Forest and Wildlife Management (FWM 305) Forest Management Option

Forest management is the branch of forestry concerned with the overall administrative, economic, legal, and social aspects and with the essentially scientific and technical aspects, especially Silviculture, protection, and forest regulation. This includes management for aesthetics, fish, recreation, urban values, water, wilderness, wildlife, wood products, forest genetic resources and other forest resource values [1]. Management can be based on conservation, economics, or a mixture of the two. Techniques include timber extraction, planting and replanting of various species, cutting roads and pathways through forests, and preventing fire.

There has been an increased public awareness of natural resource policy, including forest management. Public concern regarding forest management may have shifted from the extraction of timber to the preservation of additional forest resources, including wildlife and old growth forest, protecting biodiversity, watershed management, and recreation. Increased environmental awareness may contribute to an increased public mistrust of forest management professionals.

Many tools like GIS modeling have been developed to improve forest inventory and management planning. The abundance and diversity of birds, mammals, amphibians and other wildlife are affected by strategies and types of forest management.

Deforestation and increased road-building in the Amazon Rainforest are a significant concern because of increased human encroachment upon wild areas, increased resource extraction and further threats to biodiversity.

Natural resources

Natural resources (economically referred to as land or raw materials) occur naturally within environments that exist relatively undisturbed by mankind, in a natural form. A natural resource is often characterized by amounts of biodiversity existent in various ecosystems. Natural resources are derived from the environment. This is currently restricted to the environment of Earth yet the theoretical possibility remains of extracting them from outside the planet, such as the asteroid belt.[1] Many of them are essential for our survival while others are used for satisfying our wants. Natural resources may be further classified in different ways.

Classification: On the basis of origin, resources may be divided into:

- Biotic - Biotic resources are obtained from the biosphere, such as forests and their products, animals, birds and their products, fish and other marine organisms. Mineral fuels such as coal and petroleum are also included in this category because they formed from decayed organic matter.
- Abiotic - Abiotic resources include non-living things. Examples include land, water, air and ores such as gold, iron, copper, silver etc.

Considering their stage of development, natural resources may be referred to in the following ways:

- Potential Resources - Potential resources are those that exist in a region and may be used in the future. For example, petroleum may exist in many parts of India, having sedimentary rocks but until the time it is actually drilled out and put into use, it remains a potential resource.
- Actual Resources are those that have been surveyed, their quantity and quality determined and are being used in present times. The development of an actual resource,

such as wood processing depends upon the technology available and the cost involved. That part of the actual resource that can be developed profitably with available technology is called a reserve.

On the basis of status of development, they can be classified into potential resources, developed resources, stock and reserves.

With respect to renewability, natural resources can be categorized as follows:

- Renewable resources are ones that can be replenished or reproduced easily. Some of them, like sunlight, air, wind, etc., are continuously available and their quantity is not affected by human consumption. Many renewable resources can be depleted by human use, but may also be replenished, thus maintaining a flow. Some of these, like agricultural crops, take a short time for renewal; others, like water, take a comparatively longer time, while still others, like forests, take even longer.
- Non-renewable resources are formed over very long geological periods. Minerals and fossil fuels are included in this category. Since their rate of formation is extremely slow, they cannot be replenished once they get depleted. Of these, the metallic minerals can be re-used by recycling them.[2] But coal and petroleum cannot be recycled.[3]

On the basis of availability, natural resources can be categorized as follows:

- Inexhaustible natural resources- Those resources which are present in unlimited quantity in nature and are not likely to be exhausted easily by human activity are inexhaustible natural resources (sunlight, air etc.)

- Exhaustible natural resources- The amount of these resources are limited. They can be exhausted by human activity in the long run (coal, petroleum, natural gas, etc.) Some examples of natural resources include the following:

- Air, wind and atmosphere
- Plants
- Animals
- Coal, fossil fuels, rock and mineral resources
- Forestry
- Range and pasture
- Soils
- Water, oceans, lakes, groundwater and rivers [4]
- Sun (Solar Power)

Natural resource management is a discipline in the management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations. Natural resource management is interrelated with the concept of sustainable development, a principle that forms a basis for land management and environmental governance throughout the world.
In contrast to the policy emphases of urban planning and the broader concept of environmental management, Natural resource management specifically focuses on a scientific and technical understanding of resources and ecology and the life-supporting capacity of those resources.

Sustainable Forest Management

It is difficult to explicitly define what sustainable forest management is. However, several

recent international meetings have suggested that the following seven thematic elements are key components.

(1) Extent of forest resources;

(2) Biological diversity;

(3) Forest health and vitality;

(4) Productive functions of forest resources;

(5) Protective functions of forest resources;

(6) Socio-economic functions;

(7) Legal, policy and institutional framework.

These thematic elements, acknowledged by UNFF, are based on the criteria of the nine on-going regional/international processes on criteria and indicators for sustainable forest management, and were acknowledged by the International Conference on Criteria and Indicators in Guatemala in February 2003 (CICI 2003) and by the FAO Committee on Forestry in 2003. In February 2004, the FAO/ITTO Expert Consultation on Criteria and Indicators recognized that these elements are important for facilitating international communication on forest-related issues. The thematic elements are also used in the FAO-led global forest resources assessment (FRA) as a reporting framework.

The following draft descriptions of the seven themes are currently proposed:

1. Extent of forest resources:

The theme expresses an overall desire to have significant forest cover and stocking, including trees outside forests, to support the social, economic and environmental dimensions of forestry. For example, the existence and extent of specific forest types are important as a basis for conservation efforts. The theme encompasses ambitions to reduce deforestation and to restore and rehabilitate degraded forest landscapes. This theme also includes the important function of forests and trees outside forests to store carbon and thereby contribute to moderating the global climate.

2**. Biological diversity:**

The theme concerns the conservation and management of biological diversity at the ecosystem (landscape), species and genetic levels. Such conservation, including protecting areas with fragile ecosystems, ensures that diversity of life is maintained, and provides opportunities to develop new products, for example medicines, in the future. Genetic improvement is also a means to improve forest productivity, for example to ensure a high wood production in intensively managed forests.

3. Forest health and vitality:

Forests need to be managed so that risks and impacts of unwanted disturbances are minimized, including wildfires, airborne pollution, storm felling, invasive species, pests,

diseases and insects. Such disturbances may impact social, economic as well as environmental dimensions of forestry.

4. Productive functions of forest resources:

Forests and trees outside forests provide a wide range of wood and non-wood forest products. The theme expresses the ambition to maintain a high and valuable supply of primary forest products, while at the same time ensuring that production and harvesting are sustainable and do not compromise management options of future generations.

5. Protective functions of forest resources:

The theme addresses the role of forests and trees outside forests to help moderate soil, hydrological and aquatic systems. This includes to maintain clean water including e.g. healthy fish populations, as well as to reduce risks or impacts of floods, avalanches, erosion and droughts. Protective functions of forest resources also contribute to ecosystem conservation efforts. Protective functions of forest resources have strong cross-sectoral aspects, as the benefits to agriculture and rural livelihoods are high.

6. Socio-economic functions:

The theme addresses the contributions of forest resources to the overall economy, for example through employment, values generated through processing and marketing of forest products and energy, trade, and investments in the forest sector. The theme also addresses the important functions of forest to host and protect sites and landscapes that have high cultural, spiritual or recreational values, and thus include aspects of land tenure, indigenous and community management systems, and traditional knowledge.

7. Legal, policy and institutional framework:

The theme includes the legal, policy and institutional arrangements necessary to support the above six themes, including participatory decision making, governance and law enforcement, and monitoring and assessment of progress. The theme also addresses broader societal aspects, including fair and equitable use of forest resources, science research and education, infrastructure arrangements to support the forest sector, transfer of technology and capacity building, and public information and communication.

Forest Management Planning:

Forest management planning is a process that helps you identify the resources and opportunities available on your property and what you would like to realize from your Property in terms of financial gain and long-term enjoyment. What do you want from your forest land? What do you want your forest to look like in the future? What about your forest is most important to you? Forest management planning is a means of identifying what can be done to enhance and protect the values and aspects of your property that are most important to you. These aspects might include wildlife, recreation, aesthetics, timber, livestock ranching, inheritance values, and others. The first step in the process of forest

management planning involves determining *where you want to be* in terms of your forest resources and property. This step involves deciding on your goals, broad reasons for owning forest land (e.g., aesthetics, wildlife, long-term financial investment and gain, immediate dollar returns, recreational opportunities), and determining more specific objectives, or actions, that will lead to your goals (e.g., improving elk habitat, increasing the value of standing timber through removal of undesirable and unhealthy trees, decreasing risk of wildfire by removing fallen timber and slash). Next, you need to determine *where you are* in terms of those goals and objectives. This is done through resource inventory and evaluation. Resource inventory provides information on the quality, quantity, and species of timber on your property; landscape features such as soils and topography; wildlife and plant species of interest or concern; and water resources. While not all of this information may be necessary to complete your objectives, the more information provided in an inventory, the better. Your goals and objectives may change over time, making this additional information necessary. The next step in forest management planning is identifying a list of recommendations describing *what to do to get to where you want to be*. The recommendations also may include a specific activity schedule that lays out how, when, and where to implement specific actions and how those actions relate to your goals and objectives. These steps should be detailed in a written plan that is used as a reference for management of your forest. The written plan may be a comprehensive management or stewardship plan that addresses all the steps just discussed, or a practice/activity plan that focuses on how to complete a specific activity to help get you where you want to be.

Types of Written Plans:
Depending on the ownership goals, a written plan may be a management plan, a stewardship plan, or a practice/ activity plan.

Management and Stewardship Plans:
Both management and stewardship plans cover long-term goals and objectives and encompass a time period of ten years or more. These plans include a discussion of your goals and objectives, a detailed property description and resource inventory, and a list of management recommendations with an activity schedule. A management plan sometimes focuses mainly on timber resources, while a stewardship plan encompasses other resource values as well, such as wildlife and recreation. Both types of plans may help you qualify for potential cost-share and tax benefits through the Stewardship Incentives Program and other programs.

Practice/Activity Plan:
A practice/activity plan or timber sale plan is not a complete management plan, but instead addresses short-term goals associated with a specific activity, like a one-time timber harvest. This type of plan focuses on describing the details of the activity, such as which trees are to be cut; marking method; method of payment; harvesting system; location of roads, skid trails, and landings; treatment of slash; and erosion control, rehabilitation, or reforestation measures. Such a plan may stand alone as an activity plan or may be prepared as part of the management recommendations section of a more comprehensive management plan. In either case, the information detailed in such a plan is essential to a successful timber harvest and should be included as part of a timber sale contract.

Reasons for Forest Management Plan:

Forest management plans allow you to sort out what you really want from your forest and help you successfully and efficiently reach your goals. Management planning can mean the difference between liquidating your timber resource for a one-time cash return or earning repeated dollar returns from intermittent thinning harvests while at the same time increasing the value of your standing timber. It can mean the difference between having to sell your property to meet property or inheritance tax obligations or insuring that your property stays under family ownership for generations to come by managing for sustainable timber harvests and income production. It can mean the difference between restricting cattle movement because of a tangle of untreated logging slash or potentially increasing livestock forage through careful opening of the forest canopy. Forest management planning can help protect you, as a landowner, from liabilities associated with the impacts of timber harvesting and other forest activities both on and off your land. Planning can help you make the most of your resources while protecting the resources that we all share, such as water quality and beautiful scenery. The more forethought that goes into how you manage your lands, the less chance you have of making costly forest management mistakes. Growing conditions in Utah are such that once mistakes in forest management have been made, it is difficult, if not impossible, for the forest resource to recover. Harvesting trees at the wrong time, cutting the wrong trees, or neglecting a forest health problem like an insect infestation may mean that the income and productive potential of your property will be impacted well beyond your lifetime! These types of mistakes can be avoided by careful planning. Forest management planning can mean the difference between making the most of your resources or having to pick up the pieces after mistakes have been made.

How to carry out Forest Management Planning:

The six basic steps for developing a forest management plan for your property are:

1. Seek the assistance of a professional.
2. Determine your goals and objectives.
3. Inventory and evaluate your resources.
4. Formulate an activity schedule.
5. Implement activities and monitor progress toward meeting your intended goals.
6. Review your plan every few years and update it when necessary

Components of a Forest Management Plan should include:

1) Ownership goals and management objectives: this is the heart of the plan and describes what you want to gain from your property and resources.
2) Maps: help to describe the property and resources and may include topographic maps, soils maps, cover type or stand maps, and aerial photos, if available.
3) Property boundary description: a legal description of your property location and acreage.
4) Resource inventory data: descriptions of water bodies, wildlife, vegetation, soils, topography, and access. Timber inventory data should include information on the species,

sizes, quality, and quantity of timber; stand structure and condition; and the presence and extent of forest pests (bark beetles, mistletoe, etc).
5) Management recommendations: detailed management options and how they relate to ownership goals and objectives.
6) Activity schedule for recommendations: specifies a timeline for management activities.

Might include:
1) Discussion of current and future forest products markets and how that relates to the timing of timber management activities.
2) Examination of costs of different management options and their potential returns.
3) Detailed recordkeeping section describing all past, current, and projected expenditures and returns.

Forest Land Use Planning:

This requires planning exercises that are carried out on a variety of scales in other to capture and assess all of the information necessary for sustainable development. In Nigeria, forest management planning and implementation is for the most parts carried out at the state level based on broad policy objectives formulated by the national government. State governments can incorporate the various levels of planning (local, regional, national and global), into their forest management planning by utilising the three scales of planning outlined below;

The three scales of planning require for sustainable forest management:

Planning type	Map scale	Objective	Planning activities
Landscape level forest management planning	50,000-250,000	Achieving sustainable land at the forest estate	Long range (100yrs) planning for agriculture, forestry, conservation, urban e. t. c.
Strategic forest management planning	10,000-50,000	Achieving sustainable land at the forest estate	Medium range (5-10yrs) planning for Silviculture treatment , timber harvesting, restoration, plantation establishment conservation e. t. c

Tactical field management planning	2,000-10,000	Achieving sustainable management of individual forest lands	Short range (1yr) planning for Silviculture, harvesting restoration and plantation establishment

Landscape level forest management planning is directed at meeting national and global objectives in forest management.

Strategic forest management planning constitutes important long-range planning at a regional scale within an estate.

Tactical field management planning operates at the field or individual forest level

Sustained yield principles:

Sustained yield may be defined as maintaining a regular supply and continuous supply of forest products without impairing the capacity of the land to support production. The key objective is the achievement of an appropriate or normal distribution of size classes of trees within the area under management. Although management for sustained yield is a traditional objective, in forestry, it may conflict with other components of sustainability. For example, large ancient trees of primary or old growth forests may often be felled to produce a size structure appropriate for sustained yield, despite their high ecological value.

Components of sustainable use

Maintenance of regenerative capacity: In order for the use of a particular tree species to be sustainable, the species must retain sufficient genetic variation to be able to adapt to changing environmental condition and the processes enabling this adaptation to occur must be maintained to avoid extinction. This requires that key regenerative processes such as pollination, seed development and dispersal, seedling establishment and growth should be maintained.

Maintenance of biodiversity: sustainable use of a tree species require that populations of other species are also maintained. Organisms that depend on trees may face three problems as a consequence of tree uses;

i. Fewer trees

ii. A different spatial distribution of trees and

iii. Different patterns of fruit and leaf production. Those species which are legally associated with particular tree species such some as some pollinating insects and avian seed dispersals are more likely to be adversely affected by the use of their ‘’host’’ trees species than other organisms

Maintenance of ecological services: Trees provides a number of ecological services including regulation of run-off and ground water flow, maintenance of soil fertility and regulation of local and regional climate. Sustainable use may be defined as maintaining the quantity and quality services being provided or in the capacity to such services in the future. The principally involve the maintenance of canopy structure and vegetation cover, and the adoption of appropriate harvesting techniques which minimize soil disturbance and compaction.

Social and cultural impact: The concept of social sustainability reflects the ability of a society to withstand shock or stresses brought about by a change in conditions. Sustainable use of tree specie should therefore remain coherence of local communities and the processes and institution which enable them persist. A key aspect of social sustainability is the well-being of the social group concerned including cultural heritage and identity, justice, safety and health. Recently, the sustainability concept has also been applied to the maintenance of cultural diversity. Social and cultural impacts of tree use are especially pronounced where species have particular cultural or spiritual importance such as the shrine forest at Osun grove in Osun State.

Economic sustainability: Economic viable operations are those which are sufficiently profitable to enable stability of operation but not at the expense of the forest resource, the ecosystem or the affected communities. Essentially, activities of current generation should not result in future generation being economically worse off. Trees may be viewed as economic asset; how these assets are valued is central to defining whether or not a particular use is economically sustainable. Failure to use properly valued forest resources results in timber being traded at artificially low and undervaluation of forest land and other forest resources by government.

Elements of sustainable management: sustainable forest management involves;

1. Planning for the production of wood for commercial purposes as well as meeting local needs for fuelwood, poles food, fodder and other purposes.

2. It includes the protection or setting aside of areas to be managed as plant or wildlife reserves, or for recreational or environmental purposes.

3. It is concerned with ensuring that conversion of forested lands to agriculture and other uses is done in properly planned and a controlled way.

4. It also covers the regeneration of wasteland and degraded forest, the integration of trees in the farming landscape and the promotion of agro-forestry.

5. It is a multidisciplinary task, requiring collaboration between government agencies, NGO's and above all, people, especially, rural people. It is concerned with local, national, regional and global levels.

Improper forest management practices:

The current poor condition of the forest resources in Nigeria is as a result of a lot of improper forest management practices that have been employed over the years. This includes;

1. There is no clearly short and long term forest management goals and objectives which states can work with.

2. There is a lack of integrated forest land use planning.

3. There is a lack of forest management planning (short and long term)

4. There is a lack of monitoring/enforcement of activities regarding the forest resource-based.

5. There are no attempts to ascertain if forest harvesting is taking place at unsustainable level

6. Annual Allowable Cut (AAC) is based purely on demand without considering the available supply and how to achieve a sustainable supply.

7. There is a great short-fall in the reforestation/afforestation require to keep pace with current and expected future rate of deforestation.

8. There is a near absence of silvicultural activities essential to enhancing timber quality and quantity (e. g thinning, pruning, fire protection e. t. c)

Introduction to operative research in forestry:

Linear programming (LP): this is a mathematical technique concerned with the allocation of scare resources. It is a procedure to optimise the value of some objective (for example, maximum profit or minimum cost) when the factors involved (e.g labour or machine hours) are subject to some constraints (e.g. only 1000 labour hours are available in a week).Thus, linear programming can be used to solve problems which conform to the following:

1. The problem must be capable of being stated in numeric terms.

2. All factors involved in the problem must have linear relationship.

3. The problem must permit a choice or choices between alternative causes of action.

4. There must be one or more restrictions on the factors involved. There may be restrictions on resources (Labour hours) but they may be on a particular characteristics, for example, fertiliser must contain a minimum of 15% phosphate and 30% N_2.

Note: The linear part of the term LP is explained above. The programming part refer to the derivation of the optimum schedule, this is invariably carried out by an iterative process whereby one moves from one solution to a better solution progressively until a solution is reached which cannot be improved upon that is optimum. In this context therefore, the term programming is not connected with computer programming. A major factor in L.P. is the requirement that all relationships are linear.

Operations Research (O. R.)

Operations research may be described as a scientific approach to decision making that involves the operations of the Organisational systems. It can also be defined as the application of scientific (especially mathematical) techniques to problems of planning an Organisation in order to optimise the performance of the system. However, this is a general description that is equally applicable to many other fields as well. Therefore the best way of grasping the technique nature of operations research is to examine its outstanding characteristics.

As its name implies, O. R. involves ‘’ Research on Operations’’. This says something about both the approach and the area of application of the field. Thus, Operations Research is applied to problems that concern how to conduct and co-ordinate the operations or activities within an organisation. The nature of the organisation is essentially immaterial and in fact O.R. has been applied extensively in Business, Industry, the Military, Civil Government and Agencies, Hospitals e. t. c. thus the breadth of application is unusually wide. The approach is that of scientific method. In particular, the process begins by carefully observing and formulating the problem and then constructing a scientific model that attempts to abstract the essence of the real problem. It is the hypothesised that this model is a sufficiently précised representation of the essential features of the situation, so that the conclusion obtained from the model are also valid for the real problem. This hypothesis is then modified and verified by suitable experimentation

Thus in a certain sense ‘’ Operation Research’’ involves creative scientific research into the fundamental properties of operations. Specifically, O.R. is also concerned with the practical management of the Organisation. Therefore, to be successful, it must also provide understandable conclusions to the decision maker(s) when they are needed.

In summary, O. R. is concerned with decision-making for situation which originates from real life. These applications, occurring in Government, Business, Engineering, Economics and the natural and social sciences are largely characterised by the need to allocate resources. In these situations, considerable insight can be obtained from scientific analysis such as that provided by O .R. The contribution from the O. R. approach stems primarily on the following;

a. The structuring of the real life situation into a mathematical model, abstracting the essential element so that a solution relevant to the decision maker's objective can be sought. This involves looking at the problem in the context of the entire system.

b. Exploring the structure of such solutions and developing systematic procedures for obtaining them

c. Developing a solution that yields an optimal value of the system's measure of desirability (or possibly comparing alternative causes of action by evaluating their measure of desirability).

Operations Research has wide application in almost all the field of studies which include:

i. Forecasting

ii. Production scheduling

iii. Inventory control

iv. Quality control

v. Transportation

vi. Advertising and sales research

vii. Maintenance and repair

viii. Accounting procedures

ix. Plant location

x. Equipment replacement

xi. Packaging

xii. Capital budgeting

Planning an Operations Research Study:

The usual phases of an O .R. study are;

1. Formulating the problem
2. Constructing a mathematical model to represent the system under study.
3. Deriving a solution from the model.
4. Testing the model and the solution derived from it.
5. Establishing control over the solution

6. Putting the solution to work i. e. implementation

Linear programming (LP)-as a model in operation research

Expressing L.P problems

Before considering the problem, two major factors are important, which are:

Objective: The first step in L.P. is to decide what result is acquired: i.e. the objective. This may be maximise profit or contribution, or minimise cost or time or some appropriate measure. Having decided upon the objective, it is now necessary to state mathematically the element involved in achieving this. This is called **objective function.** (The second step)

Example 1

A plantation is established to produce 1200 products pole (A) and fuelwood (B). The contributions that can be obtained from these products are: A contributes N20, 000 and B contributes N 30,000 and it is required to maximise contribution.

The objective function for this plantation can be expressed as:

$$\text{Maximise N } 20{,}000_{x1} + \text{N } 30{,}000_{x2}$$

Where $_{x1}$ =number of units of A produced

Where $_{x2}$ =number of units of B Produced

Example 2

A forester mixes the fertilizer to boost the growth of his trees. Fertilizer N costs 20g per naira. Fertilizer K costs 55g per naira each fertilizer contributes some essential nutrients to the growth of the trees and the forester wishes to nurse/grow the trees as cheaply as possible. The objective of the function is:

$$\text{Minimise} \quad 20_{x1} + 40_{x2} + 55_{x3}$$

Where $_{x1}$ = number of weight of N

Where $_{x2}$ = number of weight of P

Where $_{x3}$ = number of weight of K