

EMT 301: PRINCIPLES OF NATURAL RESOURCES MANAGEMENT
(3 UNITS)

LECTURE NOTE

PREPARED BY

C. O. ADEOFUN AND B. S. BADA

CONCEPT OF RESOURCES

A resource is any factor which can be used to satisfy human wants (any source of raw materials). Resources generally can be described as attributes attached to things. This leads to trade-off) A resource can be viewed in terms of material e.g. raw material's, land or in abstract terms e.g. Human Knowledge, attributes of labours.

In general, resources depend on importance attached to it. Resources are therefore man made. They are created because someone wants something, a goal and hence means of achieving the goal. If man does not make use of something, that thing is not a resource. A resource is therefore employed to meet certain defined objectives.

The attribute of labour is because someone wants to hire it. The attribute of land also is because it can be used for certain purposes and someone is willing to use it or take advantage of its fertility, topography, accessibility, scenery e. t. c.

The value of resource hence depends on the context in which man takes it. For example, it is the context of forest estate, inland water fisheries, lakes, oceans, mineral resources in the country that really matters. The context in which resources are taken also influenced by social, economic, and cultural backgrounds as well as technological know-how. Therefore, nothing is independent and nothing may be regarded as unmanageable in a vacuum. The concept of a resource therefore varies in time and space due to technological advancement and human wants. For example, the use of saw dust as cooking fuel was not appreciated in some part of the country until the scarcity of the conventional sources such as kerosene and cooking gas sequel to the industrial actions by the Petroleum and Natural Gas Workers.

After the Second World War, attentions focused on the subject of natural resources such as timber, fishes, petroleum, e. t. c. This is because they are important resources that constitute the basis of wealth and are indicators of the developmental potentials of a nation.

The unusually high rate of natural resources exploitation and misuse could result in irreversible disequilibrium of ecosystem and environment. This would retard economic development and adversely affect man survival of earth. There is therefore need for efficient management of natural resources to maintain their continued availability and improvement in man's living standard.

Economic is one of the parameters used to determine the success of a management policy or procedure when economic is introduced to resource management, it requires that maximum benefits be derived from the resource. Resource management is however a complex issue because of numerous political, economical, social and cultural factors surrounding their ownership and use.

Types of natural resources

There are basically two types of natural resources:

- Biological resources
- Mineral or non-biological resources

The biological resources e.g. forest, fishes wildlife are called renewable because they are capable of regeneration. Mineral resources e.g. gold, tin, petroleum, on the other hand, are non-renewable resources because they are not capable of regeneration except after long geological periods. Strictly speaking, both types of resources are exhaustible. The

major difference being that while biological resources are capable of replacing themselves as steady flow of them are consumed mineral resources represent fixed stock whose inventory can be diminished over time.

CHARACTERISTICS OF RENEWABLE NATURAL RESOURCES

(i) Regeneration: Renewable natural resources have abilities to regenerate, hence inexhaustible in physical sense. They are self-regenerating and hence have perpetual production potentials. The economic importance of this is that the consumption of one unit does not reduce future inventory by the same amount. Although renewable, all biological resources are potentially destructible, especially by their misuse and over-exploitation leading to depletion and perhaps extinction.

(ii) Multiplicity of species interaction and dependence: The diversity and complexity of species are important properties of biological resources. These make their management difficult due to variations in the quality and uses of different species.

(iii) Naturally determined growth rate: The rate of growth and accretion of stock of biological resources are naturally determined by pre-determined biological processes. However, man can and have been influencing this limited growth by research. Because growth is naturally determined, time is a major decision variable on the management of biological resources. This requires a minimum waiting period for the production of any desired product, with of course, implication for cost and return.

(iv.) Possibility of Man-made Improvement: Technological advancement consequent upon research leads to genetic improvement and hence high yield and thus reduction in

management cost. This is often achieved by deemphasizing complexity of species composition in favour of few selected dominant species.

(v) Biological Resources as Ecosystem: Biological resources exist in and constitute an ecosystem of flora and fauna. These conform to important elemental concepts or principles of ecosystem such as selection, food chain, in which the organisms consume and are consumed by others in a particular order or hierarchy. The ecosystem develops towards a climax or a state of equilibrium when mortality balances with regeneration. However, ecosystem tends to be in a dynamic rather than static because nature/situation is not constant all the time.

(vi) Common Property Effect: The principle of common property requires that title to all environmental resources should rest with collectively, and that the private use of these resources should be on the basis of usufructural right only. Everyone claims right to their ownership. This lead to over-exploitation as it is generally believed that if one person does not exploit the resource, someone else will do. This is contrary to their maintenance as they are everybody's property and hence no one can be held responsible. The consequences of these actions are over-exploitation and neglect.

Usufruct: Right of enjoying the use and advantages of another property short of destruction or waste of its substances.

- The characteristics of non-renewable natural resources are the opposite of these views except the common properties effect which is applicable to both.

RATIONAL USE OF RESOURCES AND THE CONCEPT OF SUSTAINABLE DEVELOPMENT

The resources of the entire world should be developed to the fullest extent possible with available means as a whole can progress only by the efficient and rational use of the natural resources. The issue of rational utilization and sustainable development is now very relevant as the world population is growing very fast while the available resources to meet man's need is decreasing at increasing rate.

Development is a dynamic process in which there is no end point. The technologically advanced Nation's continue to seek new means of improving their utilization of natural resources or for enhancing the conditions of the environment in which their people live. At the same time, the less advanced countries strive to reach levels of economic well being which advanced nations have achieved. In effect the concept of "developing" nation is misleading as all nations are developing, however, at different paces. No country can moreover claim to be morally or practically independent of other countries. Each country bears the primary moral responsibility for the conservation and rational development of its own natural resources and to ensure that the natural resources are managed and exploited in such a way that the continued and perpetual derivation of benefits from them are guaranteed.

Consequently, two interpretations of Sustainable Economic development have been given:

- That concerned with sustainable economics, ecological and social development.
- Environmentally sustainable development i.e. optimum resources use and environmental management over time.

The concept of sustained development applies, to a resource which is to be used for, the production of all desired products in perpetuity. For example the management of the country's scars and marine resources to ensure the production of fishes and other marine life or the guarantee of the exploration of the country's mineral resources.

Human race in the quest for economic development and improvement of their condition of living must come to terms with the realities of resources limitation and the carrying capacity of the ecosystem and must take account of the needs for future generations.

The first interpretation which is wider in scope and highly normative view of Sustainable Development (SD) was endorsed by the World Commission on Environment and Development (UNCED) (1987). It defined SD as "development that meets the needs of the present without compromising the ability of future generation to meet their own needs. This is the view adopted by the Rio declaration of 1992 by the United Nation Conference on Environment Development (UNCED) and World Conservation strategy.

THE CONCEPT OF SUSTAINABLE DEVELOPMENT AND ITS IMPLICATIONS

Rational use of resource and the concept of sustainable development

The resources of the entire world should be developed to the fullest extent possible with available means. Mankind as a whole can progress only by the efficient and rational use of the natural resources. The issue of rational utilization and sustainable development is very relevant now that the world population is growing very fast while the available resource to meet man's need is decreasing at increasing rate.

Development is dynamic process in which there is no end point. The technologically advanced nations continue to seek new means of improving their utilization of natural

resource or for enhancing the conditions of the environment in which their people live. At the same time the less advanced countries strive to reach level of economic well-being which advanced nations have achieved. In effect the concept of 'developing' nation is misleading as all nations are developing, however, at different paces. No country can moreover claim to be morally or practically independent of other countries. Each country bear the primary moral responsibility for the conservation and rational development of its own natural resources and to ensure that the natural resources are managed and exploited in such way that the continued and perpetual derivation of benefit from them are guaranteed.

Developed countries: refers to industrialized countries characterized by a population that has realized a high standard of living, good health and long life expectancy.

Developing countries: are countries that have started to industrialized but that still contain large segment of population live under pre-industrialized conditions.

Less Developed countries: are characterized by low level of industrialization, poor health care and low life expectancy.

Two interpretation of Economic Development have been given.

- That concerned with sustainable economics, ecological and social development.
- Environmental sustainable development i.e. optimum resources use and environmental management over time.

The first interpretation which is wider in scope and highly normative view of Sustainable Development (SD) was endorsed by the World Commission on Environment and

Development (WCED) (1987). It defined SD as **“development that meets the needs of the present without compromising the ability of future generation to meet their needs”**. This is the view adopted by the Rio declaration of 1992 by the United Nation Conference on Environment Development (UNCED) and World Conservation Strategy.

Definition

Sustainable development as a concept and development paradigm for lasting progress was originally defined by the World Commission on Environment and Development (WCED) to mean **“development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs”** (WCED, 1987). The Commission further added that “this concept does not imply limits not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities.” This definition implies that sustainable development involves policies, strategies and programmes that do not make it more difficult for the development process to be continued by future generations than it is for present generations. It would appear that this definition emphasizes the objectives to be achieved rather than explicitly defining sustainable development.

The United Nations Environment Programme (UNEP, 1992) argues that the WCED (1987) definitions of sustainable development have been criticized as ambiguous and confusing because “development,” “sustainable growth,” and “sustainable use” have been used interchangeably even though they do not have the same meaning. “Sustainable growth” is regarded as contradictory in that nothing physical can grow indefinitely, while

“sustainable use” is applicable only to renewable resources in terms of “using them at rates within the capacity for renewability.” Based on these arguments, UNEP (1992) put forward the following relevant definitions:

- Sustainable development means improving the quality of human life while living within the carrying capacity of supporting ecosystems.
- Sustainable economy is the product of sustainable development it maintains its natural resource base and it can continue to develop by adapting to changing circumstances and through improvements in knowledge organization, technical efficiency and wisdom.
- Sustainable living indicates the lifestyle of an individual who feels the obligation to care for nature and for every human individual and who acts accordingly.

Sustainable development has been defined as consisting of policies, strategies, plans, production systems and technologies used in executing projects and programmes aimed at satisfying real human needs in perpetuity while maintaining environmental quality, biodiversity, the resilience of ecosystems, and the welfare of all organisms by integrating conservation, management and rational utilization of resources at individual, institutional, community, national, regional and global levels. Conservation here, according to Jacobs (1988), is an indispensable part of a wide field known as “the wise utilization of natural resources” aiming at utilization ad infinitum. It aims at (a) maintaining essential ecological processes and life-support systems, (b) preserving genetic diversity, and (c) ensuring the sustainable utilization of species and ecosystems.

Requirements of Sustainable Development

Requirements for sustainable development, according to WCED (1987) include:

1. a political system that secures effective citizen participation,
2. an economic system that is able to generate surpluses and technical knowledge on a self-reliant basis,
3. a social system that provides for solutions for tensions arising from disharmonious development,
4. a production system that respects the obligation to preserve the ecological base for development,
5. a technological system that can search continuously for new solutions,
6. an international system that fosters sustainable patterns of trade and finance, and an administrative system that is flexible and has the capacity for self-correction.

Nine principles of Sustainable development have been enunciated by (IUCN/ UNEP/WWF, 1991)

- i. Respect and care for the community of life.
- ii. Improve the quality of human life.
- iii. Conserve the earth's vitality and diversity.
- iv. Minimize the depletion of non-renewable resources.
- v. Keep within the earth's carrying capacity.
- vi. Change personal attitudes and practices.
- vii. Enable communities to care for their own environments.
- viii. Provide a national framework for integration, development, and conservation.
- ix. Create a global alliance.

It is obvious from the above that sustainable development not only entails the embodiment of environmental concerns in development activities and technology use but also necessitates changes in attitudes, behaviour, philosophy, moral and ethical values, religious practices, and relationships among human beings and between humans on the one hand and organisms or things on the other at the local, national, regional and global levels.

Implications and Challenges in Sustainable Development

In addition to the above requirements for sustainable development, there are several implications of the sustainable development paradigm that pose serious challenges for mankind now and in the future. Some of these implications and challenges include the following:

- i. According to Pearce *et al.* (1990), a key prerequisite for sustainability is maintaining the constancy of the stock of natural resources and environmental quality. But because this condition has already been breached, in that the environment in many situations has become degraded by human activities, the problem of maintaining the constancy of the capital stock is not one of stopping further environmental degradation but undoubtedly one of enhancing the environment. The implications of this are addressed from different viewpoints by the Brundtland Report (WCED 1987), which stipulates that sustainable development requires non-depletion of the natural capital stock as indicated in the World Conservation Strategy (IUCN/ UNEP/WWF, 1980). WCED (1987) insists that, if needs are to be met on a sustainable basis, the earth's natural

- resources have to be both conserved and enhanced. Reasons for conserving the natural capital include moral obligation and the supposed mutual interdependence of development and natural capital conservation.
- ii. Goodland (1991), presents very convincing and undeniable evidence to conclude that the limits of growth in which the earth function as a source of inputs and sink for waste products have been reached and that options for ensuring sustainability in future are running out. Evidence for this conclusion includes: (a) over 80 per cent of the earth's net primary productivity is already being consumed to meet humans' food and other needs while population increasing, (b) global warming owing to increasing levels of carbon dioxide is already producing adverse climatic effects that threaten humans and various ecosystems, (c) ozone depletion is taking place owing to increasing levels of greenhouse gases (methane, CFCs and nitrous oxide), which are eating up the protective ozone layer with adverse consequences for humans and other living things, (d) land degradation and loss of soil fertility and productivity make it difficult to produce enough food, feed and fibre for rising populations of humans and animals, and (e) biodiversity has been lost with increasing deforestation, especially in species rich tropical ecosystems, with loss of species estimated at 500 per annum.
 - iii. Daly (1991), notes that the human economy has passed from an era in which human-made was the limiting factor to an economic development era in which increasingly scarce natural capital has become the limiting factor recommends that priority should be given to "qualitative development" based on more efficient

use of energy and natural resources an increase in end-use efficiency of the product through recycling, and the reduction of waste and pollutants.

- iv. Tinbergen and Huetting (1991), as well as Serafy (1991) consider equity issues, sustainability constraints under low rates of economic growth, uneven/varying population growth rates and the effects of North-South trade on the environment and development in the South. Doubts are raised about the soundness of some WCED (1987) equity considerations in economic growth and the strategies aimed at increasing economic growth and development in developing countries going *pari passu* with lower non-increasing growth rates in developed countries in order to ensure that developing countries achieve higher per capita income and alleviation of poverty in order to narrow the gap between the rich and the poor countries. The fallacy in this is that, because growth in developed countries has naturally acquired momentum, it is very likely that rate will continue to rise rather than decrease. Moreover, the intended objective can be achieved only if the developed countries transfer the resources needed to redress negative effects of richer countries arrested growth to the developing countries, thereby reducing poverty.

It is observed that the time-horizon of development should be taken into account, for some obvious reasons. First, sustainable development usually aims at a long-term time-frame of several generations, but politicians and policy makers plan on short-term time-frames of four to five years. Secondly, sustainable development that involves many generations or centuries cannot go on indefinitely where both population and per capita use of the earth's finite resources grow significantly. Even where population and

economic activities remain static, the accumulation of pollutants and waste will continue to increase with the growth of entropy beyond nature's capacity for self-repair.

The principle of the free market mechanism as a way of creating certain optimal conditions has not often yielded the expected results in sustainable development because the blessings of free trade have associated with (a) production pollution arising from the production process, (b) consumption pollution, which is the indirect effect of pollution produced by consumers in enjoying goods and services, and (c) negative impacts on the environment of the production process. Sustainable development cannot be achieved in a world where developed countries with higher technical skills for producing a wide range of technology selfishly focus on consumer goods and services instead of focusing on more basic improvements in using the world's resources to the benefit of the poor. Furthermore, sustainability cannot be achieved and inequalities eliminated through the trickle-down process from the developed countries unless the increasing ability to use resources more efficiently and to reduce waste and pollution is used to assist less fortunate people who cannot provide the minimum level of basic needs.

Liberalization and an increase in North-South trade and aid cooperation have not significantly contributed to equity and sustainable development, especially when the poor developing countries are tempted to exhaust their valuable natural reserves at lower prices in order to feed the trend-setting and unsustainable consumption patterns of the North in return for consumer goods and machinery. Such trade involves the depletion of natural resources by the sale of non-renewable minerals and harvests from soils, forests, and oceans, and the soils being increasingly used as the dumping sites of undesirable waste. Related to this is the fact that aid to developing countries to develop the same

technologies that degrade the environment and cause the same pattern of polluting consumption as in the West cannot contribute to sustainable development.

Droste and Dogse (1991) observe that investments in education, science and technology contribute to human welfare and the decisions surrounding them are also often contributors to environmental problems. Examples include:

- Investments in short-term income-generating activities such as deforestation, intensive agriculture, and plantations without concomitant investments in soil conservation and protection measures.
- Spending more money on combating pollution or on remedial measures than would be needed for preventive measures.
- The use of subsidies, trade barriers and various production technologies (including biotechnology) in the developed countries to produce surpluses that undermine the production of farmers in developing countries, making it difficult for the latter to compete or even ensure access to the inputs needed.

Constanza (1991) maintains that to achieve global sustainability, it is necessary to switch from the concept of ecological and economic goals being in conflict to one of economic system being dependent on ecological life-support systems and also to incorporate it into our thinking and actions at a very basic level. In other words, human beings must realize that:

- (a) Humans are only part of the subsystem in both local and global ecosystems.
- (b) Sustainability is a relationship between dynamic human economic systems and larger but normally slower—changing ecological systems in which human life can continue indefinitely, human cultures can develop, but the effects of human activities must remain

within bounds, so as not to destroy the diversity, complexity, and function of the ecological life-support system.

It is necessary that the idea of economics being in conflict with ecology be replaced by one of the integration of conventional economics and conventional ecology into ecological economics. There is also a need to ensure continued adequate investment in natural capital and in finding ways of limiting physical growth so as to encourage development with an emphasis on qualitative improvement.

The above survey of the implications of sustainable development is necessary because it emphasizes that the problem is not mainly one of having a better definition of what sustainable development is. The main issue or critical factor is how to rehabilitate the natural resource base and repair the damage already done while not contributing to making things worse by continuing unsustainable living - locally, nationally, regionally, or globally. In this regard, it is also obvious that the greatest challenge is how to engender a transition that is steady, continuous and on an even keel in all sectors at individual, community, national, regional, and global levels.

The concept of Economic Development and Sustainable Development

Economic development implies activities or processes whose end products are general increase in production and wealth, which in turns, reflects in general improvement in the quality of living standard of the populace. Economic development is therefore, desirable process. However, various by-products of economic development such as urbanization and industrialization with attendant production of industrial wastes, noxious assess, refuse and other solid wastes, raw domestic sewage, crude oil spillage and pollution and

agricultural pollutants cause serious reduction in environmental quality. These also affect health well being of the people and hence productivity.

Sustainable development is a process in which the exploitation of resources, the direction of investment, the orientation of technological development and institutional changes are all in harmony and enhance both current and future potentials to meet human needs and aspiration. Sustainable development is an approach that combine the developmental needs and aspiration of the present without compromising the ability of the future, while also maintaining ecological integrity. The concept of sustainable development has been repeatedly emphasized since 1960s. This involves discussion of the relationships between people resource, environment and development. The theme of such discussion has been the need for the present generation to be able to account for the needs of future generation without depleting the present limited resources. The need for sustainable development has also been endorsed by the World Commission on Environment and development since 1987.

Sustainable development required that current practices should not diminish future possibility to maintain or improve living standard. It does not necessarily however, mean the preservation of current stock of natural nor does it place artificial limit on economic growth, provided such growth is both economically and environmentally sustainable. Economic system should however be pursued in such way as to maintain or improve the resources and environmental base so that future generations can live as well or better than we do.

The maintenance of sustainable development is by no means an easy task because of prevailing environmental degradation associated with such economic projects. There is

therefore for rational and careful planning in the implementation of development projects. Globally, the economy will need to be restructured and unless each national government takes the issue of sustainable future resources very seriously and a central concern in planning development projects, there will continue to be deterioration of the environment.

Development means different things to different people whichever the case, a developed society will include one in which real per capita income rises over time, where there is continuous improvement in knowledge and health as measured by indices such as literacy level and life expectancy. Also it will include human freedom. Consequently, a high income country with no democracy may not qualify as a developed nation.

SD can thus simply mean development that sustain over time and a priori condition is that next generation should not be worse off, thus leaving them with stock of capital assets that provide them with the capability to generate at least as much as is achieved by the present generation.

Capital stock refers to:

- (a) Man-made capital
- (b) Knowledge and skill capital (human capital)
- (c) Environmental capital or natural capital

Natural resources as comprising natural capital stock of the economy have potential to contribute to economic productivity and welfare. This is directly related to the services and quality of the assets over time.

It can be argued that it is being justified to run down any part of the capital stock as long as the benefit accrued to the overall capital. For example, deforestation may be justified

provided the proceeds from environmental degradation are invested in other forms of development. This is not a viable reason for deforestation especially on critical and sensitive terrain, irreversible loss of natural capital stock is not justified even when it results in capital formation elsewhere in the economy.

The cost-benefit rule cautions against running down environmental capital unless the benefit outweighs the cost. This cost-benefit rule in sustainability concept is called "WEAK SUSTAINABILITY". Weak sustainability proposes that it is acceptable to run down environmental capital if other forms of capital are built up instead. From sustainable development point of view, this argument is not feasible and it is not acceptable to run down environmental capital. Moreover, it is necessary to protect natural capital for the following reasons.

1. Uncertainty: The consequence of running down natural capital is not known due to ignorance of the workings of the complex ecosystem.
2. Irreversibility: Some of the consequences of running down natural capital such as extinction, global climatic change, depletion of ozone layer are not reversible.
3. Life Support: Some ecological assets serve life support functions and have no man-made substitutes.
4. Loss of Aversion: Many people feel a natural right to their existing natural endowment and cannot think of losing them.

Practice QUESTION: Discuss the concept of weak sustainability and its validity in natural resources management

POPULATION AND PRESSURE ON RESOURCE UTILIZATION

Estimates of world's population before 1650 AD were at best a vague reconstruction. Population estimate during this time was based mainly on calculation of individual locality culture. The picture of the world population before 1650 was that of a slow growth rate resulting from high infant mortality and low longevity. The advent of scientific medicine alters this trend. Durand (1967), moreover, suggested that the structure of agricultural improvement in the 16th and 17th centuries provided the potentials for considerable population expansion. In the same way, the improvement in nutrition in the 18th century was considered responsible for the decline in infectious diseases.

In 1987, the world population was estimated at 5 billions with a growth rate of 1.7 % per annum. This is projected to reach 6 billion at the end of the century. However, the world's population is unevenly distributed.

By the end of 19th century, the dichotomy in demographic processes between developed countries (DCs) and less developed countries (LDCs) was very apparent. While there is rapid rate of urbanization in DCs, birth control in LDC's are beginning to reduce fertility level. Growth rate in DCs have virtually stabilized.

Developed Countries: refers to industrialized countries characterized by a population that has realized a high standard of living, good health and long life expectancy.

Developing Countries: are countries that have started to industrialized but that still contain large segment of population that live under pre-industrialized conditions.

Less Developed Countries: are characterized by low level of industrialization, poor health care and low life expectancy.

Population growth rate is consistent with the magnitude of resource base, as a result, the trend in population growth is a reflection of the use of energy; hence, distinction between DCs and LDCs. While DCs have access to technology and consequently access to resources beyond those which are physically present in their territory and which are necessary to sustain their life. In the LDCs, emphasis is on the provision of necessities such as food, shelter and employment. Based on the distinction between the DCs and LDCs, in relation to resources availability and technological growth vis-à-vis population growth, five types of regional classification of population resource relationship can be identified.

1. Type A - The United State type
2. Type B - The European type
3. Type C - The Egyptian type
4. Type D - The Brazilian type
5. Type E - The Arctic desert type

The common denominator in all the groups is the role of technology — i.e. the degree of mechanical and electronic technology backed up by manpower. In addition to the role of technology as a creator of resources, it also has power to destroy resources if misapplied. Nevertheless, technology increases the chances of minimizing or averting economic and ecological disaster.

Type A: This constitutes technological source area, where research, invention and development are at a high level. This group is characterized by:

- a. Low to moderate sized population relative to other nations.

- b. High technology which enhances access by the people to resources posterity and enabling their purchase from other countries what they lack.

The high level of material wealth was at the expense of environmental damage. As a result, there is now a great awareness and high public demand for high quality of the environment. Examples of countries in this category are the USA, Canada, New Zealand, Australia, USSR and South Africa.

TYPE B: This is also a technological source area. The population is high both in absolute number and in density. The countries are smaller and the resource bases are less abundant, hence no room for trial-and-error as in type A category. Consequently, they are more conservative in resource use. They rely on international exchange to ensure material support and thus trading with the LDCs and between themselves e.g. European common market. Examples of countries in this category are the European countries, Japan and Israel.

TYPE C: This group comprises countries with large resource base but is deficient in technological base. They are characterized by low population hence no pressure on the resource except in urban areas. Improved technology will enhance their upgrading to type A category. Continued absence of technology will however worsen the situation. One of the hindrances to economic development is that the control of exploitation of their resource is by foreign interest which makes them depend on world prices which they do not have control over and may not be in their interest. Three sub-regions within this category are distinguished e.g. Nigeria, Egypt and Philippines.

TYPE D: This is the most unfortunate group. Members of the group are characterized by low resource base, deficiency of technology and high population pressure. There is no

capacity to deal with population-resource imbalance, hence deficiency in means of subsistence and employment. Small land territory may impinge or encroach on growing population hence erosion into marginal areas by the peasants, resulting in lack of basic nutrition and animal protein. Included in this category are Rwanda, Latin America, India, and South European countries like Turkey.

TYPE E: Countries in this group possess low resource base because of physical geographical constraints. The low population lives in subsistence economy or engages in developing their resources – mineral, oil.

Category	Resources	Population	Technology	Example of Countries
A	High	Moderate	High Base	USA, Canada, South African
B	Low	High	High Base	European Countries, Japan
C	High	Moderate	Low	Nigeria, Egypt, Philippines
D	Low	High	Low	Latin America, India
E	Low	Low	Low	Algeria, Niger

Table 2: Resources, Population and Technological relations among countries

MANAGEMENT OF NATURAL RESOURCES

Resources Management and Environmental Management

The basic objective of resource management is to optimize yield from a particular resource by exerting governmental control on the resource process. The control may result in regional development or realization of the maximum use of a potential resource. For example, the Kainji Lake Hydro-electric Project in which electricity is generated to many parts of the country and other neighbouring countries. In addition to electricity, the lake was to enhance the development of other resources such as fisheries, agriculture and Wildlife — at KLNP.

The essence of resource management should be to minimize the impact of economic development upon people and the ecosystem. For example, the screening of industrial area with tree planting or construction of sewage treatment scheme. The realization of

import of inter-relationship between biota and their surroundings leads to the concept of environmental management. Since the biological environment provides the resources, the resource process must therefore be rationally managed to ensure sustained productivity. Moreover, development of one resource should not be inimical or contradictory to the operation of others which share the same space and identical ecosystem. Environment should therefore be utilized in such a way as,

- i. To be useful as a provider of materials
- ii. To be beautiful as provider of recreation, wildlife and landscape.
- iii. To be life supporting as a provider of space, food and other biological systems.

The adoption of the concept of environmental management by many LDCs was until now more of lip-service'. With the present awareness of environmental quality, various governmental and non-governmental agencies are being established to combat and educate the populace on the need for good quality of the environment. Such agencies in Nigeria include FEPA, NEST, NARESCON, NCF.

The purpose of environmental management is to produce resource vis-à-vis maintenance of sanitive life supporting environment with the aim of

- (a) Reducing stress on the ecosystem from contamination and/or over-use.
- (b) Pursue short-term strategy flexible enough to ensure that resource processes which bring about irreversible environment are not developed

Natural Resource Management in Developed Countries

In principle, the aim of government of developed countries is to maximize the general good of the community. The approach of government of developed countries can also be visualized in terms of the type of economy practiced-market or planned economy.

In market or free economy, the government encourages individuals to invest money and time in the development of the economy. The government provides environment and engages in resource process which individuals cannot profitably develop such as nature conservation, countryside recreation, etc. In planned economy (socialism, communism) the government acts as sole entrepreneur and the profits are distributed over the entire population. In both economies, the aim of resource management is resource growth. However, more resource integration and even management is expected in planned economy.

In order to ensure the quality of the environment and because of the awareness of need for high quality of the environment by the populace, the government along with certain citizen group tends to initiate actions aimed at reducing the impact of resource development on the environment. Such activities are generally referred as 'conservation' such groups includes Friends of the Earth (FOE), the Green Peas, etc. Based on the same themes as the 'conservation' group, is the search for environmental quality and the effects of industrialization and transportation on the general landscape. The most important feature of resource management in the DCs is the awareness of the need to protect the environment.

Resource Management in Less Developed Countries (LDCs)

The purposes of resource development in LDCs include:

- i. The utilization of resources for regional and national purposes to produce (a) metabolic and cultural materials - foods, shelter, infrastructures and also to (b) provide jobs and create wealth used as capital for further development.
- ii. The development of bio-environmental resources for export to DCs e.g. oil, rubber, cocoa, two types of export resources can be identified.
 - (a) Those that are dispensable and subject to over production and deterioration, mainly agricultural products e.g. cocoa, coffee, cotton, etc.
The fate of the producer is determined by the importers.
 - (b) Resources which are needed by DCs for industrial purposes e.g. oil. The LDCs force price increase and nationalize plants with impunity.

Because of low technological advancement of the LCDs and the desire and hurry to own their destiny they seek assistance from the more advanced countries which in turn seize the opportunity to 'milk' their resources to such an extent that development of such countries favour the DCs rather than sponsor countries - LDCs. Some of the multi national companies in fact have annual economy much time higher than some of the LDCs.

The common mistake in an attempt to transform basically agrarian society to a more complex industrial economy is the non-appreciation of the fact that both traditional system and natural ecosystem take many years to stabilize (climax or equilibrium stage) to the present state of equilibrium. Sudden change may therefore have unpleasant consequences.

MANAGEMENT AND ADMINISTRATION OF NATURAL RESOURCES IN NIGERIA

Management is the basic, integrating process of organizing activities. The need for management arises because of the scarcity of resources used to satisfy human wants.

Management can be viewed as a fundamental, integrating process designed to achieve organized purposeful results. Management can hence be defined as the process by which managers create, direct, maintain and operate purposeful organization through co-ordinated cooperative human efforts.

Management can also be viewed as a process, discipline, as a people as a carrier. Management of natural resources can thus be described, as the process. by which natural resources are organized for the purpose of satisfying human wants.

Administration on the other hand, is designed to foster an orderly relationship (both personal, inter person and impersonal) in any organization. The administration will determine responsibilities that would lead to smooth running of the organization. While management is a process, administration can be described, as a means of achieving an orderly organization of the resources to meet human needs.

There are two approaches to the management and administration of natural resources in Nigeria.

- (a) Management of mineral or non-biological resources and
- (b) Management of biological resources.

The management of non-biological resources is by the Federal Government. Though the Federal Government does not legally own any land except at the FCT. The 1976 Land

Use Act vested ownership of land on the State Government: The federal government nevertheless, directs and co-ordinates exploitation of mineral resources on behalf of all the citizens of the country. All companies responsible for mining and exploitation activities must obtain permission from the Federal Government. Thus revenues accruing from them go to a central national purse. However, a certain percentage of this revenue is paid to the state in which the particular mineral is found, another percentages set aside as ecological fund, while the remaining revenue and other revenues from other sectors of the economy are shared between the Federal Government and all the state governments according to agreed Revenue Allocation Formula. Management of petroleum and gas is under the auspices of Federal Ministry of Petroleum Resources, while other mineral resources – tin, gold, etc. are administered b the Federal Ministry of Mines and Power now Ministry of Solid Minerals.

The management and administration of biological resources forestry, wildlife, fisheries, livestock, etc, are the responsibility of the respective departments in each State's Ministry of Agriculture and Natural Resources. There are identical departments in the Federal Ministry of Agriculture, thus:

Resources	State	Federal
Forestry and Wildlife	Forestry Department	Federal department of Forestry
Fisheries	Fisheries Department	Federal department of Fisheries
Livestock	Livestock department	Federal Livestock Department

For proper management, each resource is back up by policy specifying the objectives and ways of managing them for sustainable production.

Unlike mineral resources, where the federal ministries responsible for the management of each non-biological resources has absolute power, the duties of federal agents in the management of biological resources have been reduced to overseeing the respective state agents and liaise between them and the federal government. Most activities are therefore carried out by the state departments of these biological resources except for the disbursement of fund for specific projects through the respective federal counterparts. The Federal Ministry of Agriculture and Mineral Resources has no direct control over the biological resources. However, the objectives of each federal department compliment the counterpart states objectives.

For the purpose of this course, we shall briefly outline the policy objectives of Federal Department of Fisheries and Federal Department of forestry as case studies.

Objectives of Federal Department of Fisheries

The fisheries in Nigeria is under public ownership. The objectives include:

1. To increase domestic fish production through improved and modern fishing technology.
2. To introduce improved fish processing and preservation methods to local fishermen and other producers.
3. To establish better distribution and marketing techniques.
4. To provide employment, particularly to young school leavers and foreign exchange by exporting other fish products.
5. To protect the interest of local fishermen and ensure economic exploitation of the resources.

These objectives were to be met mainly by the establishment of national

Acceleration for food production in many states of the federation. This is in addition to the establishment of field offices in all the states of the federation.

Objectives of Federal Department of Forestry (FDF)

The FDF coordinates both forestry and wildlife activities through the establishment of field offices in all the states of the Federation. The State Forestry services manage the forest estate in trust for the community in which it is located. The essence of this is to ensure that the goods and services derived from the forests are properly managed and produced in perpetuity. It is supposed that the government is more equipped both in terms of manpower and material resources than individuals or the community to look after the forest.

The Federal Government policy on forest products and wildlife aims at achieving self-sufficiency in forest and wildlife products through the employment of sound forest management principles and techniques as well as mobilization of human and material resources. The objectives include:

1. Consolidation and expansion of the forest estate in Nigeria. At present less than 10% of the country's land is under reserved forest as against 25% recommended by Lugard (1919), of which only 2% of the land is under productive forest.
2. Forest conservation and protection of the environment.
3. Regeneration of the forest at a rate higher than exploitation.
4. Reduction of waste in the utilization of forest and forest products.
5. Protection of forest estate from forest fires, poachers, trespassers and unauthorized grazing.
6. Encouragement of private forestry.
7. Increasing employment opportunities in the forestry sub-sector.
8. Development of national parks, game reserves, and (wilderness) recreational facilities.
9. Development of non-wood forest resources which are significant to local economies and encouragement of agro-forestry practices.
10. Co-operating with other nations in forestry development.
11. Encouragement of alternative sources of energy other than wood and the development of more efficient methods of wood energy use.

Practice Question:

Distinguish between management and administration. Describe the system of N.R. management in Nigeria. Discuss the possibility of the attainment of the objectives of Federal Government on:

(a) Fisheries (b) Forestry and Wildlife resources in Nigeria.

ELEMENTS OF RESOURCE ECONOMICS

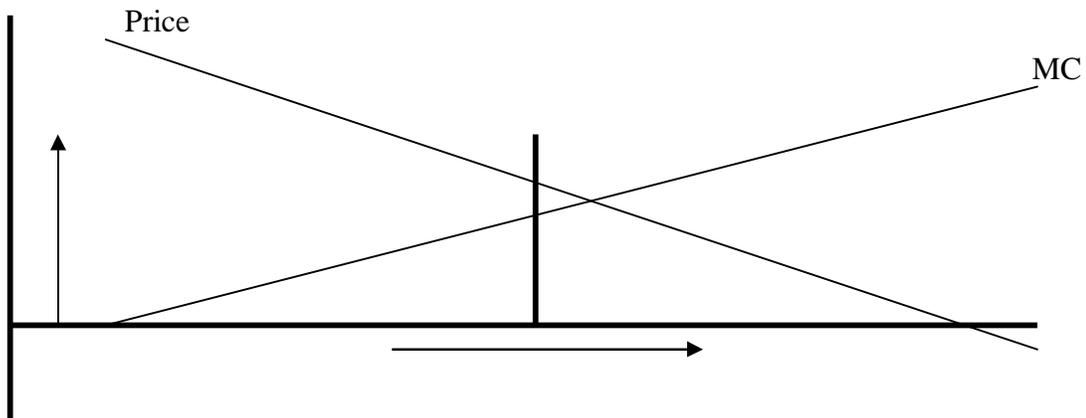
Resource economics can be described as the study of how we manage our resources to help satisfy human want. Resource economics centres on the question of resource management. It encompasses the resources itself and extends into its exploitation, conservation, distribution and consumption. Resources economics is the application of economics to natural resources and differs from conventional economics because of the nature of different resources. For example forest as a resource is different from other resources as a result of:

- i. Diversification of benefits from the forest
 - services
 - Goods - Timber
 - Non-Timber
- ii. Long gestation period
- iii. The wood represents both the interest and the capital.
- iv. Most of forest benefits are not directly quantifiable in monetary terms.
- v. The extent and location of forest products (inaccessible location of many forest products).

The peculiarities of forest as a resource in terms of organization, institutional and techniques are similar to those of other biological natural resources such as fisheries and wildlife. With non-renewable resources however, conventional economic principles are probably more directly applicable.

Optimum Resources Allocation

The decision making processes of resource allocation usually takes into account all the benefit and cost associated with the use of a particular resource. It would be rational to employ a marginal unit of resource in the production so long as the benefits derived from it exceed associated cost.



CONSERVATION OF NATURAL RESOURCES

Since time immemorial the advancement of mankind both materially and culturally has been at the expense of natural resources. These resources have been so exploited that many of them are now extinct and a very many are endemic. The consequence is that not only will the present generation has shortage of them, the future generation will completely be deprived of them if drastic measures are not taken to protect them.

There is growing concern about the disappearance of many species and varieties of plants and animals which are of potential or current use as a result of human activities. Plants supply us with food, drug, building materials, fuel, fibres, ornamental, etc. Animals supply us with necessary protein supplement for body building and development.

Scope of Conservation

Conservation is defined as management for human use of natural resource so that they may yield the greatest sustainable benefit to the present generation, while maintaining their potential to meet the needs and aspiration of future generation.

Conservation may be viewed at its simplest form as the preservation of genetic resources for rational use. This does not mean that the resources should not be developed, utilized or exploited in whatever manner that best serve human need. Though there is need for saving the resources to be combined with other operations needed for their effective overall management, conservation should not be thought at a preservation of the status quo. Wise utilization and conservation of resource should be perceived within the context of overall development.

Concern for the conservation of genetic resources in general and of forest genetic resources in particular, has been building up in the past 25 years or so. Conservation of genetic resources is one of the issues FAO has been addressing itself. Thus FAO panel on forest genetic resources was established in 1968. UNESCO had also considered the opportunities of combining conservation of genetic resources with conservation of natural areas which contain them; thus the establishment of United Nations Environment Programme (UNEP).

The objective of conservation according to IUCN (1980) are:

- a) To maintain essential ecological processes and life supporting systems.
- (b) To preserve genetic diversity.
- (c) To ensure the sustainable utilization of species and ecosystems.

There are two methods of conservation of genetic resource: In-situ and Ex-situ

In-situ means conserving the genetic resources where the resources or its immediate parents were growing or living. In-situ conservation thus implies protection of the resource in its vicinity e.g. nature reserve, forest reserve, game and national park.

Ex-situ on the other hand, means that the resource is protected at a place outside the distribution of the parent population e.g. gene bank, botanical garden, zoological garden, seed bank.

In-situ conservation involves conserving the entire genetic population. It is more difficult and expensive than ex-situ conservation but it ensures the protection of the wild genetic constitution without modification by different environment (phenotypic influence)

Relationship between Conservation and Economic Development

Conservation and economic development are ideally directed towards rational use of the earth's resources to achieve the highest quality of living for mankind. While economic development is primarily concerned with quantitative increases in production aimed at enhancing the material well-being of the people. Conservation is concerned with sustained quantitative yield, also with emphasis on management of more qualitative aspects of human environment. Conservation can ensure that the environment resulting from development is one that will be satisfactory to the people. Both conservation and economic development are important in considering the physical and biological rules under which earth must operate.

Consideration of ecological principles enable development and conservation to achieve the desired goals without undue environmental consequences. Lack of consideration for ecological implication of projects on the environment can doom development efforts resulting in economic waste and impairment of healthy life conditions. Harmonization of interests on development and conservation minimizes conflicts between the two. There is need for economic developers to have good regards for environmental values which are required for conservation for scientific, recreation and other purposes. On the other hand, conservationists need to recognize the political, social and economic reasons for development drive and be ready to provide alternative course of action or reach reasonable compromise whenever there is conflict of interest.

Conservation Strategy for Renewable Natural Resources

For renewable resources, especially vegetation and forage resource, improvement of rural environment is a major consideration accent. Ecologically sound rural development lessens the pressure on natural vegetation. Adequate incentive should therefore be provided to facilitate private and community participation in forest and grazing and land regeneration programmes especially the use of alternative fuel to wood. This will halt and reverse the disappearance of over 62 endangered tree species in Nigeria. It has been shown that the consumption pattern of fuel wood and charcoal is inversely proportional to urbanization.

In the northern part of the country, the anti-desertification programme is meant to conserve agricultural land and prevent the loss of many valuable tree species which are of industrial and domestic importance such as *Acacia albida*, *A. polyacantha*, *Securidaca longipedunculata*, *Ziziphus Mauritania*. Fibres are obtainable from *Ceiba pentandra*, *Calotropis procera* and *Adanasonia digitata*. Also soup condiment (iru) is obtained from the seed of Park of *Parkia biglobosa*.

In the ecological disaster areas where the soil had been devastated by gully erosion, a strategy is a co-ordination of development programme — tree planting at the erosion source i.e. the hill, and engineering works such as drainage channeling of immediate affected areas.

Wild animals and fisheries thrive in-situ and ex-situ best in suitable habitat, pollution-free water bodies and relatively undisturbed forest and woodland. A common strategy is the establishment of game reserve and national parks to protect the wild animals. Wild plants are protected in nature reserve and sanctuary and botanical garden and arboratum. Seeds

of plant species are kept in seed bank. Meristem culture and other forms of artificial propagation are employed to ensure continuity of plant species especially “seedless” plants.

Conservation Strategy of Mineral Resources

1. **Reduction of our Present Consumption:** Obviously, resource conservation is of prime importance. The most fundamental approach to the conservation of mineral resources has been suggested as the reduction of our present consumption of them (since they are not renewable). This can be done either voluntary or through government imposed regulations to provide time for technology and energy sources required for their exploration and extraction.
2. **Non-Discriminatory harvesting:** Another means of conserving non renewable resources is the non-discriminatory harvesting of the resource in a particular site. Formerly, in mining expedition. low grade minerals were abandoned because extraction of low grade deposits was uneconomical (e.g gold at Ilesha). As a result of scarcity of mineral deposits, miners are encouraged to remove both high and low grade deposits.
3. **Substitution of renewable for essentially non-renewable mineral resources:** is another conservation strategy. For example, wood in the construction instead of metals. The reverse is also true for the case of substitution of non-renewable for renewable not only to conserve the renewable resource, but also to reduce environmental degradation. For example using kerosene or gas instead of firewood to conserve forest resources.

4. **Recycling:** is an important strategy of mineral conservation. Although metal (for example) are not destroyed in manufacturing processes, they are disposed in and dispersed over earth surface. Recycling initially requires recovery and collection of dispersed metals and subsequently re-melted for further use. Worn out car engines are also remoulded to new ones. In the same way, used chemicals that would have been thrown away are recycled for further re-use.

RANGE MANAGEMENT

The importance of effective development of grazing land for animal production cannot be over-emphasized. This is in recognition of the contribution of domestic and wild animals to nutritional quality of human diet and for protein supplies. About 60% of the world agricultural land is said to unsuitable for arable farming except for grazing. These lands need to be properly developed as rangeland. This is more so that domestic animals can feed on variety of plant species and forage.

Ecological Problems Associated with Grazing

The damaging effects of grazing to the environment are second to none. The conversion of productive land to rangeland is as old as domestication of first animal. Much areas had been damaged, productivity impaired as a result of uncontrolled grazing. Ecological problems of grazing include:

- (a) Destruction of arable crops and other vegetation.
- (b) Compaction of soil and subsequent degradation thus predisposing the soil to erosion and other ecological hazards.

(c) Loss of genetic materials.

(d) Setting vegetation ablaze by graze-men to induce growth of new shoot resulting in destruction of vegetation, properties and cause other environmental problems.

Ecological Peculiarities of Rangeland

In Nigeria, like any other part of the world, rangelands are mainly located in the savannah or woodland vegetation. These are thus found in Nigeria in derived savannah, Guinea savannah (northern and southern Guinea savannah) and Sudan savannah. Rangeland seldomly occur in semi-desert or desert except near lakes and oasis. As a result of the peculiarities of these locations, temperature is extremely high, solar radiation high rainfall erratic and less predictable. Dry cycles are very severe and evapo-transpiration from vegetation soon depletes the soil moisture which is further worsen by strong wind.

Rangeland Vegetation

Rangeland vegetation varies from dominant of woody plants to complete dominance of grasses. The former in the humid derived savannah and the latter in stepped type vegetation. The woody plants in derived savannah are less fire resistant than the more northerly Guinea and Sudan savannah. However, the trees in the derived savannah are still more fire resistant than those in the rainforest.

The Nigeria savannah vegetation can be distinguished into derived savannah, Guinea (southern and northern), Sudan and Sahel — savannah based on increasing intensity of grasses in relation to trees.

The Guinea savannah is classified as a mosaic of lowland rainforest and secondary woodland (White, 1983). The Southern Guinea savannah is immediately beyond the derived savannah. The typical tree species include *Daniella oliverii*, *Lophira lanceolata*, *Pterocarpus erinaceus*, *Azelia Africana* and *Khaya senegalensis*. Grasses include *Andropogon spp*, *Cenium spp* and *Hyparrhonia spp* immediately beyond this is the northern Guinea savanna. The common woody species include: *Isberlina doka*, *Albizia zygia*, *Anthocleista vogelii*, *Erythrophleum suaveolens*, *Annona senegalensis*, *Vitellaria Paradoxa* and *Parkia biglobosa*. The boundary between the northern and southern Guinea savannas is not distinct due to the continuity of the soil parent material (basement complex (Lowe, 1990). Common grasses include *Schiachryium spp*, *Loudetia spp.*, *Cenium spp.* and *Andropogon spp.*

North of the limit of the Guinea savannah is the Sudan savannah. It extends to the most north—westerly limit of the country and is associated with desert derived sands and black cracking soils (vertisols). The mean annual rainfall is between 510mm and 1140mm. The trees are usually thorny especially, the Acacia species. The common tree species being *A. nilotica*, *A. senegal*, *Afromosa laxiflora* and *Isberlina doka*. The boundary between the Guinea and Sudan savannah is distinct probably due to difference in parent materials. Grasses include *Aristida spp.*, *Brachiaria spp.*, *Panicum spp.*, *Chloris spp.* and *Digitaria spp.*

At the north-eastern limit of the country is the Sahel savannah. It is the driest woodland vegetation in Nigeria. It is characterized by low flat—crown trees of *Acacia laeta*, *A. tortilis*, *Commiphora quadricinta*, *Cordia rothii* and *Salvadora persia*.

Fire as a Range Management Tool

Fire is one of the important factors influencing the vegetation of grassland and savannah. Fire may be caused by lightning, controlled human action and incendiarism. Fire can either be a good servant or a bad master when it is out of control. The effects of fire depend among other things on the extent, intensity and time of the day/year.

Fire as a management tool is used to open up rangeland, remove shrubs and promote the growth of new grasses which are more palatable, nutritious and hence more attractive to grazing animals. Fire can also be used to eradicate certain pest attack for example the sleeping sickness flies.

The adverse effects of fires may include destruction of the rangeland, encouragement of invasion of certain plant species such as *Chromolaena odorata*. Fire may also disrupt the animal life especially in game reserve.

In spite of management importance of fire in range land, it should be used discriminately and with caution. This is important, if it is realized that burning cannot repair grazing damage, and as grazing pressure increases, fire as management tool decreases.

Successional Stages of Rangeland Vegetation

Climax grasslands are dominated by perennial grasses. These grow as tussocks and are in compact clumps or grasses with rhizomes or stolon forming continuous cover over the ground. Under grazing pressure, least resistant species will disappear. Virtually, all palatable species will disappear leaving unpalatable ones.

Under range management, grasses are classified as either:

1. Decreasers: There are palatable species that cannot tolerate grazing pressure.
 2. Increasers: These are part of climax species which are able to withstand the grazing pressure or are less favoured by grazing animals. However, under serious grazing condition, most of the increasers are also grazed and the ground occupied by invaders.
 3. Invaders: these are weedy species that are normally restricted to heavily disturbed areas when grass is in good condition but everywhere when grazing is excessive.
- A good rangeland should comprise predominantly of the decreaseers and increasers. There may nevertheless be need for “Seeding” with decreaseers to improve the productivity of rangeland.