

Natural Resources

Natural Resources

- Natural resources are components of the atmosphere, goods and services supplied by our environment
 - *Forest, water, mineral, food, energy, land (soil), Atmosphere (air), plants and animals*
- They are naturally occurring substances that are considered valuable in their relatively unmodified (natural) form
- A natural resource's value rests in the **amount of the material available and the demand for it**, the latter is determined by its usefulness to production
- A commodity is generally considered a natural resource when the primary activities associated with it are extraction and purification, as opposed to creation
- Thus, mining, petroleum extraction, fishing, hunting, and forestry are generally considered natural-resource industries (natural resources include its minerals, energy, land, water, and biota)

Characteristics of resources

- Resources have three main characteristics:
 - Utility
 - quantity (often in terms of availability), and
 - use in producing other resources


Types of resources

- *On the basis of origin, resources may be divided into*
- *Biotic* - Biotic resources are the ones which are obtained from the biosphere
 - Forests and their products, animals, birds and their products, fish and other marine organisms are important examples
 - Minerals such as coal and petroleum are also included in this category because they were formed from decayed organic matter
- *Abiotic* - Abiotic resources comprise of non-living things
 - Examples include land, water, air and minerals such as gold, iron, copper, silver etc.

- *On the basis of renew ability, natural resources can be categorized into*
- Renewable Resources (Inexhaustible Resource)
 - **Inexhaustible** resources have the **ability to reappear** or replenish themselves by recycling, reproduction or replacement. Includes
 - Sunlight
 - Plants
 - Animals
 - Soil
 - Water
 - Living organisms
- Non-renewable Resources (Exhaustible Resources)
 - The non- renewable resources are the earth's materials. These renewable sources include
 - Minerals
 - Fossil fuels

Exploitation of natural resources

- Exploitation of natural resources is an essential condition of the human existence
 - This refers primarily to food production, but minerals, timber, and a whole raft of other entities from the natural environment also have been extracted
- Often the exploitation of nature has been done in a non-sustainable way, which is causing increasing concern, as a non-sustainable exploitation of natural resources ultimately threatens human existence

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- Over-exploitation in some cases lead to exhaustion, particularly by excessive forestry, fishing and hunting
 - This over-exploitation may be explained in part by human overpopulation in some areas of the planet, ever-increasing world demand for these resources and the development of international trade

Examples of over exploitation

- Industrial-scale logging, for wood products and timber, destroys or fragments millions of acres of forests each year, along with the habitat they provide to many uniquely adapted species
- Over-harvesting of fisheries has driven several fish species to the brink of extinction and reduced the overall diversity of marine life
- Over-hunting and illegal trade in endangered species are a prime threat to their survival
- Over Extraction of minerals from mining

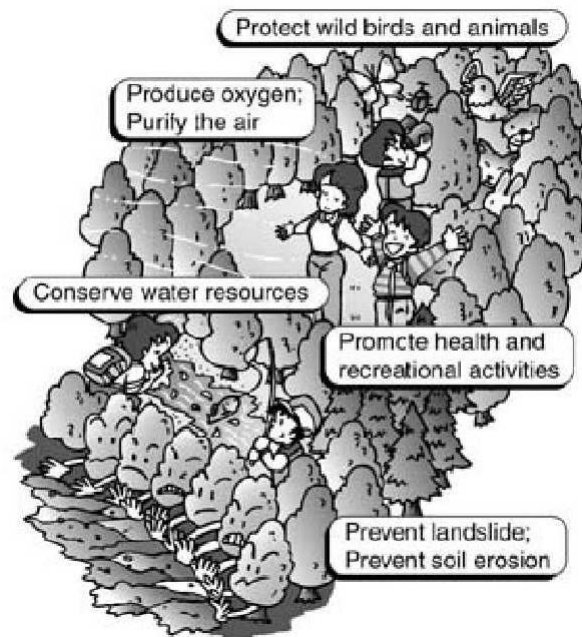
Forest Resources

Forest Resources

- Forests are **ecosystems** characterized by a dominance of tree cover and they contain a variety of other organisms (e.g., other plants, animals)
- Forests differ in composition and structure. These are both affected by biotic (e.g., animals, plants, humans) and abiotic (e.g., soil, moisture, sunlight, climate) factors
- Administration purpose, India has classified forest into
 - Reserved forests
 - Production of timber and other forest products
 - Protected forests
 - Restrictions
 - Unclassed forests
 - Inaccessible forest

Importance of forest

- Protective functions:
 - Soil erosion, against droughts, floods, intense radiations
- Productive functions:
 - Source of wood, gums, resins, medicines, pulp, paper etc
- Accessory functions
 - Adobe of animals and tribal people
 - Maintains the biodiversity of nature



Significance

- Ecological significance

- Balancing oxygen and carbon dioxide level in atmosphere
- Hydrological cycle
- Increases local precipitation and water holding capacity of soil and so preventing drought situation
- Maintains fertility of soil
- Reducing global warming:
 - The main green house gas carbon dioxide (CO_2) is absorbed by the forests as a raw material for photosynthesis. Thus forest acts as a sink for CO_2 thereby reducing global warming

- Economic Significance

- Wood
- Timber, in building constructions
- Wood as fuel
 - Advantage over coal as its sulfur and ash contents are very low
 - Excessive use is pressure on forests
- Bamboo, resins, gums, fibers medicines

Deforestation

- Deforestation is the **clearance of naturally occurring forests** by the processes of humans logging and/or burning of trees in a forested area
- **Imbalance** between demand and production of **fuel wood** and **timber** is one single factor that has contributed most to the depletion of forests in the country
- Excessive grazing, frequent farming, forest fire, shifting cultivation



Consequences of deforestation

- Decreasing soil stability
- Increasing erosion
- Sediment transport
- Degradation of air quality
- Increase in the level of green houses gas,

Effects of Deforestation

- *Soil erosion*: the soil in slope area gets washed away with rain water, since soil become loose due to the absence of forests/trees.
- *Expansions of deserts*: barren land is getting converted into deserts due to the action of strong winds. Since there is no barrier to strong wind because of absence of trees.
- *Decrease in rainfall*: Forests bring rains due to high rate of transpiration and precipitation. In the absence of forests, rainfall declines considerably
- *Loss of fertile land*: Less rainfall results into the loss of fertile land owing to less natural vegetation.

- *Effect on climate*: The climate of a region is mainly controlled by the rainfall, snowfall, etc. Deforestation causes decrease in rainfall, which in turn increases the climatic temperature.
- *Lowering of water table*: Decrease in rainfall results into a lowered water table due to lack of recharging of underground reservoirs.
- *Economic losses*: Deforestation will cause loss of industrial timber and non-timber products and loss of long-term productivity on the site.
- *Loss of biodiversity*: Loss of flora and fauna leads to disturbances in ecological balance worldwide. Certain species of flora and fauna are getting extinct

Conservation of Forest

- The forest conservation Act, 1980
 - Bans of unnecessary and avoidable forest conversion to non forest use
 - Compensatory afforestation
 - Establishments of national parks and wild life sanctururies
 - Afforestation Programme
 - Joint forest management
 - Removal of subsidies to industry
 - Industry used to get guaranteed supply of timber at low or nominal rate
 - Industry is expected to use forest resources efficiently
 - Environmental movements

Conservation of Forest Cont..

- National Forest Policy
 - Maintain of environmental stability, preservation and restoration of ecological balance
 - Preservation of remaining natural forests, maintaining the vast diversity of flora and fauna
 - Control soil erosion
 - Checking extensions of sand dunes in the desert areas
 - Increasing forest/tree cover in the country
 - Looking for substitution of wood
 - Awareness through movements

Timber Extraction

- Impact of timber extraction
 - Loss of biodiversity
 - Loss of animal habitat and plant species
 - Drought, soil erosion
 - Drying of forest lead to increase risk of forest fire
 - Loss of carbon storage capacity
 - Reduces atmospheric CO₂
 - Additional carbon released

Mining

- Coal is mined either by **surface** or **underground** methods
- Ground **is cleared of vegetation** and the soil is removed resulting in disfiguring of land
- Impact of surface mining on Environment
 - Soil erosion
 - Blasting operation in the surface results in **air pollution**
- Impact of Underground Mining on Environment
 - Land Damage: Damaging the strata
 - Environment Pollution
 - Mismanagement of Land-use
- Impact of coal mining on Human Health

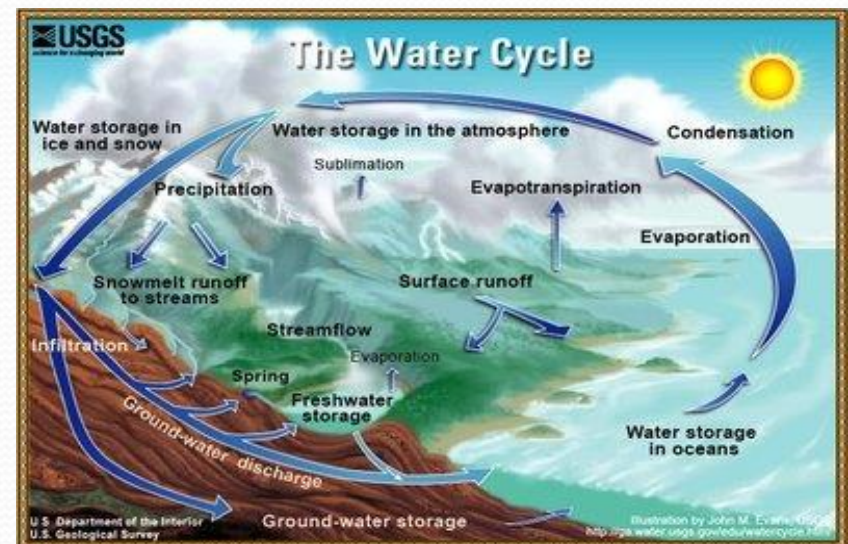
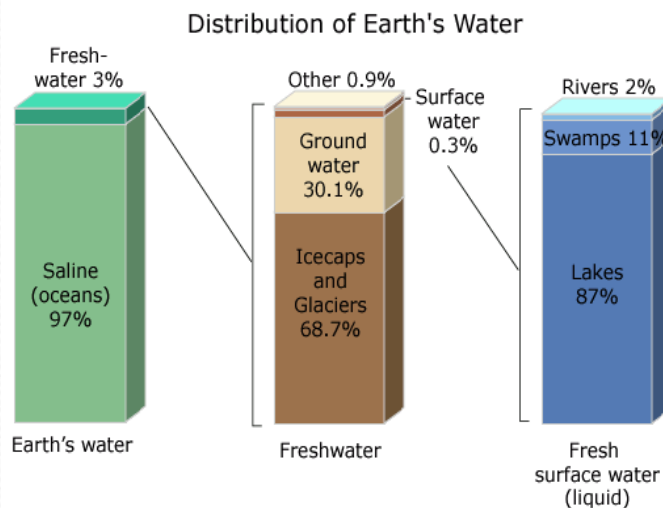
Dams

- Series of large dams planned on the major rivers of India
- Promised to solve problem of hunger, starvation. Control floods
- Ecological costs of large dams were underestimated and largely ignored
- Dams are single largest cause of displacement accounting for 75% to 80% of the total displacement
- Well known struggle
 - Narmada Bachao Andolan

Water Resources

Introduction

- Primary source of water on earth is precipitation that comes in the form of rain and snowfall
- Water resources are sources of water that are useful or potentially useful to humans.
- Uses of water include agriculture, industrial, household, recreational and environmental activities



Over utilization of surface and ground water

- Surface water is water collecting on the ground or in a stream, river, lake, wetland, or ocean
- Groundwater is water located beneath the ground surface in soil pore spaces
- Worldwide the largest use of water is
 - Irrigation (70%)
 - Industry (20%)
 - Direct Human use (10%)
- Conserve and manage our water resources to safeguard
 - Health Hazards
 - Ensure food security
- Prevent degradation of our natural ecosystem

Consequences

- Over exploitation of surface water resources
 - Dams and reservoirs have ecological impacts
 - Aquatic life, food chains involving aquatic organisms are adversely affected
 - Reservoirs created on floodplains submerge the existing vegetation
- Due to depletion of ground water
 - Fall of water table leading to drying up of springs
 - Loss of support to the overlying soil and rocks
 - Results in gradual settling of sand “*Land subsidence*”
 - *Salt water Intrusion*
 - Results from dropping of water table
 - High water table maintains sufficient head pressure, making fresh water available in aquifer and flow of fresh water to ocean
 - So wells in coastal areas also have fresh water
 - Lowering of water table reduces pressure in the aquifer allowing salt water flow into the aquifer and wells

Mineral Resources

Introduction

- India is rich in minerals
 - Abundant reserve of iron ore and mica
 - Adequate supplies of
 - Manganese, Titanium, bauxite and coal
 - Foreign exchange
 - Export of minerals like iron ore, titanium, manganese , bauxite and granite
 - Over 3000 mines in India
 - 8 lakh people are employed in mining sector
 - 11% of the country's industrial output

Classification of Minerals

- Geologist classify minerals according to their chemical composition and crystalline structure
- General classification
 - Metallic
 - Ferrous (containing iron) e.g., iron ore, manganese, nickel, cobalt
 - Nonferrous (copper, lead, tin bauxite etc
 - Precious e.g. gold, silver , platinum
 - Non-metallic
 - Mica, Salt Potash, Sulfur, Granite, Limestone, marble, sandstone
 - Energy
 - Coal, fossil fuels
- Almost all metals are found in the form of ore, containing impurities and so processing is required before use

Distribution of minerals and their use

● Iron Ore

- Used for manufacturing of machines, agricultural implements
- India shares 20% of the world reserve of iron ore
- Mines in the area: Chhattisgarh, Jharkhand, Orissa, Goa and Karnataka
- Export is primarily to Japan, Korea, European and Gulf countries

● Manganese Ore

- Used for making iron and steel and preparing alloy
- Preparing bleaching powder, insecticides, paints and batteries
- About one-fifth of world's deposit of manganese ore are found in India
- Main reserve in Karnataka, Orissa, MP, Maharashtra, Goa
- MP produces more than half of national total

● Copper

- Used for making utensils, electric wire and alloy
- Production of copper in the country is less than the requirement, hence it is imported

Distribution of minerals and their use

- Lead

- Ore of lead is known as **Galena**
- Soft and heavy metal, bad conductor of heat
- Used: cable cover, ammunitions, glass, rubber making
- Lead ore: Rajasthan, AP and TN
- India produces 25% of its requirement, rest imported from Australia, Canada and Myanmar

- Bauxite

- It is an ore from which aluminum is extracted
- Used : manufacturing of aero planes
- India has vast reserve of Bauxite

- Mica

- Insulating properties
- India produces 60% of world production of mica

- Limestone

- Found associated with rocks composed of calcium carbonate
- Used: cement industry, smelting

Exploitation of the mineral wealth

- Steps involved are
 - Locating a supply of minerals
 - Mining
 - Processing the minerals to get desired products
 - Grinding and crushing
 - Sorting
 - Smelting
 - Purification
- Conservation of Minerals
- Recycling of metallic scrap like steel, copper, aluminum , zinc , lead should be encouraged
- Improved technologies need to be constantly involved

Environment Impacts of Mineral Use

- Locating minerals, mining and processing minerals affects the environment
- Using good practices helps keep damage to the environment to small extend
- Mining Damage
 - Disrupts the earth's natural landscape and forest ecosystem
 - Excavation makes surface uneven causing land slide
 - Mined area may have substance that react with water to form acid
 - Excavated land can erode and damage water quality
- Waste Disposal
 - Tremendous amount of solid waste materials may result from processing minerals
 - Large piles of tailings may be seen at smelting plant
 - Can be used to fill the low lying areas and road paving
- Emission Control
 - Smoke, steam, particulates may be released by mining



Food Resources

Overgrazing

- Livestock wealth plays a crucial role in the rural life of our country
- India leads in livestock population
- The huge population of live stock needs to be fed and the grazing land or the pastures areas are not adequate
- Livestock grazing on a particular piece of grass land or pasture surpass the carry capacity
- Carrying capacity of any system is the maximum population that can be supported by it on a sustainable basis
- However, most often, the grazing pressure is so high that its carrying capacity is crossed and the sustainability of the grazing land fails

Impacts of Overgrazing

➤ Land Degradation

- Overgrazing removes the vegetal cover over the soil and the exposed soil gets compacted due to which the operative soil depth declines
 - Roots cannot go deep into the soil
 - Adequate soil moisture is not available
- Organic recycling also declines in the ecosystem
 - Because → not enough detritus or litter remains on the soil to be decomposed
 - The humus content of the soil decreases and overgrazing leads to organically poor, dry, compacted soil
- Due trampling by cattle the soil loses infiltration capacity, which reduces percolation of water into the soil and as a result of this more water gets lost from the ecosystem along with surface runoff
- Thus overgrazing leads to multiple actions resulting in loss of soil structure, hydraulic conductivity and soil fertility


Impacts of Overgrazing cont...

➤ Soil Erosion

- Due to overgrazing by cattle, the cover of vegetation almost gets removed from the land
- The soil becomes exposed and gets eroded by the action of strong wind, rainfall etc...
- The grass roots are very good binders of soil
- When the grasses are removed, the soil becomes loose and susceptible to the action of wind and water

➤ Loss of useful species

- Overgrazing adversely affects the composition of plant population and their regeneration capacity

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- The original grassland consists of good quality grasses and forbs with high nutritive value
 - Heavy grazing – root stocks which carry the reserve food for regeneration gets destroyed
 - Replacement by secondary species
 - The secondary species are hardier and are less nutritive in nature
 - Thus overgrazing makes the grazing land lose its
 - regeneration capacity and once good quality pasture land gets converted into an ecosystem with poor quality thorny vegetation

Agriculture

- Slash and burn cultivation or shifting cultivation
- Modern agriculture
- The types of agriculture are very different in their process and their outputs in terms of yield as well as their impacts on the environment

Traditional Agriculture and its Impacts

- It usually involves a small plot, simple tools, naturally available water, organic fertilizers and a mix of crops
- It is more near to natural conditions and usually it results in low production

Impacts caused by agriculture

- *Onsite Impacts → Soil Erosion, Deforestation, depletion of nutrients*
 - Deforestation the slash and burn of trees in forests to clear the land for cultivation and frequent shifting results in loss of forest cover
 - Soil Erosion clearing of forest cover exposes the soil to wind, rain and storms, thereby resulting in loss of top fertile layer of soil
 - Depletion of nutrients during burning of organic matter in the soil gets destroyed and most of the nutrients are taken up by the crops within the short period, thus making the soil nutrient poor which makes the cultivator to shift to new area
- *Offsite Impacts → Water Pollution due to agriculture runoff, dispersion of agriculture chemicals like fertilizers*

Modern Agriculture and its Impacts

- It makes use of hybrid seeds of selected single crop variety, high-tech equipments and lots of energy subsidies in the form of fertilizers, pesticides and irrigation water
- The food production has increased tremendously, evidenced by the “green revolution”

The Impacts

- Impacts related to high yielding varieties
 - Fertilizer related problems
 - Pesticide related problems
 - Water logging
 - Salinity problems

Impacts related to high yielding varieties

- The use of high yielding varieties encourage monoculture
- In case of an attack by some pathogen, there is total devastation of the crop by the disease due to exactly uniform conditions, which help in rapid spread of disease

Fertilizer related problems

➤ **Micronutrient Imbalance**

- Most of the chemical fertilizers used in modern agriculture have nitrogen, phosphorus and potassium which are essential macronutrients
- Farmers use these indiscriminately to boost up crop growth.

➤ **Nitrate Pollution**

- Nitrogenous fertilizers applied in the fields often leach deep into soil and ultimately contaminate the ground water
- The nitrates get concentrated in the water and when their concentration exceeds 25 mg/l, they become the cause of a serious health hazard called “Blue Baby syndrome”

➤ **Eutrophication**

- Eutrophication means Over Nourishment
- Due to eutrophication lakes get invaded by algal blooms; these algae grows very fast by rapidly using up the nutrients, they often are toxic and badly affect the food chain

Pesticide related problems

- **Creating resistance** in pests and producing new pests
 - Some individuals of the pest species usually survive even after pesticide spray
 - The survivors give rise to highly resistant generations
 - About 20 species of pests are now known which have become immune to all types of pesticides and are known as “super pests”

- **Death of non-target organisms**
 - Many insecticides are broad spectrum poisons which not only kill the target species but also several non-target species which are useful to us

- **Biological magnification**
 - Many of the pesticides are not biodegradable and keep on accumulating in the food chain, this process is called as *biomagnifications*

Water logging

Soil Surface area becomes saturated and soil pores are full of water

- **Over irrigation of croplands** by farmers for good growth of their crop usually leads to water logging
- **Inadequate drainage** causes excess water to accumulate underground and gradually forms a continuous column with the water table
- Under water logged conditions, pore spaces in the soil get fully drenched with water and the soil-air gets depleted
- The **water table rises** while the roots of the plant do not get adequate air for respiration
- Mechanical strength of the soil declines, crop plants get lodged and crop yield fails
- Preventing excessive irrigation
 - Sub-surface drainage technology and bio-drainage with trees like Eucalyptus are some of the remedial measures to prevent water logging

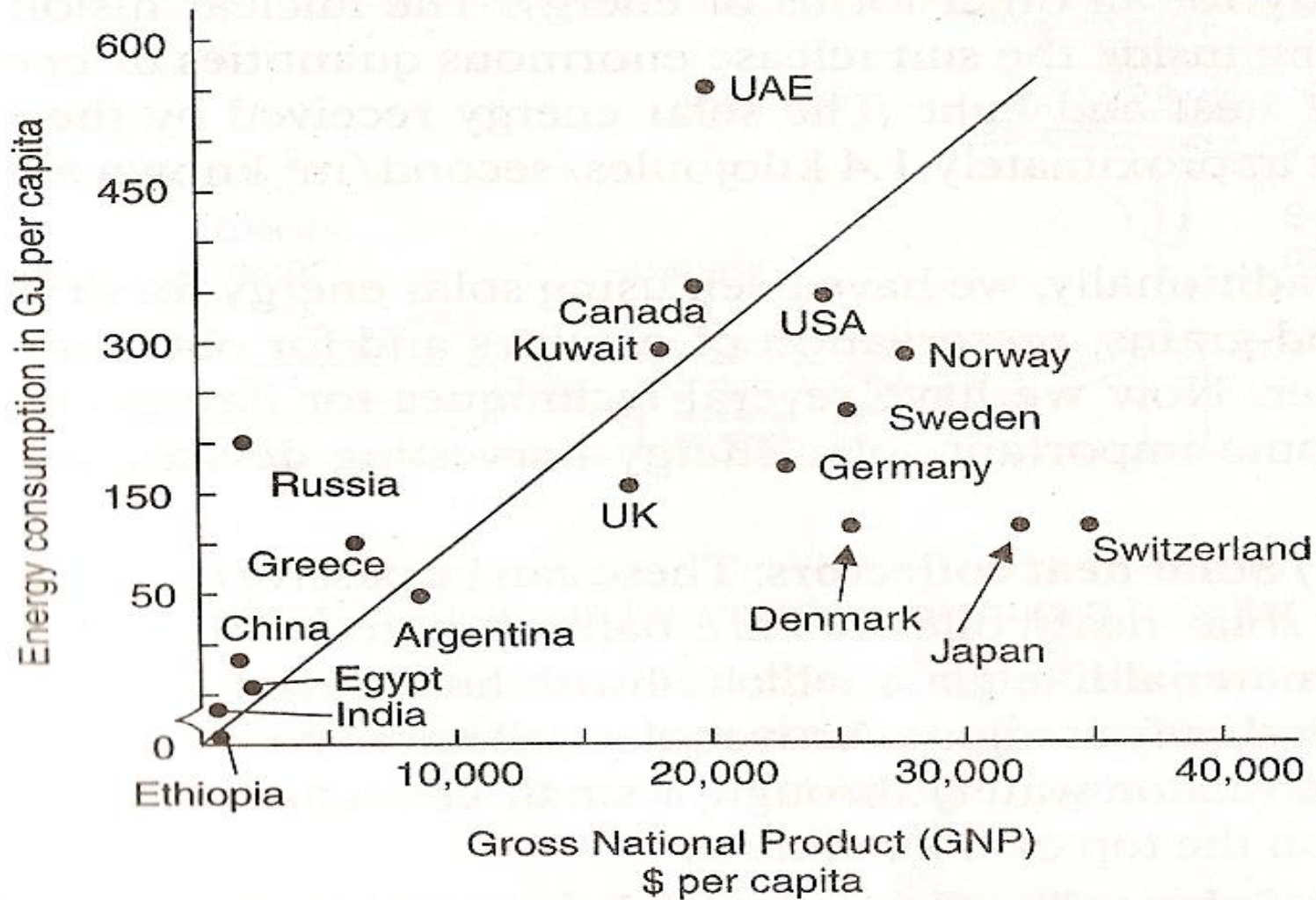
Salinity Problems

- At present $\frac{1}{3}^{\text{rd}}$ of the total cultivable land area of the world is affected by salts
- In India about 7 million Hectares of land are estimated to be salt affected
- Saline soils are characterized by the accumulation of soluble salts like
 - sodium chloride, sodium sulfate, calcium chloride, magnesium chloride
- The most common method for getting rid of salts
 - Flush them out by applying more good quality water to affected soils.
 - Laying under ground network of perforated drainage pipes for flushing out the salts slowly

Energy Resources

- Energy consumption is considered as an index of its development
- The first form of energy known was FIRE
- Wind and Hydropower have been in use for the last 10,000 years
- The invention of steam engines replaced the burning of wood by coal and coal was later replaced to a great extent by oil.
- In 1970's due to Iranian revolution and Arab oil ban the prices of oil shoot up, leading to exploration and use of several alternate sources of energy

Growing Energy Needs



Per capita energy use and GNP

(Data from World Resources Institute, 1997)

Energy Sources

- A source of energy is one that can provide adequate amount of in a usable form over a long period of time
- These sources are of two types:
 - ***Renewable Resources*** – which can be generated continuously in nature and are inexhaustible (also called as non-conventional energy sources) e.g., wood, solar energy, wind energy, tidal energy, hydro power, bio-mass energy, bio-fuels, geo-thermal energy and hydrogen
 - ***Non-renewable Resources*** – which have accumulated in nature over a long span of time and cannot be quickly replenished when exhausted. e.g., coal, petroleum, natural gas and nuclear fuels like uranium thorium...

Solar Energy


- Sun is the ultimate source of energy.
- The nuclear fusion reaction taking place inside the sun release enormous quantities of energy in the form of heat and light
- Techniques for harnessing Solar energy
 - Solar Heat Collectors
 - Solar Cookers
 - Solar Furnaces
 - Solar Cells
 - Solar Water Heaters
 - Solar Power Plants



Land Resources


Land Resources

- Land, a critically important national resource, supports all living organisms including plants
- All primary production system such as roads, industries, communication and storage for surface and ground water, among others
- The **soil profile** of land determines its ability to serve socio-economic needs

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- It has been estimated that more than **5,000 million tonnes** of top **soil is eroded** annually along with about **5 million tonnes of nutrients**
 - About **a third** of this is **lost to the sea**, while the rest builds the silt load in reservoirs and river beds leading to floods
 - Arid areas suffering from moderate or high degree of soil loss comprise up to 4% of the geographical area
 - **Land degradation:** is the reduction in the capacity of the land to provide ecosystem goods and services and assure its functions over a period of time

Land degradation

- Causes of land degradation: *Deforestation and removal of natural degradation, Over exploitation of wood cover for domestic use, Overgrazing, Agricultural activities*
- **Land pollution** is the degradation of earth's land surfaces often caused by human activities and its misuse
- Haphazard **disposal of urban and industrial wastes**, exploitation of minerals, and improper use of soil by inadequate agricultural practices are a few of the contributing factors
- Also, **increasing urbanization, industrialization** and other demands on the environment and its resources is of great consequence to many countries land surfaces often caused by human activities and its misuse.

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- We often assume that land degradation only affects soil fertility
 - However, the effects of land degradation often have more significant impacts on receiving water courses (rivers, wetlands and lakes) since soil, along with nutrients and contaminants associated with soil, are delivered in large quantities to environments that respond harmlessly to their input
 - Land degradation therefore has potentially disastrous impacts on lakes and reservoirs that are designed to alleviate flooding, provide irrigation, and generate hydroelectricity.

Soil

- Soil is thin layer of **organic and inorganic material** that covers the earth's rocky layer
- Composition
 - Stone and gravel
 - Coarser sand
 - Fine sand
 - Silt
 - Clay

Soil Degradation

- When plants (trees & shrubs) are cleared from a site, soil is exposed to sunlight and the eroding effects of wind and water
- Soil aeration is increased and the rate of weathering increases
- Apart from erosion, the proportion of organic matter in the soil gradually decreases, through the action of microbes in the soil which use it as a source of energy - unless the new land use provides some replacement.

Major problem

- Soil erosion
 - Topsoil of land is of essential nutrients for plants and vegetables
 - Soil erodes, Rich top layer “humus” is removed
 - Unfit for growth for many years
- Loss of fertility by mismanagement
 - Unscientific cropping practices
 - Imbalance of nutrients
 - Loss of organic matter
 - Soil pollution
- Deterioration of soil structure
- Floods and drought

Soil Pollution

➤ Sources of Soil Pollution

- Disposal Industrial Waste
- Disposal of Soil wastes in urban areas
- Accumulation of lead particulates from automobile exhaust
- Garbage containing plastics, glasses, metallic cans
- Agricultural practices
 - Excessive use of fertilizers
 - Pesticides used to kill unwanted species
- Biological agents
 - Excreta, faulty sanitation, municipal garbage

Effects of Soil Pollution

- Agricultural

- Reduced soil fertility
- Larger loss of soil and nutrients
- Deposition of silt in tanks and reservoirs
- Reduced crop yield
- Imbalance in soil fauna and flora

- Industrial

- Dangerous chemicals entering underground water
- Ecological imbalance
- Release of pollutant gases
- Release of radioactive rays causing health problems
- Increased salinity
- Reduced vegetation

Control of Soil Pollution

- Proper dumping of waste
- Ban on use of plastic bags which are major cause of pollution in cities
- Recycling of plastic wastes to manufacture many 'remake' items
- Ban on deforestation
- Encouraging forest re-plantation programs
- Undertaking many pollution awareness programs
- Crop rotation- revive the depleted nutrients

Causes of Land and Soil Degradation

- The causes of land and soil degradation are mainly anthropogenic and related to agriculture:
 - Land clearance, such as clear cutting and deforestation
 - Agricultural depletion of soil nutrients through poor farming practices
 - farm animals
 - Urban conversion
 - Irrigation
 - Pollution
 - Vehicle Off-roading

Effects of Land & Soil Degradation

- The major stresses on land and soil include
 - Accelerated soil erosion by wind and water
 - Soil acidification or alkalisation
 - Salination
 - Destruction of soil structure including loss of organic matter
 - neglected soil
- Severe land degradation affects a significant portion of the earth's arable lands, decreasing the wealth and economic development of nations. As the land resource base becomes less productive, food security is compromised and competition for dwindling resources increases, the seeds of famine and potential conflict are sown.