LECTURE

SOS 514

LAND-USE MANAGEMENT

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Definitions

Land

- The part of the earth that is not covered by water
- An area of the earth's surface, including all elements of the physical and biological environment that influence land use. It refers not only to soil, but also landforms, climate, hydrology, vegetation and fauna, together with land improvements such as terraces and drainage works.
- Land can also be defined in relation to ownership, demarcation, or use as any portion, large or small, of the surface of the earth, considered by itself, or as belonging to an individual or a people, as a country, estate, farm, or tract.; or in respect to its nature or quality; soil; as, wet land; good or bad land.

Land use

- The management of land to meet specified socio-economic objectives. Land use is described by the purposes for which the land is used, and the types and sequences of development, conservation and environmental management activities carried out upon the land.
- Tin order words, it refers to the purpose to which land is committed, including the production of goods (such as crops, timber and manufactures) and services (such as defence, recreation, biodiversity and natural resources protection). Some land uses, such as cropping, have a characteristic land cover pattern.

Land management practice

- This refers to the means by which the land management objective is achieved - the 'how' of land use (For example cultivation practices such as minimum tillage or direct drilling).
- Some land management practices, such as waste disposal, tillage and rotation systems, may be discriminated by characteristic land cover patterns.

Tenure

- The form of an interest in land. Some forms of tenure (such as pastoral or mineral leases or nature conservation reserves) relate directly to land use and land management.
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Land capability and suitability

- Land capability assesses the limitations to land use imposed by land characteristics and specifies management options. Land suitability (part of the process of land evaluation) is the fitness of a given type of land for a specified kind of land use.

Land resources

- Land resources are the resources of climate, water, soils, forests, pastures and wildlife, on which agriculture, forestry and other forms of rural land use depend.

Land degradation - the reduction or loss of the biological or economic productivity from rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands.

Land degradation usually results from unsustainable land use. It destroys land resources

Components of land:

Soil

- The interface between the atmosphere and the lithosphere, and in interface with the hydrosphere. The soil derive its components from these spheres and support the growth of many plants and animals
- Soil is a complex mixture of eroded rock, mineral nutrients, decaying organic material, water, air and millions of microscopic organisms involved in the process of rotting and breaking down of dead organic material and re-incorporating their nutrients into the soil

Global context of land use

Humans make use of the land they inhabit to a degree unmatched by any other species. Land represents about 29 percent of the earth's surface. The uses to which this land is put (land-use morphology) vary considerably from place to place.

For example in the US, land is more or less equally divided among forest, pasture, crops, and built-up areas. On the other hand, 75 percent of the land in the Democratic Republic of the Congo (DRC) is forested, and only about 10 percent is devoted to crops and pasture.

- Useable land is an especially precious commodity in some countries due to constraints imposed by geography, population density, climate, and other factors. For example, in the Netherlands, land reclamation from the sea is part of efforts to increase the amount of land available for economic use.

- Also in Japan, where most of the population is crowded onto the narrow coastal plains that lie between the mountainous interior and the sea, engineers create additional land by filling bays and harbours.
- The land area available for human use are becoming more threatened to permanently reduce as a result of increasing natural disasters such as flood, earthquake, tsunamis combined with slowly rising sea levels.
- For example, devastating floods are constitute regular scenario in Bangladesh as a result of extensive deforestation in the mountains upstream, torrential monsoon rainfall, and occasional tidal waves in the Bay of Bengal.
- In most countries, increasing pressure to use land for economic development is leading to conflict.
- Farmland, wetlands or other land close to cities may be sought by developers to convert into suburbs, motorways, or shopping centres.
- Conservationists may resist efforts to replace natural forests with tree plantations, ranches, or farms.
- Developing countries are particularly often faced with a dilemma. Their need for money leads them to liquidate their forests and modify their savannas to obtain cash crops for export, yet they must conserve these same ecosystems to guarantee resources for the future.

Land Use Planning:

- The limited supply of land and the increasing demand for land use for alternative uses calls seriously for land use planning
- Among the pressures on the use of land by man the need for housing, the importance of fertile land to grow food, land for industry, land for recreation such as parks, sportsfields and nature and game reserves, and various other land uses.
- In order to balance the different needs and priorities, land use planning must be undertaken at all levels
- The key to good land use planning is communication between the different land users to achieve a balance of land use and zoning that will satisfy as many people as possible.

Land use for food production

- Food production involves the use fertilisers, pesticides, genetically developed species, crop rotation and machinery all of which tend to have effects on the land environment. Care must be taken to ensure that intensive farming methods do not affect the environment negatively.
- For example, if a farmer puts too much fertiliser onto his land, it may be washed into rivers and streams where it may cause pollution which may reduce the quality of water required for other purposes.
- It has been estimated that about 11 percent of the earth's total available land area is occupied by farmlands.
- Land use for agricultural purposes varies from place to place and is affected by the climate, culture, population pressure, and soil quality.
- The amount of land given over to farming however varies greatly from country to country.
- For example, it is as high as 77 percent in Barbados, and 60 percent in Denmark, whereas it is as low as 0.2 percent of the total land area in Oman.
- Land use for agricultural purposes is lowest in the arid countries of Southwest Asia.

What percentage of land in Nigeria is used for food production?

- Nigeria is endowed with vast land resources
- Total land area of about 923,768 km2, about 9% yet unused, 35% devoted to arable and permanent pastures, and about 31% with potential for agricultural use.
- The pattern of land use for farming tends to vary with the distance from large centres of population, a pattern described by the German economist Johann Heinrich von Thünen in 1826. He noted that farms close to cities, where land is most valuable, tend to occupy comparatively small plots and raise intensive crops —those that perish quickly, command a high market price, and are costly to transport. With increasing distance from the centre, the farms become larger and the crops, such as wheat, corn, and other grains, as well as livestock, are more extensive. Although improvements in transportation and refrigeration have permitted departures from von Thünen's model of rural land use, it is still considered to underpin patterns of farming today

Soil and land use planning

- The soil is a major land resource especially for food production. A knowledge of the soil is important for effective land use planning.
- Soil Surveys provide extensive land use planning information such as limitations for certain uses
- Modern soil survey for land use planning involves the use of advanced techniques that make use of satellite, GIS etc.
- Soil survey helps in soil classification which may be on its capability, or suitability for a proposed use
- For example, land that is endowed with fertile soil is good for crop production and should not be used for industrial estate, commercial centre, or for recreation.

Spatial distribution and land use in Nigeria

- Nigeria is endowed with vast land resources
- Total land area of about 923,768 km^2, about 9% yet unused, 35% devoted to arable and permanent pastures, and about 31% with potential for agricultural use. Nigeria displays physiographic regions of varying relief, nature and spatial distribution. These attributes also correspond to the occurrence of the three rock types from which the parent materials of the soils were derived – igneous and metamorphic (the basement complex), and the sedimentary rocks. Nigeria is endowed with both uplands and lowland
- The Niger-Benue drainage system divides the uplands into three: the north-central plateau; the eastern and north-eastern highlands; and the western highlands.
- The lowlands mainly developed along the Niger-Benue trough, the Sokoto plains, the Chad basin, and the depositional area of Niger Delta along with the coastal regions.
- The use of land in Nigeria includes: settlement establishment; agricultural activities such as arable and permanent crops, fishing, forest establishment, cattle rearing; mining activities; games and commercial activities.
- Factors affecting land use in Nigeria include: climatic conditions; socio-economic development, land tenure system, among others.

Planning rural land use and management

Agricultural purposes constitute the major land-use in the rural areas. There are two parts of land-use planning with regards to rural areas. – physical and socio-economic. Physical planning has to do with spatial, environmental and infrastructural aspects.

Spatial planning involves identification of its location for reference purposes, and gives context to the plan. Spatial factors add dimensions and magnitude to the area and strengthens the contextual reference to it.

Environmental planning aspect takes into consideration ecologically related issues that are unique to the local community. These are issues that have to do with the norms of land-use in the local community.

Climatic conditions and other land-use practices in to agricultural practices determine the presence of such environmental problems as deforestation, and associated problems as erosion and land degradation.

Infrastructural aspect of planning focus on basic facilities that are essential for life support in a community – housing, transportation, utility such as water for agricultural cultivation and domestic use, electricity, sanitary waste disposal, and communication facilities

URBAN WASTE MANAGEMENT

Waste management is an essential aspect of urban land-use and management especially as waste contribute majorly to the problems associated with improper land-use approach.

Definition of Waste

- **Waste** refers to unwanted or unusable. Other terms used for waste materials include rubbish, trash, refuse, garbage, or junk. When waste has been disposed of improperly or carelessly disposed of in plain sight, it is called litter. Waste is said to be dumped if it has been deliberately left somewhere to avoid the management or disposal cost

Classification of wastes

Wastes can be categorized on the basis of their

- *physical nature* (solid waste, semi-solid, liquid, gaseous),
- *chemical nature* (**organic wastes**- technically, waste containing carbon, including paper, plastics, wood, food wastes, and yard wastes. In practice -material that is more directly derived from plant or animal sources, and which can generally be decomposed)

Inorganic waste - composed of material other than plant or animal matter, such as sand, dust, glass, and many synthetics)

- **sources** (domestic, municipal, industrial, clinical, electronic, institutional waste, construction and demolition, commercial), properties (biodegradable, radioactive, hazardous)

Key Facts on Waste Issues

- Only between 25 and 55 per cent of all waste generated in large cities is collected by municipal authorities.
- more than five million people die each year from diseases related to inadequate waste disposal systems.
- solid waste disposal was among their biggest environmental concerns.
- More than half of the world's municipal waste is generated in developed countries.
- Industrialized countries generate more than 90 per cent of the world's annual total toxic and hazardous waste, mostly from the chemical and petrochemical industries.
- There are more than 80,000 tons of irradiated fuel and hundreds of thousands of tons of other radioactive waste accumulated so far from the commercial generation of electricity from nuclear power.
- Irradiated fuel can take hundreds of thousands of years to decay into a harmless substance.

Waste disposal methods

OCEAN DUMPING

- **Advantages:** convenient
- inexpensive
- source of nutrients, shelter and breeding
- **Disadvantages:**
- ocean overburdened
- distruction of food sources
- killing of plankton
- desalination

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SANITARY LANDFILL

Advantages:

- volume can increase with little addition of people/equipment
- filled land can be reused for other community purposes

Disadvantages:

- completed landfill areas can settle and requires maintenance
- requires proper planning, design, and operation

INCINERATION

Advantages:

- requires minimum land
- can be operated in any weather
- produces stable odor-free residue
- refuse volume is reduced by half

Disadvantages:

- expensive to build and operate
- high energy requirement
- requires skilled personnel and continuous maintenance unsightly - smell, waste, vermin

OPEN DUMPING

Advantages:

- inexpensive

Disadvantages:

- health-hazard - insects, rodents etc.
- damage due to air pollution
- ground water and run-off pollution

RECYCLING

Advantages:

- key to providing a liviable environment for the future

Disadvantages:

- expensive
- some wastes cannot be recycled
- technological push needed
- separation of useful material from waste difficult

Waste minimization

Waste minimization is a methodology used to achieve waste reduction, primarily through reduction at source, but also including recycling and re-use of materials.

Some of the main benefits include:

- improved bottom line through improved process efficiency
- reduced burden on the environment, with improved public image and compliance with legislation

LANDSCAPE DEFINITION

What is a landscape

A heterogeneous land area composed of a cluster of interacting components that is repeated in a similar format throughout. The emphases lie on

- spatial arrangement
- interaction among diverse landscape components
- resulting landscape processes

A landscape is distinguished by its

- component units (e.g. the pattern of farms, cultivation, vegetation, hills, valley etc)
- Spatial arrangement of those components

Characteristics of a landscape

One landscape can be differentiated from another based on the component units, and how they are arranged

Five characteristics are usually repeated across a landscape

- a cluster of ecosystem types
- the flows of interaction among the ecosystems of the cluster
- the geomorphology and climate

- the set of disturbance regime
- the relative abundance of ecosystems within a cluster

Environmental Impact Assessment (EIA)

Environmental impact refers to changes in environmental quality due to external disturbance to a system. It includes beneficial and adverse, primary and secondary, cumulative, synergistic, short, medium and long-term, reversible and irreversible. Described in terms of magnitude (of effect), direction (of change) and probability (of occurrence), with or without mitigation.

Environmental Impact Assessment can be defined as:
The process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made

EIA is a process that produces a research report which examines the environmental impact (positive and negative) of a project or development on a particular area.

It looks at different alternatives to a project to assist the decision makers in deciding which type of project will best suit an area or particular environment while having the least negative environmental impact. With regards to land-use management, EIA helps in making decision on what is the best use for a piece of land with least negative impact on the quality of the land resources. It is a tool for evaluation of problem sites

The EIA is a **planning tool** and can only provide guidance to decision makers such as politicians. It will present a set of alternatives indicating the benefits and drawbacks of each alternative. This will then assist the decision maker in deciding whether the project may go ahead and in what form and under which conditions it should go ahead.

EIA can be carried out at micro and macro levels.

EIA is an important tool in land-use planning, making decision on alternative uses in order to minimize compromise of environmental integrity, and in making decision on land-use management to achieve sustainability.

Geographic information system

Geographic Information System (GIS) is an information storage system of huge spatially referenced databases. Nowadays, soil information can be collected in digital form or converted from analogue to digital form, and stored in the GIS. The GIS databases with their layer of

information about soil properties and on soil environment, can be used to create digital soil maps.
GIS is instrumental in delineation of different land-use, land-use suitability mapping and modeling.
One of the most useful applications of GIS for planning and management is the land-use suitability mapping and analysis.
Land-use suitability analysis aims at identifying the most appropriate spatial pattern for future land uses according to specify requirements, preferences, or predictors of some activity. GIS could be used in land-use suitability analysis with regards to land suitability/habitant for animal and plant species, geological favorability, suitability of land for agricultural activities, landscape evaluation and planning, environmental impact assessment, selecting the best site for the public and private sector facilities, and regional planning.

Remote Sensing
Remote sensing relies on detecting differences in the reflected or emitted radiation from different areas on the land surface over a range of wavelengths. It can be carried out from several platforms but mainly aircraft and spacecraft (Satellites) and the data are recorded as photographs or in digital form. When data are recorded in photographic form, they have to be transformed to digital data to enable computer processing. Data from remote sensing constitute input for GIS which can be synthesized with other data such as spatial data (roads, rivers, buildings, boundaries), and attribute data that describes the properties of a spartial feature in the GIS. Such attribute data for soil may be pH, texture, soil depth etc. up to predominant predetermined soil series in a defined area.
Remote sensing provides information for GIS use. Such data include those that are difficult to obtain through conventional means.

Geostatistics
Geostatistics is a subset of statistics specialized in analysis and interpretation of geographically referenced data. In other words, geostatistics comprises statistical techniques that are adjusted to spatial data. Typical questions of interest to a geostatistician are: How does a variable vary in space? What controls its variation in space? Where to locate samples to describe its spatial variability? How many samples are needed to represent its spatial variability? What is a value of a variable at some new location? What is the uncertainty of the estimate? In the most pragmatic context, geostatistics is an analytical tool for statistical analysis of sampled field data. Today, geostatistics is not only used to analyse point data but also increasingly in combination with various GIS layers: e.g. to explore spatial variation in remote sensing data, to quantify noise in the images and for their filtering (e.g. filling of the voids/missing pixels), to improve generation of DEMs and for their simulations, to optimize spatial sampling, selection of spatial resolution for image data and selection of support size for ground data.
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Soil science is one of the major basis in life sciences for the development of Geostatistics though it has its application in other disciplines. It also have some overlap with GIS and spatial statistics in general.