

NATURAL RESOURCE CONSERVATION AND MANAGEMENT POLICIES

Objectives

- a) Differentiate between management and conservation of resources
- b) Identify property management regimes
- c) Explain the threats to and conservation measures of selected natural resources

Management and Conservation

Natural resource management refers to 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 ([stewardship](#)).

Natural resource management deals with managing the way in which people and natural [landscapes](#) interact. It brings together land use planning, water management, [biodiversity conservation](#), and the future sustainability of industries like [agriculture](#), [mining](#), [tourism](#), [fisheries](#) and [forestry](#). It recognizes that people and their livelihoods rely on the health and productivity of our landscapes, and their actions as stewards of the land play a critical role in maintaining this health and productivity.

Natural resource management is also congruent with the concept of [sustainable development](#), a scientific principle that forms a basis for [sustainable](#) global land management and [environmental governance](#) to conserve and preserve natural resources.

Natural resource management specifically focuses on a scientific and technical understanding of resources and [ecology](#) and the life-supporting capacity of those resources. [Environmental management](#) is also similar to natural resource management. In academic contexts, the [sociology of natural resources](#) is closely related to, but distinct from, natural resource management.

Conservation is an effort to maintain and use natural resources wisely in an attempt to ensure that those resources will be available for future generations.

- Conservation is defined as “the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations”.
- Conservation is the protection, preservation, management, or restoration of wildlife and natural resources such as forests and water.
- Conservation is an ethic of resource use, allocation, and protection. Its primary focus is upon maintaining the health of the natural world: its, fisheries, habitats, and biological diversity etc.
- Conservation is the sustainable use of resources and encompasses protection as well as exploitation

Conservation can broadly be divided into two types:

In-situ: Conservation of habitats, species and ecosystems where they naturally occur. The natural processes and interaction and conserved as well as the elements of biodiversity.

Ex-situ: The conservation of elements of biodiversity out of the context of their natural habitats. Zoos, botanical gardens, museums and seed/gene banks are all example of ex-situ conservation. For threatened and endangered species

In-situ conservation is not always possible as habitats may have been degraded and there may be competition for land which means species need to be removed from the area to save them.

Preservation is a component or part of conservation in which natural systems are left alone without human disturbance or manipulation. Preservationists (people who believe in preservation) feel natural resources should be protected, unspoiled, and untouched by humans. The goal of preservation is often maintaining the integrity of the ecosystem as exemplified by nature preserves or wilderness areas. Preservation – is an aspect of conservation, meaning to keep something without altering or changing it.

Property regimes

Property rights

Property rights are part of formal institutions that are important in managing natural resources. Property rights can be defined as a bundle of entitlements defining owner’s rights, privileges, and

limitations for the use of a resource. A structure of property rights will provide the necessary incentives to resource owners/users (hence sustainable management of the same) if it has the following four main characteristics:

Universality: All resources should be owned or ownable by someone (except resources so plentiful that everyone can consume without reducing availability to others).

Exclusivity: All benefits and costs accrued as a result of owning and using the resources should accrue to the owner, and only to the owner, either directly or indirectly by sale to others.

Transferability: All property rights should be transferable from one owner to another in a voluntary exchange.

Enforceability: Property rights should be secure from involuntary seizure or encroachment by others.

Depending on how property rights are assigned and specified, we have different management approaches on natural resource:

Private property system: are found where property rights are assigned to individuals and utility is the primary incentive for cooperation. The rights and limitations for use of a resource should ideally be immune from government interference. Private ownership of land guarantees security of tenure and is likely to result in the adoption of appropriate and efficient management strategies. However, this is not always the case; other mitigating factors such as land size, its productivity, gender and access to land and control of other resources particularly money may become more influential.

Common property: exist where property rights are assigned to groups or communities, and collective action, based on voluntary or normative incentives is required for the management of the resources. These well-defined groups of individuals may then set up rules to control access to and use of the resource. In most common property regimes, the rules on resource extraction always appear to some authority higher than the individual users. Such authority could emanate from the area chief, a democratic governing body, or a government agency, among others. The groups hold customary ownership of certain resources such as farmland, grazing land and water resources, Non-members are excluded from the use of resources managed by a different group. The problem of common property regime is degradation of resources in cases where population growth or change in land tenure threatens the social fabric in which the system operates.

State property: exists where property rights are assigned to the state and cooperation is enforced, with sanctions and penalties as the primary incentives. Individuals and groups may make use of resources but must seek permission from the state. Examples are national parks and forests that are managed by the state. The state may directly manage and control the use of state owner natural resources through government agencies, or it may lease the natural resources to a group of people or individuals, but they are not given title to land. State owned resources are not always the best managed, especially where the use is not properly regulated. An example is the Mau water tower which is severely degraded, a problem attributed to illegal settlement in the forest.

Open access/free access: no property rights have been assigned to the resources. Therefore, such resources are not managed or controlled by anyone. Access is not restricted, and therefore, the resources can be exploited on a first-come, first-served basis. Individuals and groups are allowed to make use of the scarce resources without regard for the interest of others who may also seek to make use of the same resources. In an open access regime, the resource belongs to the first person to exercise control over it.

These resources are subject to over exploitation and degradation due to lack of individual or group control. There is usually stiff competition for resources with minimal regard for their usefulness in the future. The urge to benefit as much as possible and more than any other land user results in massive destruction of the resources.

Conclusion

- Open access situation should be distinguished from *common property resources*. Common property resources are resources owned collectively by a well-defined group of individuals, which may then set up rules to control access to and use of the resource.
- Closely related to state resources, are public good resources overexploitation.
- Public goods resources are resources which **exhibit non-rivalry in consumption** and are **fully accessible to all** (non-excludability).
- Non-rivalry in consumption means that a person's consumption of a good does not diminish the amount available to others e.g. beautiful landscapes, clean air etc.

- An owner of a resource with property rights (with the four characteristics) has powerful incentives to manage the resource efficiently because a decline in the value of the resource represents a personal loss.
- If property rights are not enforced this leads to encroachment/illegal access, e.g. the case of Mau forest.

Conservation measures

Biodiversity

Biodiversity is the degree of variation of [life](#) forms within a given [species](#), [ecosystem](#), [biome](#), or [planet](#). Terrestrial biodiversity tends to be highest at low [latitudes](#) near the equator, which seems to be the result of the warm climate and high primary productivity. Marine biodiversity tends to be highest along coasts in the Western Pacific, where sea surface temperature is highest and in mid-latitude band in all oceans. Biodiversity generally tends to cluster in hotspots, and has been increasing through time, but will be likely to slow in the future.

"Biodiversity" is most commonly used to replace the more clearly defined and long established terms, [species diversity](#) and [species richness](#). Biologists most often define biodiversity as the "totality of genes, species, and ecosystems of a region". An advantage of this definition is that it seems to describe most circumstances and presents a unified view of the traditional three levels at which biological variety has been identified:

- [species diversity](#)
- [ecosystem diversity](#)
- [genetic diversity](#)

Biodiversity is not evenly distributed, rather it varies greatly across the globe as well as within regions. Among other factors, the diversity of all living things ([biota](#)) depends on temperature, precipitation, altitude, [soils](#), geography and the presence of other species. The study of the spatial distribution of [organisms](#), species, and [ecosystems](#), is the science of [biogeography](#).

Services enhanced by biodiversity

Provisioning services

- greater species diversity of plants increases fodder yield
- greater genetic diversity of plants (i.e.: diversity within a single species) increases overall crop yield
- greater species diversity of trees increases overall wood production (synthesis of 53 experimental studies).^[58] however, there is not enough data to draw a conclusion about the effect of tree trait diversity on wood production^[53]

Regulating services

- greater species diversity of fish increases the stability of fisheries yield
- greater species diversity of natural pest enemies decreases herbivorous pest populations
- greater species diversity of plants decreases disease prevalence on plants
- greater species diversity of plants increases resistance to plant invasion
- greater species diversity of plants increases carbon sequestration, but note that this finding only relates to actual uptake of carbon dioxide and not long term storage
- greater species diversity of plants increases soil nutrient demineralization
- greater species diversity of plants increases soil organic matter

Ecological effects of biodiversity

The diversity of [species](#) and [genes](#) in [ecological communities](#) affects the functioning of these communities. these **ecological effects of biodiversity** in turn affect both [climate change](#) through enhanced [greenhouse gases](#), [aerosols](#) and loss of land cover, and biological diversity, causing a rapid loss of [ecosystems](#) and [extinctions](#) of [species](#) and local populations. The current rate of extinction is sometimes considered a [mass extinction](#), with current species extinction rates on the order of 100 to 1000 times as high as in the past.

The two main areas where the effect of biodiversity on ecosystem function have been studied are the relationship between diversity and productivity, and the relationship between diversity and community stability. more biologically diverse communities appear to be more productive (in

terms of [biomass](#) production) than are less diverse communities, and they appear to be more stable in the face of perturbations.

Biodiversity conservation

Biodiversity is both essential for our existence and intrinsically valuable in its own right. This is because biodiversity provides the fundamental building blocks for the many goods and services a healthy environment provides. These include things that are fundamental to our health, like clean air, fresh water and food products, as well as the many other products such as timber and fibre.

Other important services provided by our biodiversity include recreational, cultural and spiritual nourishment that maintain our personal and social wellbeing. Looking after our biodiversity is therefore an important task for all people.

The main threats to our biodiversity are:

- loss, fragmentation and degradation of habitat
- the spread of invasive species
- unsustainable use of natural resources
- climate change
- inappropriate fire regimes
- changes to the aquatic environment and water flows

Why Conserve Biodiversity?

We are learning more every day about the answers to this question, which has moved closer to the forefront of our collective psyche as new environmental challenges emerge. Biodiversity is the incredible, dizzying variety of life that surrounds us, including all of the earth's plants, animals, their habitats, and the natural processes that they are a part of.

It has become clear that biodiversity is the cornerstone of our existence on Earth. It is also important to conserve biodiversity for the sake of our own curiosity and aesthetic appreciation. Kenya's mountains are spectacular, but what would they be without our splendid variety of wildlife and wildflowers? Kenya is full of biodiversity wonders, many of which are unique to our state.

Medicines originating from wild species, including penicillin, aspirin, taxol, and quinine, have saved millions of lives and alleviated tremendous suffering. 40% of all prescriptions are for medicines that originated from plants and animals. No one knows how many more cures await discovery, hidden in Earth's poorly studied species.

There are 80,000 species of edible plants known on Earth, but 90% of the world's food comes from a mere 20 of these species. Edible plant species, both those we know of and those we don't, offer a tremendous resource of possibilities that could greatly add to the security of our food. How many of these have high potential for commercial exploitation and for feeding the hungry? Certainly, quite many. Breeding cultivars with their wild counterparts can also confer resistance to diseases and increase crop yield.

Biodiversity is the life support system of our planet- we depend on it for the air we breathe, the food we eat, and the water we drink. Wetlands filter pollutants from water, trees and plants reduce global warming by absorbing carbon, and bacteria and fungi break down organic material and fertilize the soil. It has been empirically shown that native species richness is linked to the health of ecosystems, as is the quality of life for humans.

The connections between biodiversity and our sustainable future appear closer and closer the more we look. We literally need to conserve biodiversity like our lives depend on it! The number of species of plants, animals, and microorganisms, the enormous diversity of genes in these species, the different ecosystems on the planet, such as deserts, rainforests and coral reefs are all part of a biologically diverse Earth.

Appropriate conservation and sustainable development strategies attempt to recognize this as being integral to any approach to preserving biodiversity. Almost all cultures have their roots in our biological diversity in some way or form. Declining biodiversity is therefore a concern for many reasons.

Water resources

Water is distributed unevenly both in time and space. It is a fundamental resources essential in all the sectors; domestic, agricultural, livestock and industrial. Lack of availability of water undermines government and societal efforts to improve the quality of life in Kenya. The

government acknowledges the strong correlation between availability of water and socio-economic development. Most of the activities cannot survive without adequate quantities of water. Shortage of water affects all actors of production, ranging from domestic to manufacturing, agriculture, energy etc.

One of the problems facing water resources is drought. Drought brings about:

- a) Reduced water volumes in rivers, lakes and ground water. This affects not only hydro-electric power generation, but also urban water supplies, and rural water supplies.
- b) Competition over water resources, which often lead to conflicts especially in arid and semi-arid areas.
- c) Deterioration of water quality in both surface and ground water; as shortage of water forces people and animals to share the remaining pools, leading to contamination.

Contributing Factors to Water Shortage/Scarcity

1. Inadequate water storage capacity especially in rural areas.
2. Poor management of catchment areas. Forests and wetlands play a critical role in water retention. Unfortunately, most indigenous forests are threatened by charcoal production, commercial logging, overgrazing, and clearing of land for cultivation.
3. Cultivation of unsuitable areas such as stream banks and steep slopes causes erosion of top soil, which silts up dams and pans used in dry weather as water sources.
4. Lack of policy for managing water and drought. Water resource management is still planned on the assumption of a reliable equilibrium, yet drought and decrease in precipitation have seen reduced water volumes.
5. Inadequate enforcement of the Water Act and other legislation.
6. Inequitable distribution of water.

Possible measures to ensure water quality and quantity

1. Promote water conservation through water harvesting
2. Strengthen integrated management of river catchment by all water users. There's need for a high level awareness on the need to protect forests as part of water resource management. A conservation ethic should be inculcated in individuals and communities regarding their roles, obligations and responsibility on catchment management.

3. Empower women to own and manage water resources as they do not have any ownership of water resources.
4. Adopt demand management approach where possible. This is reducing water consumption in certain areas; and using savings to meet increased demand. This can be achieved by using technologies that use low volumes of water. Supply management also involves meeting increased demand by providing more water.
5. Access ground water resources
6. Promote waste water reuse; by treating both domestic and industrial water to promote efficient use of water.
7. Exploiting traditional knowledge for managing water resources, this has been largely overlooked in favor of more modern methods.
- 8.

Energy conservation

Energy conservation refers to reducing energy through using less of an energy service. For example, driving less is an example of energy conservation. Driving the same amount with a higher mileage vehicle is an example of energy efficiency. Energy conservation and efficiency are both energy reduction techniques.

Renewable energy is [energy](#) that comes from resources which are continually replenished such as [sunlight](#), [wind](#), [rain](#), [tides](#), [waves](#) and [geothermal heat](#). About 16% of global final energy consumption comes from [renewable resources](#), with 10% of all energy from traditional [biomass](#), mainly used for [heating](#), and 3.4% from [hydroelectricity](#). New renewable resources (small hydro, modern biomass, wind, solar, geothermal, and biofuels) accounted for another 3% and are growing very rapidly. The share of renewables in [electricity generation](#) is around 19%, with 16% of electricity coming from hydroelectricity and 3% from new renewable resources.

Examples of renewable sources of energy

1. Bio-mass Energy from plants-It is a rich source of carbon and hydrogen. Biomass including forest residues, plumber and paper waste can be used to reduce heat transformation fuel and energy, while at the same time reducing environmental burdens.
2. Solar energy from the sun-It's free and inexhaustible. Converting sunlight into useful forms is not free but the fuel is. Sunlight has been used by humans for drying crops and heating water
3. Wind power from the wind-Advanced aerodynamics research has developed wind turbines that can produce electricity at a lower cost than power from polluting coal plants.
4. Geothermal Energy-It taps into the heat under the earth's crust to boil water. The hot water is then used to drive electric turbines and heat buildings
5. Hydroelectric Power-It uses the force of moving water to produce electricity. Hydropower is one of the main suppliers of electricity in the world but most often in the form of large dams that disrupt habitats and displace people.

While many renewable energy projects are large-scale, renewable technologies are also suited to [rural](#) and remote areas, where energy is often crucial in [human development](#). As of 2011, small solar PV systems provide electricity to a few million households, and micro-hydro configured into mini-grids serves many more. Over 44 million households use [biogas](#) made in household-scale digesters for [lighting](#) and/or [cooking](#), and more than 166 million households rely on a new generation of more-efficient biomass cooking stoves.

Purpose of energy conservation

- Improvement in energy efficiency in these sectors leading to a reduction in Green House Gas (GHG) and a reduction in the incidence of fuel dependence e.g. CO₂
- Create awareness amongst the stakeholders to improve energy efficiency
- Reduction of energy consumption
- Reduction of energy cost
- Energy management - The strategy of adjusting and optimizing energy, using symptoms and procedures so as to reduce energy requirements per unit of output while holding constant and reducing total costs of reducing the output from the systems.

Objectives of Energy Conservation

1. Energy Security-To ensure a constant and stable supply of energy, it is necessary for countries to increase the domestic energy, self sufficient ration and to undertake diplomatic endeavors to secure a stable energy supply for the country to maintain its supply.
2. Income increase-Income increase by reducing cost of energy utilities is a direct purpose and incentive of energy conservation throughout the implementation of energy consumption and income will increase equivalently to the amount of reduction.
3. Measures of the global environment-Under this circumstance, concrete measures are required these days to regulate green house gas emissions with efforts by the government and private sectors since energy conservation limits greenhouse gas emissions, such as Co₂ which leads to global warming.

Benefits of conserving energy

1. Decreased air pollution- When fossils e.g. coal are burned to produce energy, then various gases as well as other fine particles are released into the air, causing pollution if those emitted substances are not controlled.
2. Better safety and health- Through cleaning air appliances frequently, we would possibly make our houses even more energy efficient.
3. Saves money- It is essential that you undertake some money saving measures and technique partially due to the global crisis. Through use of energy conservation it is more that you will save lots of money e.g. energy saving heating appliances, bulbs, etc.
4. Longer life span- Usually its products like low voltage bulbs and other electronic items have a long life span in comparison to the normal bulbs.

Threats to energy conservation

- i. Over exploitation of energy which can cause depletion

When energy is over used it can get depleted which is a threat to ways of conserving energy.

ii. Projected community and economic growth

Population projection for countries in Kenya suggest that additional residential development should be expected; regional employment projections suggest additional non-residential growth as well as a result, traffic volumes are expected to raise congestion, which will continue to increase unless substantial portions or new residential, commercial and industrial development are located within or adjacent to existing transit service areas. Development and transportation planning program can help to minimize congestion increments.

iii. Ageing structures

The ageing buildings stock of countries poses challenges to energy conservation. Significant advances in energy conservation technology have secured since the construction of many of these buildings and without adequate maintenance or upgrades, may lead to higher than necessary operational cost.

Forests

Forests are a vital resource as a habitat for wildlife, water catchment areas and a source of timber and wood for fuel and other products of cultural value to the surrounding communities. Forestry-based industries are a source of livelihood for many families. Forests promote tourism industry by providing habitat for wildlife as well as scenic sites. Forests are catchment areas, storing and releasing water to streams and rivers that are used as a source of water for domestic, livestock and irrigation purposes. They supply water to dams that are used to generate hydro-electric power, which is used in industries and urban centers.

Deforestation

Deforestation is a major problem that is experienced in state-owned, private and community forests alike. As the population increases, so does the demand for land for agriculture and settlements. Forests have fallen victim to this demand. Forest excisions and illegal encroachments have significantly reduced the extent of forest cover in the country, with occasional loss of biodiversity, habitats and water catchment areas. Both legal and illegal excision of forests has reduced the size of Kenyan forests to an alarming level. The efficiency of these forests as water catchment areas is diminishing rapidly.

The major threats to forests include:

- i. Charcoal burning: This is done for commercial purposes as increased number of people search for alternative means of survival. This is as a result of the collapse of farming and livestock activities due to drought. Charcoal burning is a threat to forests through the potential loss of biodiversity, by accelerated exploitation of particular species which produce good quality charcoal.
- ii. Cleaning forest for agriculture: As the population increases, the increased demand for food lead people to clear forests for agricultural purposes.
- iii. Increased logging in both state-owned and private forests. Tree cutting for timber has resulted from the need to seek an alternative source of livelihood, especially for farmers who are affected by repeated crop failures or inadequate harvests.
- iv. Frequent fires are common during the dry period. Fires destroy large areas of forest vegetation, sometimes causing depletion of valuable species.
- v. Use of forest products as livestock fodder: As pastures diminish, livestock keepers turn to forests in search of fodder. Examples are around the Aberdares, Mount Kenya and Karura forests.
- vi. Increase in forest diseases. In Kenya, extended dry periods are associated with forest diseases, resulting in drying up of trees.
- vii. Reduced forestation rates: In many state-owned forests, inadequate rainfall has led to either shortage of water for tree nurseries or the drying out of planted seedlings. This is a serious problem in farm forestry in areas where most trees have been cut for timber or charcoal without being replaced.
- viii. Ineffective enforcement of forest rules and regulation: The forest department in Kenya is unable to enforce regulations on access and utilization of forest resources. This is mainly attributed to inadequate human and financial resources, as well as due to corruption.

Possible Forest Management Practices

1. Afforestation and reafforestation programs.

2. Agro forestry
3. Legislation on forest conservation
4. Formulating forest management policies and enforcing them. This includes review of policy on forest excisions.
5. Promote non-destructive utilization of forest resources by local communities, by encouraging them to support forest conservation.
6. Promote use of renewable sources of energy in order to reduce the over-reliance of communities on natural resources for energy.

Wildlife conservation

A definition of wildlife should include all living organisms out of the direct control of man, including undomesticated or cultivated plants and animals.

Uses of wildlife

- A wide variety of forests are habitat for wild animals, birds and insects.
- Rivers and other water bodies are habitats for some animals which include: fish, crocodiles, and hippopotamus among others. These also provide water for domestic use and irrigation. Water bodies also act as a source of energy e.g. in production of electricity.
- Various plant species are used for herbal medicine and cure.
- Animal and human beings depend on plant species and various animal species for food.
- Wildlife is also a source of tourism attraction, through which the nation earns revenue.
- Places where trees are dense normally experiences rainfall more than places that have less trees, this prevents desertification.
- Wildlife is also a source of income, this is through production of hides and skins which are used to make various things such as shoes and belts.
- A source of shelter for human beings through cutting trees which are used for building.

Wildlife conservation is the practice of protecting [endangered plant and animal species](#) and their [habitats](#). Among the goals of wildlife conservation are to ensure that nature will be around for future generations to enjoy and to recognize the importance of [wildlife](#) and [wilderness](#) lands to humans. Many nations have [government agencies](#) dedicated to wildlife conservation, which help to implement policies designed to protect wildlife. Numerous independent [nonprofit organizations](#) also promote various wildlife conservation causes.

Conservation has become an increasingly important practice due to the negative effects of [human activity](#) on [wildlife](#). An endangered species is defined as a population of a living being that is at the danger of becoming extinct because of several reasons. Either they are few in number or are threatened by the varying environmental or predation parameters.

Major threats to wildlife can be categorized as below

- Habitat loss: Fewer natural wildlife habitat areas remain each year. Moreover, the habitat that remains has often been degraded to bear little resemblance to the wild areas which existed in the past.
- Climate change: Because many types of plants and animals have specific habitat requirements, climate change could cause disastrous loss of wildlife species. A slight drop or rise in average rainfall will translate into large seasonal changes. Hibernating mammals, reptiles, amphibians and insects are harmed and disturbed. Plants and wildlife are sensitive to moisture change so, they will be harmed by any change in moisture level.
- Pesticides and toxic chemical: Widely used, making the environment toxic to certain plants, insects, and rodents.
- Unregulated Hunting and poaching: Unregulated hunting and [poaching](#) causes a major threat to wildlife. Along with this, mismanagement of forest department and forest guards triggers this problem.
- Natural phenomena: Floods, earthquakes, volcanoes, lightning, forest fires.
- Pollution: Pollutants released into the environment are ingested by a wide variety of organisms.
- Over-exploitation of resources: Exploitation of wild populations for food has resulted in population crashes (over-fishing and over-grazing for example)

- Perhaps the largest threat is the extreme growing indifference of the public to wildlife, conservation and environmental issues in general⁴

Options for Wildlife Management

- Any discussion of wildlife resources must begin by recognizing the potential for managing for a variety of wildlife species. These include game and nongame species, threatened and endangered species, and even nuisance species. Managing the wildlife resource as the primary objective requires, in some instances, that other resources be managed differently. For example, timber harvests would be designed primarily to improve wildlife habitat, with maximum wood production being a secondary benefit. In this case management strategies could include or accomplish the following:
 - create, enhance or improve sufficient habitat to support suitable populations of desired wildlife species;
 - maintain healthy game populations in a manner consistent with habitat carrying capacity;
 - provide diverse and abundant populations of desired nongame wildlife species, particularly those that are dependent on mature timber; and
 - manage habitat and populations to protect flora and fauna listed as threatened or endangered.
- The key is that all resource management decisions are based on creating and maintaining sufficient habitat.
- Where wildlife management is a secondary objective to other resources, the compatibility of various management options becomes important. Wildlife species whose habitat requirements are compatible with practices designed to enhance the landowner's primary management objective will thrive. All plans should include ways to accomplish the following:
 - enhance, maintain or create habitat for desired species in a manner that is consistent with the primary objective for the land;

- achieve and maintain a natural diversity and abundance of game and nongame wildlife species including those dependent on mature timber (special consideration and/or protection should be afforded resident threatened and endangered species);
- manage other resources in ways that provide habitat needs of desired wildlife species, considering the species and the entire property.
- Regardless of the landowner's goals, providing suitable wildlife habitat should be considered when performing any management activity.

Watersheds

Understanding the Watershed

The hydrological cycle interacts with all other biogeochemical cycle as water moves, it redistributes heat, erodes mountain ranges, builds rivers as water moves, maintains organisms and ecosystem, shape civilizations and gives rise to political conflicts. Water carries sediments along with nutrients from the continents to oceans, via river, streams and surface run offs, and distributes sediments onwards in ocean currents.

Increasingly, water also distributes artificial pollutants. The hydrological cycle, summarizes how water; liquid, gaseous and solid form, flow through our biotic and abiotic environment.

The oceans are the main reserves of water in the hydrological cycle holding 97% of all water on earth. The fresh water we depend on for our survival accounts for less than 3% and two thirds of this is tied up in glaciers, permanent snow fields and ice caps, thus considerably 1% of the planet's water is in a form which we can readily use it:

- Ground water
- Surface water
- Rain from water vapor in the atmosphere

The main process of this cycle includes:

- i. Precipitation
- ii. Snow metamorphosis
- iii. Formation of snow cover
- iv. Formation of ice
- v. Interception of precipitation by vegetation cover

- vi. Storage in land surface depressions (e.g. lakes, oceans)
- vii. Infiltration into soil
- viii. Vertical transfer of soil moisture
- ix. Evaporation
- x. Recharge of ground water and ground flow
- xi. River run off generation
- xii. Movement of water in river channel systems.

Evaporation and Transpiration

Water moves into the atmosphere via evaporation, warmer temperatures and stronger winds speeds rates of evaporation, a greater degree of exposure has the same effects. An area cut off on its forest or converted into agriculture or residential use will lose water more readily than vegetative areas. Water also enters into the atmosphere via transpiration. Transpiration and evaporation acts as natural process of distillation effectively creating pure water by separating it from minerals carried within in solution.

Precipitation, runoff and surface runoff; Water returns to the earth surface as precipitation, when water vapor condenses and fall in droplets or/and crystal form. Rain or snow that falls on land may be taken up by plants and used by animals but much of it flows into streams, rivers, lakes and ponds, and in many cases eventually to the rivers and/or oceans as runoff. Precipitation varies greatly from region to region globally on small scale especially due to effects of mountains.

Ground water; some precipitation and surface water socks down through soil and rocks to return to underground water reserves known as *aquifers*. Aquifers may hold ground water for a long period of time, in some cases aquifers may take hundreds or thousands of years to fully recharge after being depleted.

Human Impacts on Hydrological Cycle

Human activities have affected every aspect of the water cycle both on the quantity and quality of water flowing within it;

1. A common problem is the overuse of water courses, resulting in drastically reduced flow through rivers and natural stores.
2. By damming rivers to create reserves, we have increased evaporation and in some cases infiltration of surface water drastically.

3. By altering earth's surface and its vegetation, we have increased surface runoff and erosion that result from it.
4. By drawing ground water to the surface for drinking, irrigation and industrial uses, we have begun to deplete ground water resources.
5. By spreading water on agricultural fields, we have depleted rivers, lakes and streams; and increased evaporation.
6. By removing forest and other vegetation, we have reduced transpiration in some areas.
7. By emitting into the atmosphere certain pollutants that results in water droplets, we have changed the chemical nature of precipitation; in effect sabotaging the natural distillation process that evaporation and transpiration provides.
8. Fresh water depletion leads to shortages and scarcity of such a vital resource can lead to social conflicts including hostility and armed clashes between political states and within communities in watersheds.

Reflection Questions

1. Differentiate between "management" and "conservation" of natural resources.
2. Explain the significance of the following natural resources in Kenya:
 - i. Mau Forest
 - ii. Lake Victoria
3. Identify the major threats to the conservation of the above resources
4. Discuss any 2 key drivers of environmental degradation and show how they can be arrested.