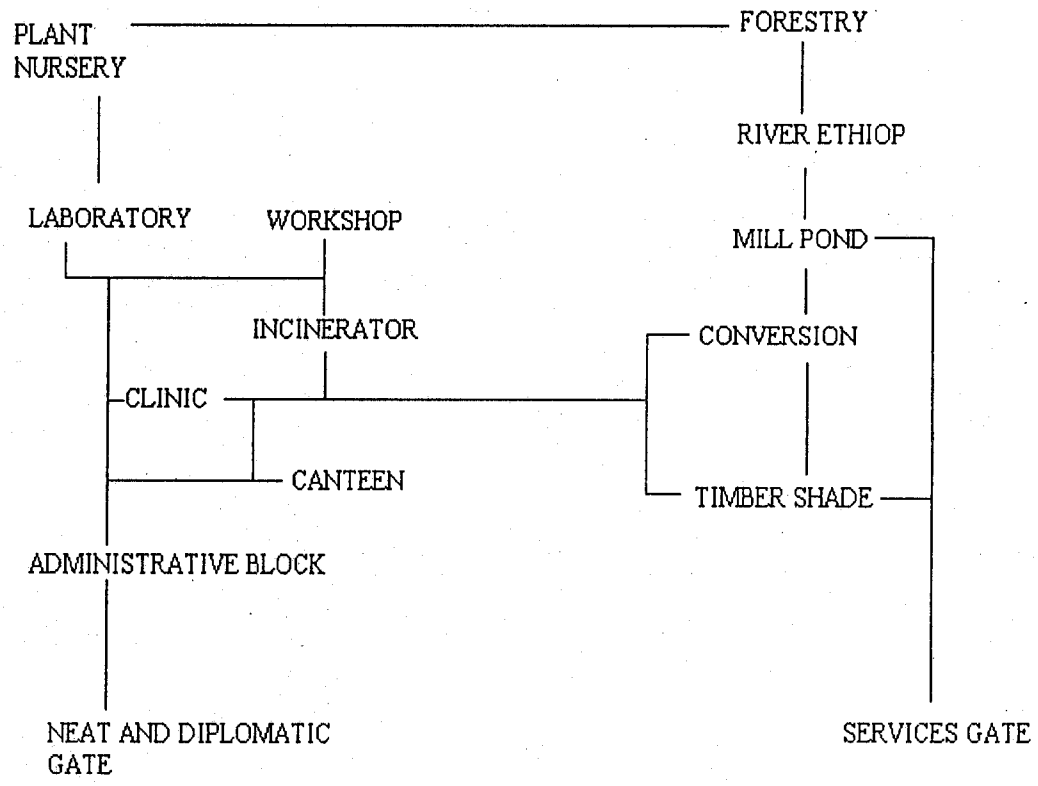
The concept for the furniture center is a chain saw in elevation while other buildings have at least triangular elements to symbolize the hand saw or circular elements to symbolize tree trunks.

The concept of the research center is symbolic of two wood weevils standing face to face since they signify destruction which is what the research center is to fight against.

7.4 FUNCTIONAL AND SPACE ANALYSIS

The functional flow of this project transcends from the overall site plan to the unit plans. Every thing has being arranged to optimize performance right from the site to the individual buildings.

FUNCTIONAL FLOW DIAGRAME



7.5 BUILDING MATERIALS AND CONSTRUCTION

Building materials are many and divers, they require proper understanding of their classification so that the architect may conveniently and effectively specify from the abundance of these materials. In selecting materials for this project, factors including cost, durability, application, availability, site influence and maintenance where put into consideration putting in mind their various appropriate areas of application .

7.6 FOUNDATION .

Building are divided into two, the sub - structure and super structure . The sub - structure which is basically the foundation is to be constructed from reinforced concrete and sand - create blocks, the foundation footing of 675 x 150 mm (or dimensions recommended by engineers.) will be cast. Then sand - screte blocks will be used to build the foundation footing to the required height in relation to ground level before casting the floor slab. With appropriate damp course proofing. An appropriate foundation will be designed for the embankment and retaining wall of the mill pond.

7.7 WALL

The super structure will be basically constructed with sand screte blocks with external walls at 225 mm and internal and non load bearing / internal walls 150 mm other super structure elements include reinforced concrete columns and beams, all these will be finished with plaster and painted with emulsion paint on the interior and texcote on the exterior.

Certain walls are simply glazed with openings at the appropriate as reflected by the design.

7.8 DOORS AND WINDOWS.

These will be glazed to reflect heat and solar heating and also to insulate external fumes and noise while keeping the interior well lit. The frames are to be purposely made chrome frames to also elevate the aesthetics of the applied areas, these frames will be of two or three hour fire rating.

Only doors to the offices, enlightenment hall, ward rooms, toilets, baths and other specified areas will be of wood.

7.9 CEILING.

The ceiling will be suspended celotex in aluminium frames in the administrative block and research center. in the saw mill no ceiling will be required as a design measure against fire. The folded plate roof of the saw mill will be left bare while the steel roof trusses in in the timber shade too will be left bare and painted for aesthetics.

7.10 FLOOR FINISHES.

The kitchen, toilets and washing rooms will be covered with non-slip glazed floor tiles. All the office spaces in the administrative block are to be finished in colored terrazzo. The work shop, stores, walk ways and the conversion area are to be finished in cement sand screed.

7.11 ROOF.

The roof has R.C. gutters and parapets. Welded steel members are to be used in the timber shed with asbestos roof coverage. Other buildings namely, the administrative building, the staff canteen, the research center, the clinic and furniture center are all roofed with long span alluminium roofing sheets. The choice of predominant steel and concrete is influenced by their non combustibility. All roof gutters, slabs and parapets will be cast in - situ and treated with felt to avoid leakage's.

CHAPTER EIGTH

8.0 SERVICES

8.1 PLUMBING

All liquid wastes from the building will be drained through pipes into the septic tank and soak away outside the building. since there is already portable water on the site, this will be distributed within the building adequately.

8.2 ELECTRICITY

Electricity will be tapped from the existing NEPA distribution lines to serve the complex and since light is highly essential at the complex, a stand by power generating plant will be put in place in case of inevitable power failure.

8.3 FIRE.

This is an especially very sensitive issue here, since the center will be dealing extensively in wood which is highly combustible and this varies with different kinds of wood. Fire protection here has being separated into two stages; passive and active fire protection.

Passive fire protection refers to fire protection by design. This involves the various fire protection measures I have taken in ensuring that fire doesn't even start especially at areas of high fire probability like the conversion center where I have avoided the use of combustible roofing and aesthetically materials like celotex ceiling and wooden roof members. Fire is also one of the reasons why I have favored compartmentalization to designing a single unit to cater for all the needs of the center

Active fire protection involves fire protection measures after the fire has already started, this has been taken care of by the provision of various fire protection gadgets and equipment. The class of fire expected here is A. Class A fires are fire of normal combustible materials like wood and paper. This kind of fire can be extinguished by water, foam and normal fire extinguisers (carbondioxide).

This fire extinguishers will be mounted in all buildings at a distance of not more than twenty five meters from each other.

An integrated fire alarm and sprinkler system will be installed in all the buildings so that in the event of fire outbreak, the alarms will alert people to evacuate while the sprinklers get busy to put out the fire. I have favored smoke detection systems because class one fires are usually accompanied

by considerable smoke . some even emit smoke before flames. also, fire hydrant (F. H.) will be provided on the site to serve fire service men during fire outbreaks.

8.4 SECURITY

All entrances to the site have a gate house where security personnel will be situated. Security lights and personnel will be mounted at strategic positions within and around the building. since sapele has high crime rate, security alarms will be provided to alert security men of security breaches.

8.5 AESTHETICS AND GENERAL APPRAISAL

Aesthetics in this project have been divided into three, that of the building its self, that of the landscape and the co-ordinated beauty of the two.

The landscape of the lumbering and wood research center is a combination of simple hard landscape elements with natural soft landscape techniques to create an appealing atmosphere and functional beauty. Functional beauty as in noise and wind barriers.

The land scaping of the lumbering and wood center is to be done in such a way as to as much as possible retain and enhance the natural land scape conversion tree samples will be planted so that visitors can see and

recognize this trees, how they look before they are harvested. This arrangement is to enhance or hinder noise, sun rays, view etc as the case may be

The main hard landscape elements are kerbs, roads and walk ways, these have been combined with the strategically planned planting to achieve the landscape.

Aesthetics in the building have been achieved by articulating forms, texture, color and proportions.

CONCLUTION

1- National forests should be managed under the multiple-use system like in the united states of America to provide watershed protection, lands for recreation, food and shelter for wildlife, and a supply of timber. Private companies should bid competitively for timber on government lands. Logging should be done under the supervision of government foresters.

2-Trees are harvested in a way that protects the future of the forest.

3- Government should encourage more people to read forest management Foresters and landowners should be made to plant seeds or seedlings of trees. The seedlings should be grown in large nurseries, much as ornamental plants are grown for landscaping, and transplanted when they are older and better able to survive.

4-Government should enforce replanting after harvesting

5-Government should enforce replanting after harvesting

6-In forests where the ground is too rough to allow the use of planting machines, planting is can be done by hand. Sometimes seeds can be spread over the ground by airplane or helicopter.

7-Government should carry out and encourage sourvailance on forest specifying stiff penalties for violators.

8-Individuals and companies should learn to practice better harvesting techniques. The long-accepted practice of cutting only a few trees at a time from a particular stand should be discouraged as the practice almost always results in taking the best trees and leaving inferior specimens to take over the forest. They should following nature's approach of harvesting all the trees in an area at one time and encouraging seeds from the best trees available to reforest the land.

9-By planting species they prefer, human beings can improve the quality of the trees they plant. The learned about the development of genetically improved strains of corn, wheat, and other food crops. This should be applied to forestry and plants that grow faster and achieve desirable girt, trees with long, straight trunks that can be sawed into lumber or peeled for plywood more economically, trees with small crowns, or tops, trees that are insect and disease resistant so their chances of maturing are better should be engineered.

10-As a rule, older, slower-growing trees that have lost their vigor, and trees that have been damaged by fire or drought, are most vulnerable to attack by insects and disease. This trees should be harvested for conversion or other uses promptly.

11-Protection against forest fires is often a matter of education. Many fires started by people to burn trash or leaves or dead grass get out of control and burn forests as well. Sometimes campfires or cigarettes cause fires. Arson is another common cause of fires in some areas. Government should take drastic measures in taking care of this problems in the interest of the future of Nigerians.

12-Forests should be watched during the dry seasons to detect fires as early as possible since fire damage can be held to a minimum by quick action. Fire roads should be t through forests to allow firefighters to quench blazes before they get hot enough to reach the tops of trees.

13-Our fire fighting service should be well equipped and personnel trained to be able to fight forest fires effectively.

14-Once a stand has been damaged or killed by fire, useable wood should be removed quickly to prevent the buildup of destructive insect populations and to prepare for the reforestation of the area, foresters should learn to set fires that imitate nature to benefit the forest. Fires set by lightning destroy climax forests and allow a new succession of tree species, starting with softwoods, to begin. Natural fires also serve to reduce competition in softwood forests. Forest managers should be competent enough to use controlled fire to control unwanted hardwood growth in pine stands. This leaves more moisture and nutrients for the pines. It also reduces the ground litter of leaves and branches that might fuel a hotter fire, and it exposes the soil, allowing grasses and brush to grow and feed wildlife.

15-Recreational activities like Hunting, hiking, fishing, and camping should be encouraged under strict supervision so as to enable people appreciate the forest more

16-Forestland should generally be regulated by government agencies as a national resource. a large part of the forestland should belong to the federal government. Most of this should be managed by the Forestry Department of the ministry of Agriculture to perpetuate the forest and provide all the

benefits of timber supply, wildlife management, watershed management, and recreation.

17-State governments too should own forests which should be managed by forestry agencies that will also help private landowners develop the forests on their lands.

18-Forest industry companies practice good forest management and encourage their neighbors to do the same.

19-Trees with severe knots should be put into other uses apart from timber

20-wood should be properly seasoned to enhance strength.

21-During conversion wood should be sawn along the grain also to enhance strength.

22-Wood is naturally a very durable substance. If not attacked by living organisms, it will last for hundreds or even thousands of years. wood should be treated with the appropriate chemicals to enable it last long. Sapwood should be avoided when necessary.

23-Wood should be properly seasoned before sawing it to small sections

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