ENVIRONMENTAL SCIENCE

Course Code : 18 CE M01

UNIT-1

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SYLLABUS

- **Environmental Studies:** Definition, Scope and importance, need for public awareness.

- **Natural resources:** Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

ENVIRONMENT

- The word environment is derived from the french word 'environner' meaning surroundings. Hence, everything surrounding us is called "ENVIRONMENT"

Scope of environmental studies

1. Awareness among the people to know about various **renewable** and **nonrenewable** resources of the region.
2. Knowledge about **ecological systems** & cause and effect relationships.
3. Information about **biodiversity richness** and the potential dangers to the species of plants, animals and microorganisms in the environment.

4. Understand the **causes** and **consequences** due to natural and man induced **disasters**; **measures** to minimize the effects.
5. Evaluate **alternative responses to environmental issues** before deciding an alternative course of action.
6. Knowing the **environmental acts, rights, rules, legislations** to make appropriate judgments and decisions for the protection and improvement of the earth.

7. Problems of **over population, health, hygiene**, etc. and the role of **arts, science and technology** in eliminating/ minimizing the evils from the society.
8. Identify and develop appropriate and indigenous **eco-friendly** skills and technologies to various environmental issues.
9. The need for **sustainable utilization** of resources.
10. Theoretical knowledge into **practice**.

Importance of Environmental Studies

- World **population** is increasing at an alarming rate especially in developing countries.
- The natural resources endowment in the earth is **limited**.
- The methods and techniques of **exploiting** natural resources are **advanced**.
- The resources are **over-exploited** and there is **no foresight** of leaving the resources to the future generations.
- The **unplanned exploitation** of natural resources lead to **pollution** of all types and at all levels.

- The **pollution** and degraded environment seriously affect the **health** of all living things on earth , including man.
- The people should take a **combined responsibility** for the deteriorating environment and begin to take appropriate **actions** to spare the earth.
- **Education and training** are needed to save the biodiversity and species extinction.
- The urban area, coupled with **industries**, is major sources of pollution.

- The number and area extinct under **protected area** should be increased so that the wild life is protected at least in these sites.
- The study motivates students to get involved in **community action**, and to participate in various environmental and management projects.
- It is a high time to **reorient educational systems** and curricula towards these needs.

Need for Public Awareness

- Discoveries & inventions from 16th century → overexploited the natural resource → acid rain, ozone layer depletion, green house effect, land slides, cancer and other health problems.
- Lack of awareness and less number of people participation leads to poor pollution management → unhealthy ecosystem.
- To protect the environment through implementing proper regulations.
- In order to protect the environment from the pollution, Supreme court has initiated the environmental awareness to the public through government and non governmental agencies.
- Cooperate with government from our side and work for the protection of environment.

NATURAL RESOURCES

- The basic need of life are fulfilled by minerals present in the nature. These are referred to as Natural Resources.

Classification of Natural Resources

1. Based on Origin:

a. BIOTIC: (living organisms)

b. ABIOTIC: (non living organisms)

2. Based on Availability:

a. Inexhaustible: (replenishes naturally)

b. Exhaustible: (replenishing process extremely slow

3. Based on Distribution:

a. Omni present: (found everywhere)

b. Location based: (found at some specific locations only)

4. Based on Source:

a. Water Resources

b. Forest Resources

c. Mineral Resources

d. Marine Resources

5. Based on Chemical Composition:

a. organic: (vegetables, animals, bacteria, mineral oil)

b. Inorganic: (Air, water, minerals)

c. mixed: (land)

RENEWABLE RESOURCES

- Continual harvest with proper planning and management, such as plants, animals, solar energy, wind energy, etc.,

(They can renew themselves, provided they are Not over harvested).

NON RENEWABLE RESOURCES

- Resources which once gone have very little chance of recovery or resynthesis.

Ex: coal, minerals, and petroleum. (Total stock is limited).

1. LAND RESOURCES

USES:

- Land is used for agriculture, contains huge amount of mineral deposits; contains water in the form of underground water.
- Most of the animals find their habitat on land.
- Land directly or indirectly provides all the resources required to fulfil the basic needs of humans: food, cloth, and shelter.

LAND DEGRADATION

- The fertility of land supports the growth and productivity of natural vegetation and agricultural crops.
- A number of natural and man made factors lower the quality of land. This is called **Land degradation**.

Causes:

Natural factors

- Heavy rains
- High speed wind and storms
- Natural disasters like earthquakes ,floods, prolonged drought, etc.

Anthropogenic factors

- Mining
- Urbanization
- The indiscriminate and uncontrolled removal of trees
- Excess use of fertilizers
- Industrial discharges
- Overgrazing, soil erosion, etc.,

(a) SOIL EROSION

- Removal of top soil from its resting place by various physical agencies like wind and water.
- Detachment and transport of the fertile layer of soil by water or air. It is also known as the creeping death of land.

CAUSES:

- Large-scale deforestation for meeting commercial as well as day-to-day needs
- Heavy floods in rivers
- Overgrazing by cattle
- Dry violent winds
- Improper agricultural techniques

EFFECTS:

- Decrease in productivity of land
- Desertification of land
- Reduction in the agricultural land at the banks of rivers
- Deposition of soil in river beds and canals causing diversion of their natural flow and hence leading to disasters

Methods of controlling Soil Erosion

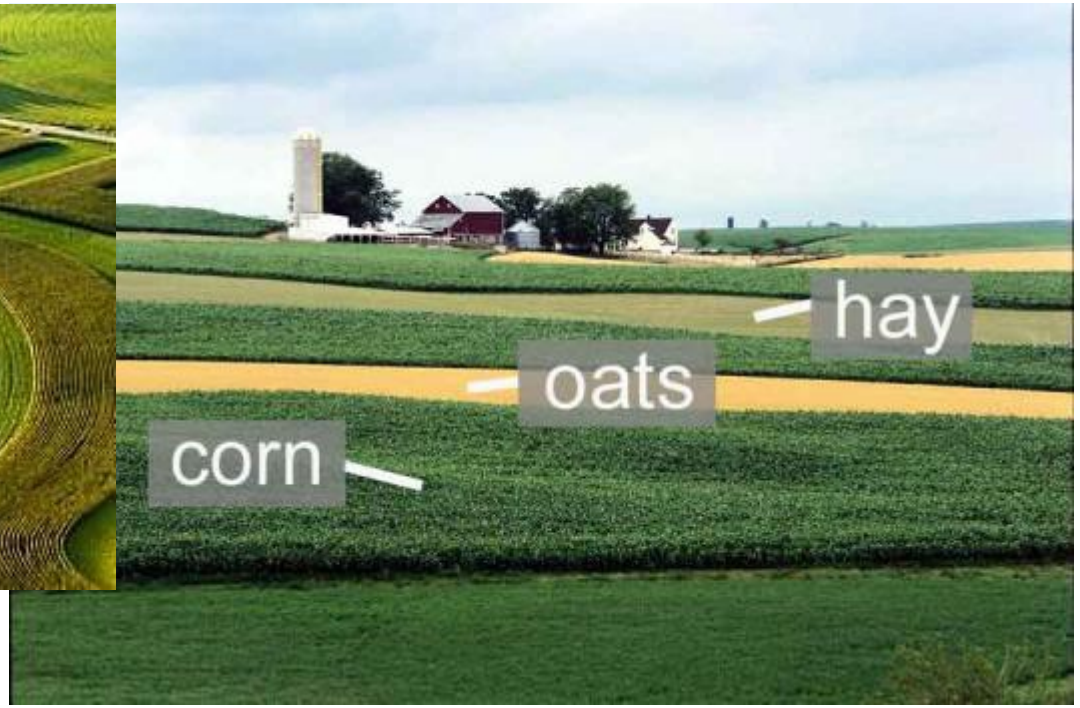
- Contour cultivation
- Strip cropping
- Terracing
- Afforestation on barren land
- Control of overgrazing
- Construction of small check dams
- Promotion of equitable use of water resources
- Prevention of excavation of rocks

Methods to Conserve Land

- Waste Land Reclamation
- Agricultural lands kept for agriculture only
- Use of hybrid seeds → maintain fertility for longer period

Afforestation

Construction of small check dams



Strip Cropping:

- Alternating crop rows between heavy-rooted plants and loosely-rooted plants to minimize erosion.

Terrace farming:

- Growing crops on sides of hills by planting on graduated terraces built into the slope.

Contour farming :

- Farming practice of planting across a slope following its elevation contour lines.

(b) Desertification

- *Conversion of fertile land into an infertile desert land is called **Desertification**.*

CAUSES :

Natural Factors	**Anthropogenic factors**
• Very low rainfall	Continuous cutting of trees
• Excessive evaporation	Overgrazing
• Vast difference in temperature extremes	Over irrigation
• High salinity of soils	Excessive ploughing
	Excessive use of fertilizers

Effects of Desertification:

- Rapid soil erosion
- Poor soil quality
- Unfavorable climate
- Low water table, salty and hard water
- Huge economic losses

Control of Desertification:

- Promoting large-scale plantation of trees
- Changing agricultural practices and promoting dry land farming
- Development of pasture lands (suitable for Grazing) and control of overgrazing
- Promoting equitable use of water resources
- Development of water catchment areas

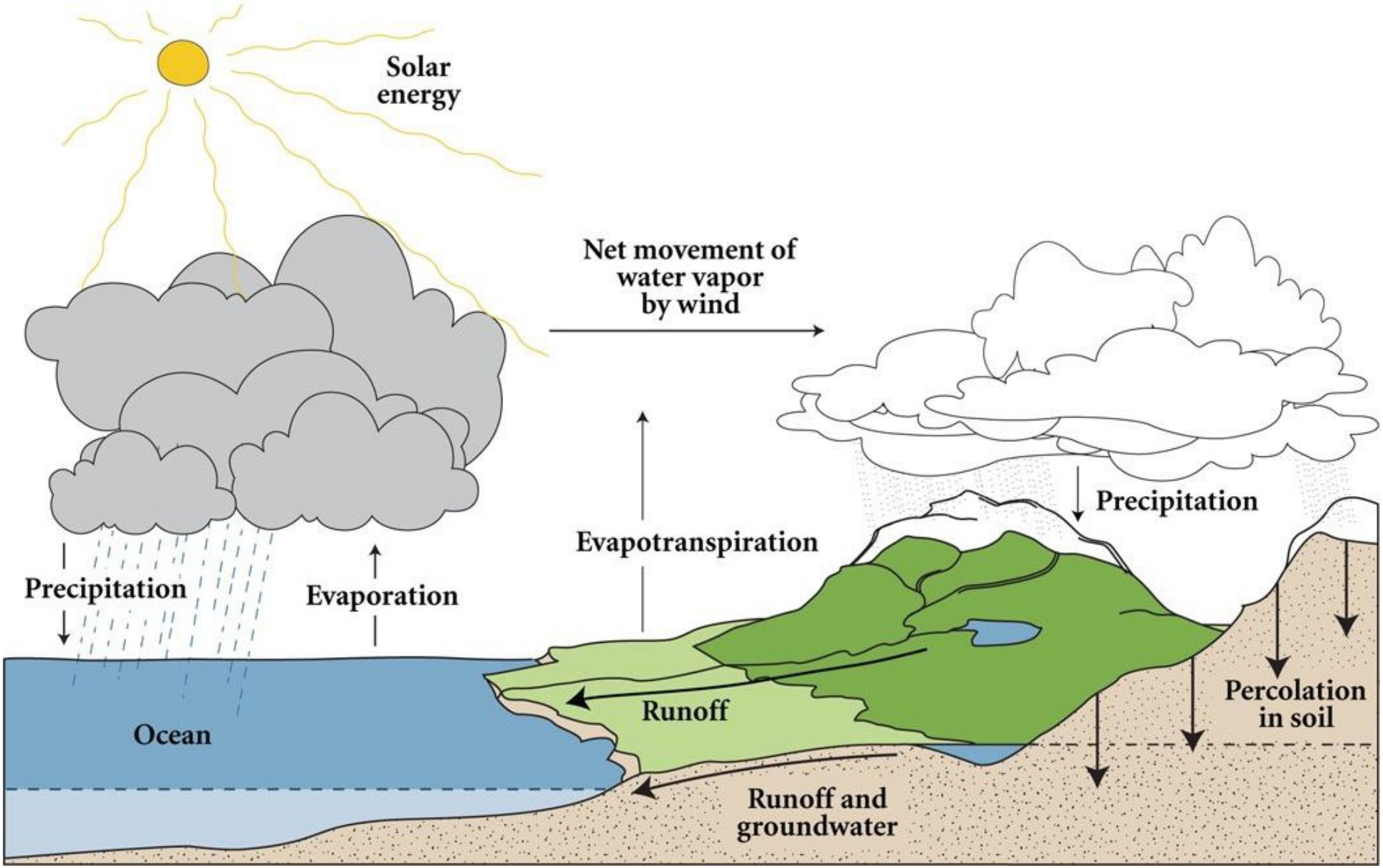
2. WATER RESOURCES

USES:

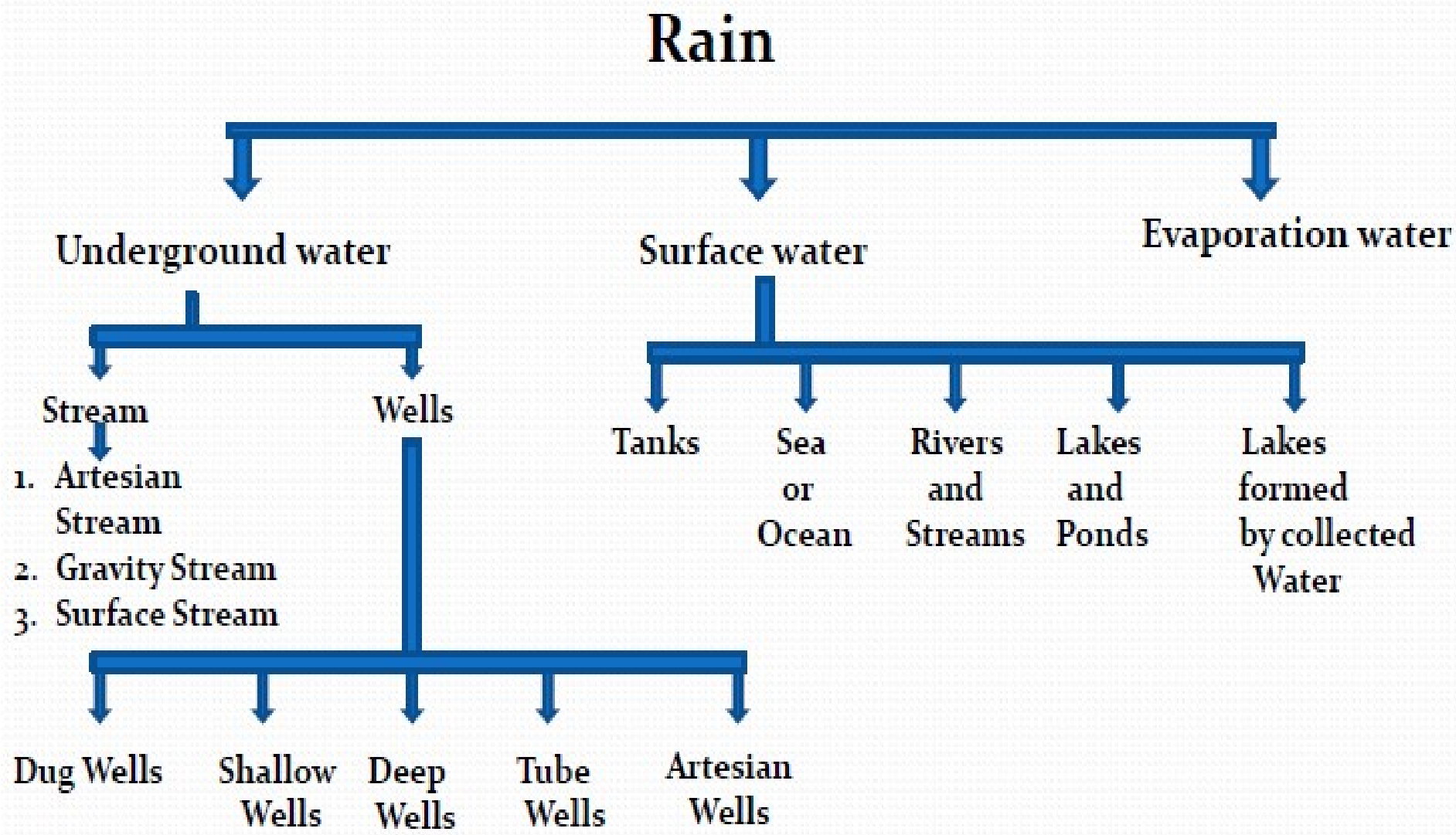
- Water is the basic component of every living cell.
- It is the basic input required for agriculture.
- Hydel power can be used for generating hydroelectricity.
- It provides habitat to aquatic flora and fauna.
- Common salt can be obtained from water.

SOURCES :

GROUND WATER SURFACE WATER


Solar energy
Net movement of water vapor by wind
Precipitation
Evapotranspiration
Precipitation
Evaporation
Ocean
Runoff
Percolation in soil
Runoff and groundwater

SOURCES OF WATER



Effects of Over-utilization of Ground Water

- Reduced flow of surface water
- Lowering of water table
- Water logging (saturation of the soil by G.W)
- Ground Subsidence (To sink to a lower or normal level)
- Degradation of water quality
- Increased salt content
- Increased power costs

Water Calamities: Floods and Droughts

- **Flash Floods**
- **River floods**
- **Coastal Floods**

- **Meteorological Drought** (Actual rainfall is less than climatological mean of that area)
- **Hydrological Drought** (Running down of surface water leading to a very low stream flow and drying of lakes, rivers.
- **Agricultural Drought** (Inadequate soil moisture result in fall in agricultural productivity)

Conflicts over water

- Conflict means a situation in which people, groups, countries are involved in a serious argument.
- Construction of Farakka Barrage across Ganga → India and Bangladesh. The Barrage is intended to divert water into river Hoogly to protect Calcutta port.
- The Cauvery water dispute → Tamil Nadu and Karnataka.
- Tamil Nadu d/s of river wants to use u/s water whereas the upstream state Karnataka refused to do so.

- The Sutlej –Yamuna link is the dispute between Punjab & Haryana.
- The river basin of Fordan and the Nile are the shared water resources for Middle East Countries (Asia; Africa; Europe). Ethiopia controls 80% of Nile River water whereas Sudan (South Africa) too is trying to divert more water. The sufferer is Egypt.

DAMS

ADVANTAGES:

1. Helps in water supply in Summer.
2. Blocking the water flow towards Sea.
3. For forming artificial lakes to maintain daily water supply.
4. Helps in irrigation and electricity generation.
5. Useful in creating Ecosystems for Birds and aquatic animals.
6. Useful to farmers to yield multiple crops in a year.

PROBLEMS CAUSED BY DAMS :

1. Fragmentation and Physical Transformation of rivers.
2. Serious impact on river-line Ecosystem.
3. Social consequences of large dams due to displacement of people.
4. Water logging and salination of the surrounding land.
5. Dislodging animal population, damaging their habitat and cutting of their migratory routes.
6. Disruption of fishing and water-way traffic.
7. Emission of green house gases due to rotting of vegetation.
8. Serious impact on tribal people.
9. Failure in achieving the targeted objectives and high cost.

Impact of Over Utilization of SurfaceWater:

1. Water scarcity specially in summer.
2. Wastage of water may lead to blockage of drainage line, water pollution, air pollution and virulent disease or epidemics.
3. Economic loss due to over usage of Water.
4. It may be considered as crime or offence in the court of Almighty.

Recharging and Conservation of Water:

1. Construction of small Dams and artificial lakes for the water storage purpose.
2. Construction of ponds for the purpose of storing rainwater.
3. Grow more trees to increase the chances of rain.
4. Economical use of water (avoid water wastage)

5. Try to reuse the water. Ex.:

   (i) Water used for bathing can be reused for vegetation in the veranda.

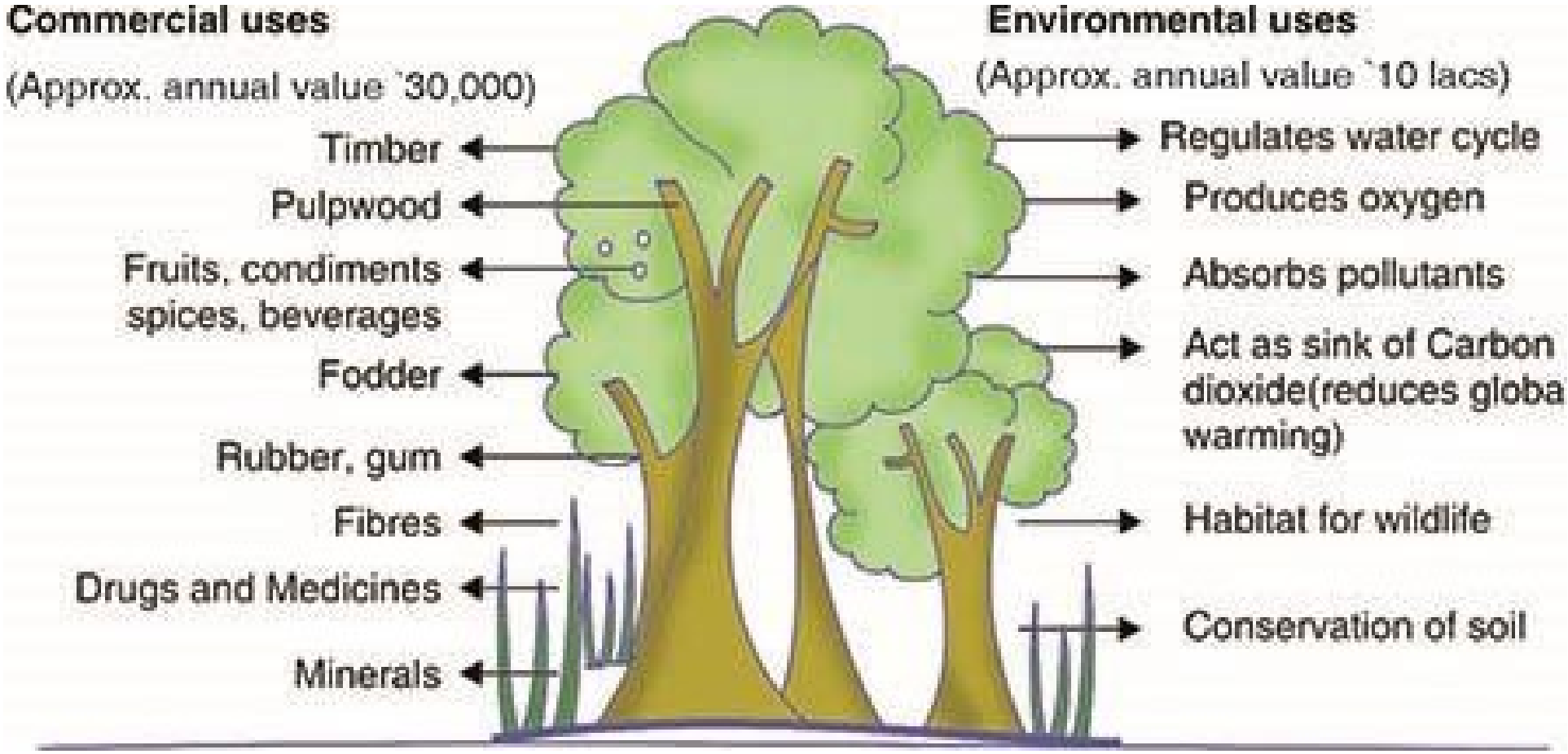
   (ii) Reuse of water by spraying it on dusty roads to prevent small particles to mix with air.

6. Use based water charges for controlling water usage.

7. After purification of Dirty water it should be used in farms or grasslands.

3. FOREST RESOURCES

- Important renewable resource.
- Restore O_2 in atmosphere through photosynthesis
- Provide solvents, medicines, fuels, etc.,
- India is rich in forest resources with a great diversity of flora and fauna
- Apart from innumerable material goods, forests provide several environmental services.



Economic vs Environmental Value of a tree

Functions/Uses of Forests

- *Protective Function*
- *Productive Function*
- *Regulative Function*
- *Accessory Function*

Protective Function : Provides protection against

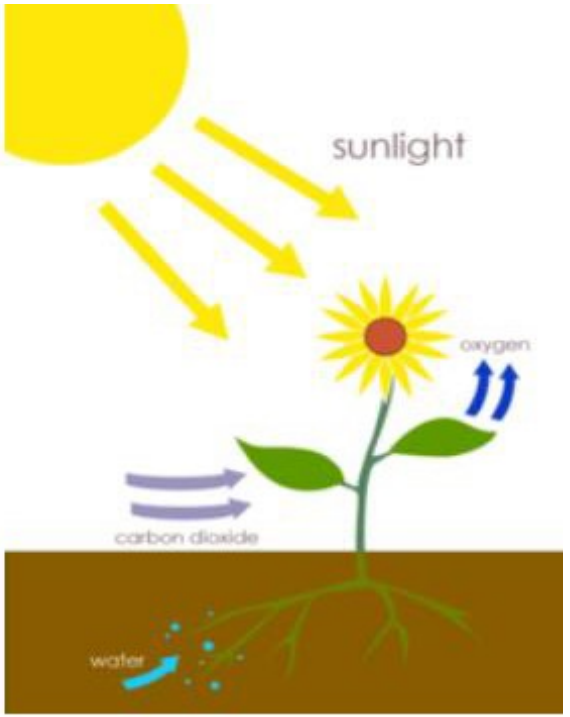
- Soil erosion
- Droughts
- Floods
- Noise
- Radiations

Productive Function:

- Provide various products like gum resins, medicines, honey, pulp, bamboo, timber, vegetables and fruits.

Regulative Function:

- **The Forest regulates the level of Oxygen and carbon dioxide in atmosphere.**
- **The forests also help in regulating temperature conditions**



$$6CO_2 \text{ Carbon dioxide} + 6H_2O \text{ Water} \xrightarrow{\text{Light}} C_6H_{12}O_6 \text{ Sugar} + 6O_2 \text{ Oxygen}$$

Accessory Function:

- Provides aesthetics, habitat to various flora and fauna besides that it also has an recreational value.

DEFORESTATION

- Encroachment of forest land for agricultural use to meet the growing demands of foods.
- Expansion of cities to accommodate the growing population
- Construction of dams, canals, and highways
- Establishment of industrial areas
- Demand for firewood
- Mining

Causes of Deforestation:

1. For obtaining raw materials for industry.
2. For obtaining timber for furniture and construction work.
3. For obtaining fire wood.
4. For developing the mineral industry.
5. For constructing projects on rivers.
6. For expanding Agricultural land.
7. For the purpose of constructing the roads.
8. For establishing industries.
9. For the construction of railway tracks.
10. Human accommodation.
11. Over grassing of forest by live stocks.
12. Destruction by insects and pests.
13. Forest fires.
14. Extreme weather conditions.

Effects of Deforestation:

1. Increase in the possibilities of flash floods.
2. Decrease in the rain fall.
3. Increase in the atmospheric temperature.
4. Increase in the amount of soil erosion.
5. Migration of tribal population leads to mental frustration.
6. Extinction of some useful medicinal species.
7. Shelter problem for forest animals will increase.
8. Problem of urbanization will arise.
9. Atmosphere will become adverse.
10. Desertification of forests and agricultural land.
11. Forest dwellers will have a problem of survival.
12. Decrease in the population of animal species.
13. Increased chances of cyclone due to climate change

Control of Deforestation:

1. Forest fires should be prevented.
2. Use of pesticides to eliminate the risk of pests.
3. Plantation of resistant varieties.
4. Replacements of trees (afforestation)
5. Replacing the fire woods by biogas and solar cooker.
6. Implementation of social forestry programmes.
7. Afforestation programmes should be undertaken on wastelands.
8. Trees of aesthetic value should be planted.
9. Renewal of forest crops.
10. Reforestation by suitable monoculture.
11. Unwanted felling of trees should be restricted.

4. MINERAL RESOURCES

- A mineral is a naturally occurring substance of definite composition and identifiable physical properties.
- Coal, natural gas and mineral oil
- Metals like iron, copper, silver, aluminium, manganese and other valuable stones.
- Physical removal of minerals from the crust of the Earth

Classification:

1. Energy Providing Minerals: Coal, Natural Gas and Mineral oil etc.
2. Valuable Minerals: Gold, Silver and Diamond.
3. Minerals Useful in Construction Work: Stones, Marbles, Lime etc.
4. Industrial Minerals: Iron, Copper, Manganese, aluminium

Mineral Resources of India

Mineral Name	Quantity ('000 tons)	Mineral Name	Quantity ('000 tons)
Copper	5393	Fire Clay	445
Lime stone	66900	Celica	1139
Manganese	1363	Canite	38
Lead- Zink	43- 138	Steatite	390
Bauxite	4773	Dolomite	2505
Chromite	939	Mica	4
Asbestos	26	Gypsum	1657
Pyrite	94	Iron	53700
Gold	1983 kg	Lignite	13900
Diamond	18000 carets	Magnetite	544
Silver	33	Silmenite	17
Falspar	46837	Barytes	707
Salt	3	Tugsten	22

Exploitation of Minerals

- Air pollution by emission of SO_2 and NO during mining
- Various disasters due to air pollution
- Acid rain due to toxic substances in air
- Noise pollution due to use of heavy machinery
- Emission of Radon and Thorone in Uranium mines
- Water flowing through mines → Water pollution
- Polluted water from natural oil wells → Land pollution

Conservation of Minerals

- Recycling: Reusing of useless articles
- Reusing: Reusing the articles again and again
- Decrease Consumption: Minimizing the requirement of certain minerals and reducing the wastage
- Substitution
- Use of Waste: Wastage of some industries can be raw material in other industries

5. Food Resources

- The main sources of human food are plants and animals.
- Human beings consume almost all parts of plants in the form of
- ***Cereals (wheat, barley, millet,*** rye, oats, maize, corn, rice etc.);
- ***Pulses (peas, red grams, green grams);***
- ***Vegetables (carrot, cauliflower, beans);***
- ***Fruits (banana, orange, grapes,*** pineapple) and
- ***Spices (pepper, cloves).***
- Milk, butter, egg and meat supplement the requirements.

- Physiological metabolism of human system → continuous supply of energy in the form of food is required.
- Food comes from 3 sources:

- ***Agriculture activity is the major source for food production*** which provide 76% of the total, mostly as good grains.

- ***Meat from grazing*** livestock (cows, sheep eat grass that is growing in a field), accounting for 17% and

- ***Fisheries that supply the remaining 7%.***

- Growing world's population → demand of food
- World's food production has increased 3 times during the last 50 years
- World food problem is a complex one depending on food production, population increase, the prevalence of poverty and environmental impacts.
- Famines are due to lack of access to food but not lack of food.
- Modern agriculture→ use of improved seeds, chemical fertilizers, synthetic pesticides etc…

6. Energy Resources

- Energy is the amount of force or power when applied can move one object from one position to another.
- Energy defines the capacity of a system to do work.
- Energy exists in everybody whether they are human beings or animals or non living things.

  Ex: Jet, Light, Machines etc..

- According to the law of conservation of energy, any form of energy can be converted into another form, the total energy will remain the same.

- For Ex: when you charge your mobile phone the electrical energy is converted into the chemical energy which gets stored inside the battery.

RENEWABLE ENERGY

- Energy which is generated from natural sources i.e. sun, wind, rain, tides and can be generated again and again as and when required.
- Available in plenty and by far most the cleanest sources of energy available on this planet.
- Renewable technologies are suited to large-scale production & small off grid applications.

Main forms of renewable energy

- Wind energy
- Hydro energy
- Solar energy
- Bio-fuel
- Geothermal energy

WIND POWER

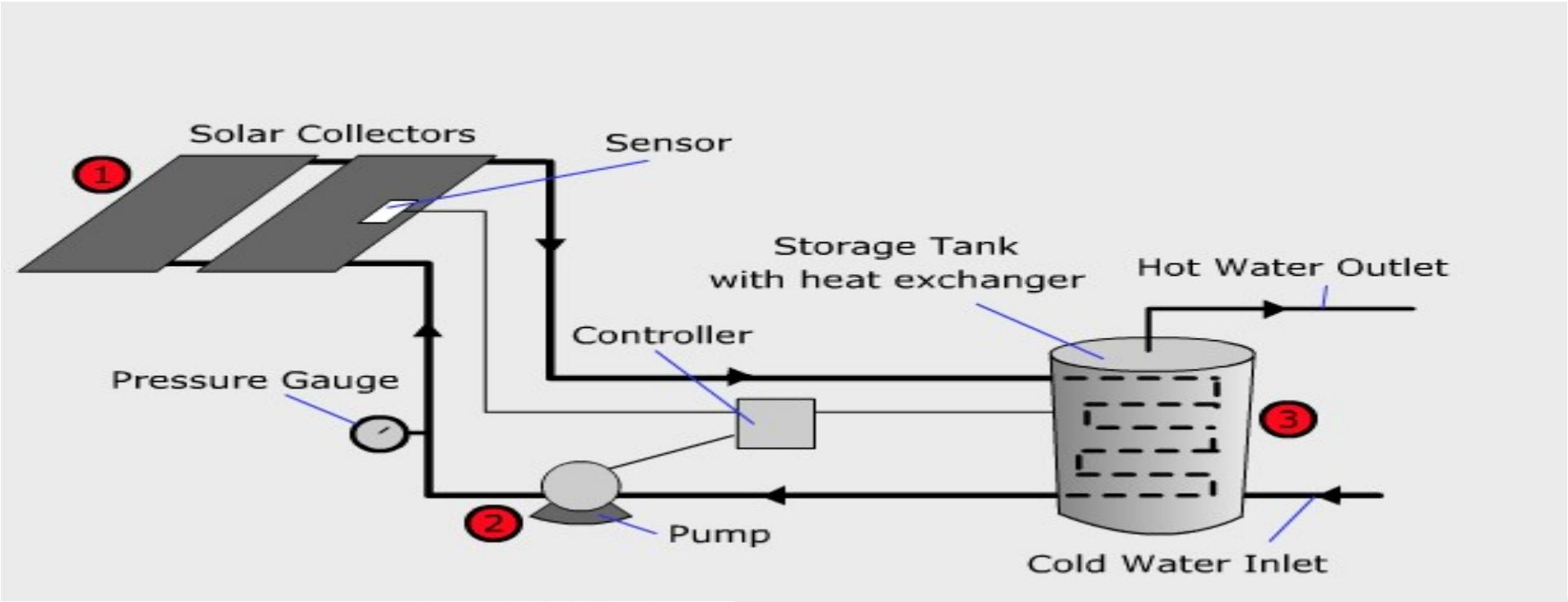
- Airflows can be used to run wind turbines.
- Areas where winds are stronger and more constant, such as offshore and high altitude sites, are preferred locations for wind farms.
- Wind energy is believed to be five times total current global energy production, or 40 times current electricity demand.

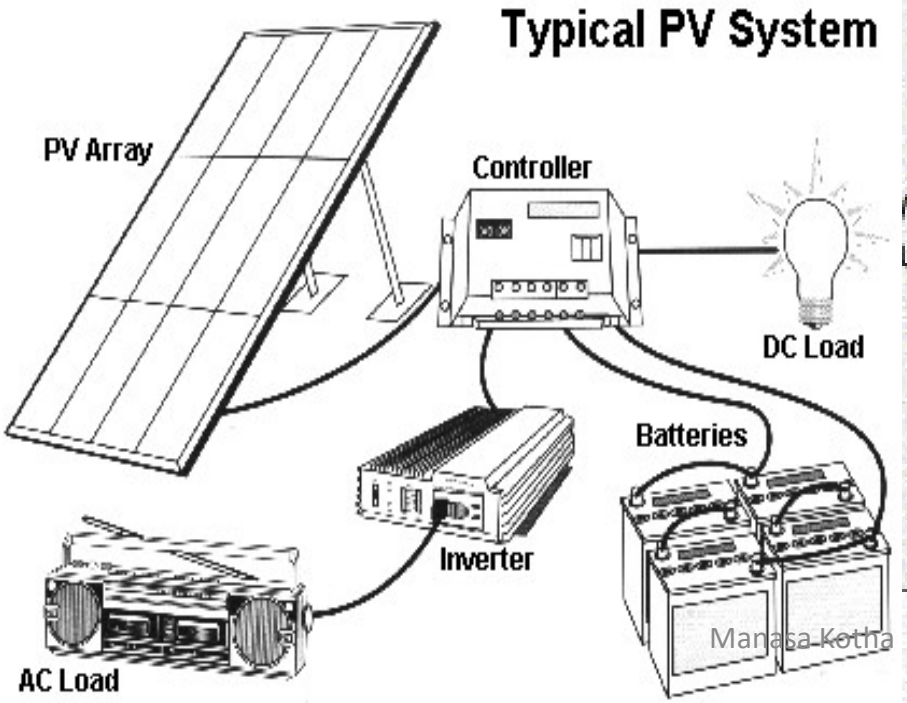
- Require large amounts of land to be used for wind turbines, particularly in areas of higher wind resources. Offshore resources experience wind speeds of 90% greater than that of land.
- Wind power produces no greenhouse gases during operation, and power is growing at the rate of 30% annually, with a worldwide installed capacity of 157,900 MW.

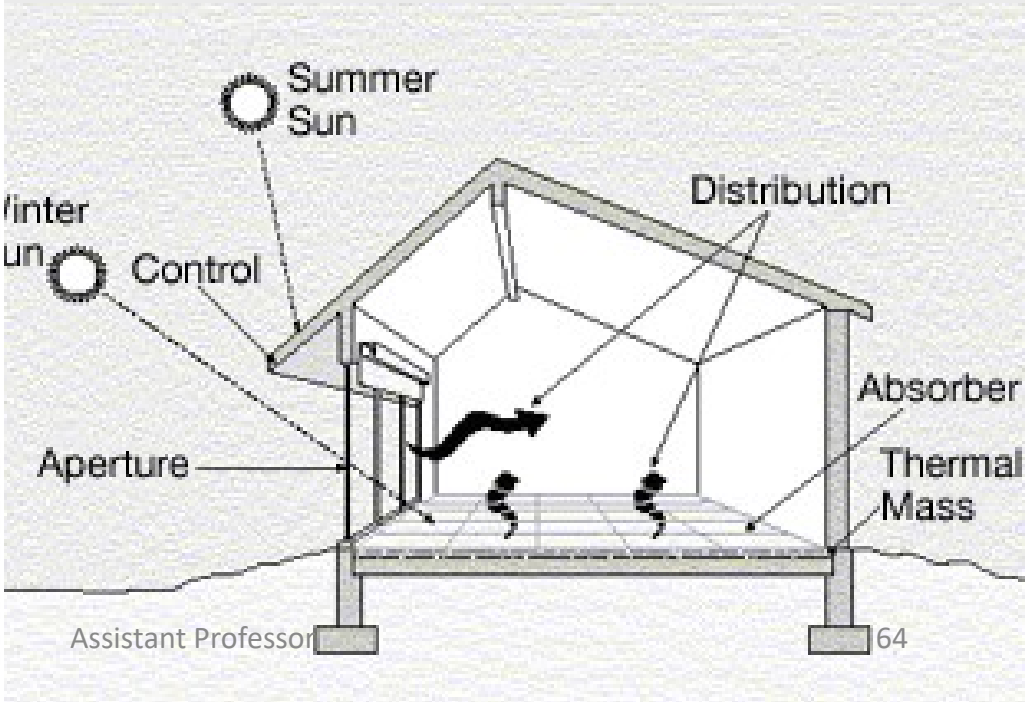
SOLAR ENERGY

- Energy derived from the sun through the form of solar radiation.
- Solar powered electrical generation relies on photovoltaic and heat engines. A partial list of other solar applications include day lighting, solar hot water, solar cooking and high temperature process heat for industrial purposes.
- Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy.

- **Active** solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy.
- **Passive** solar techniques include orienting a building to the Sun, selecting materials with favourable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

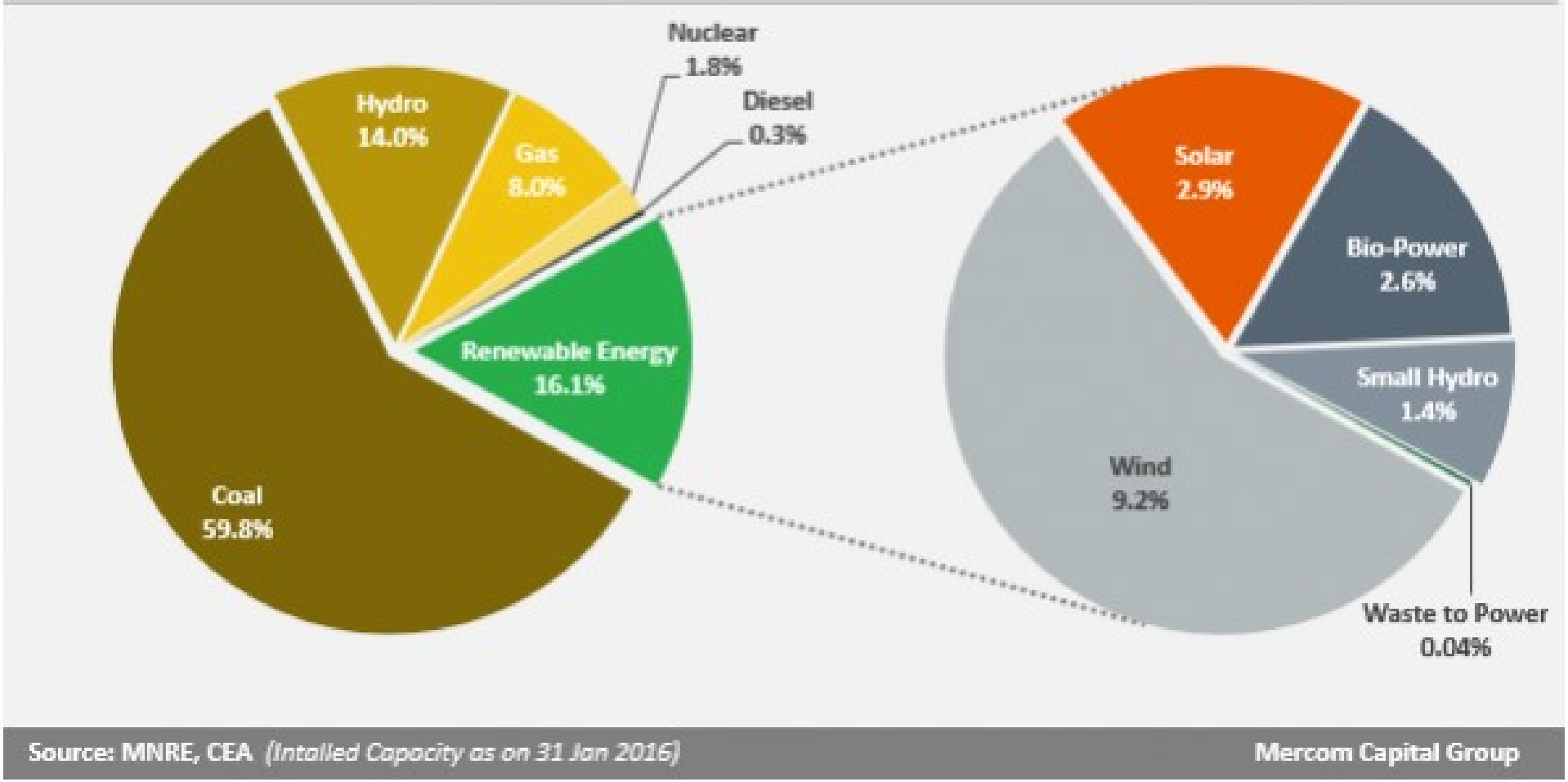

Solar Collectors
Sensor
1
Storage Tank
with heat exchanger
Hot Water Outlet
Controller
Pressure Gauge
3
2
Pump
Cold Water Inlet


Typical PV System
PV Array
Controller
DC Load
Batteries
Inverter
AC Load

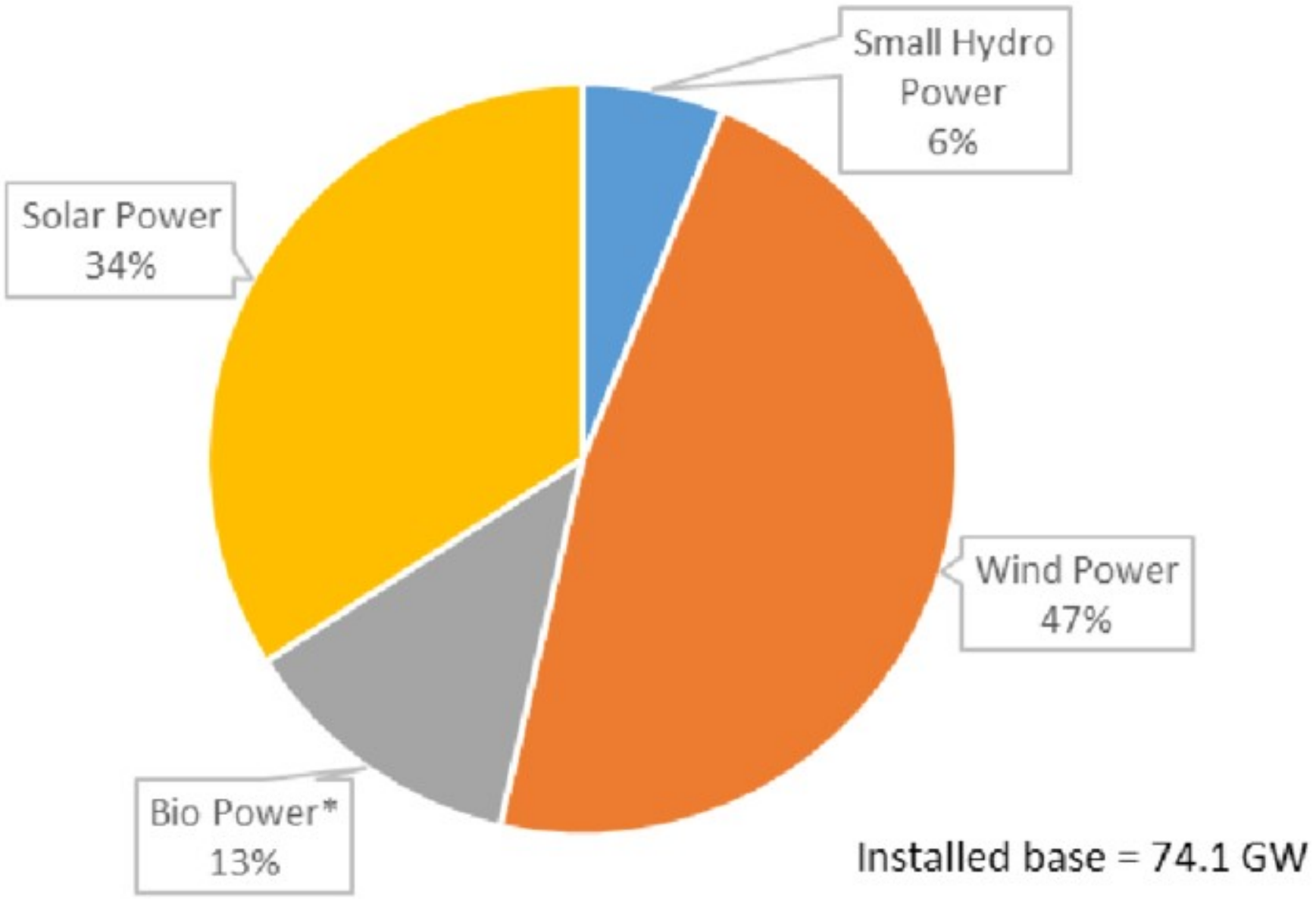

Summer
Sun
Distribution
Control
Absorber
Aperture
Thermal
Mass

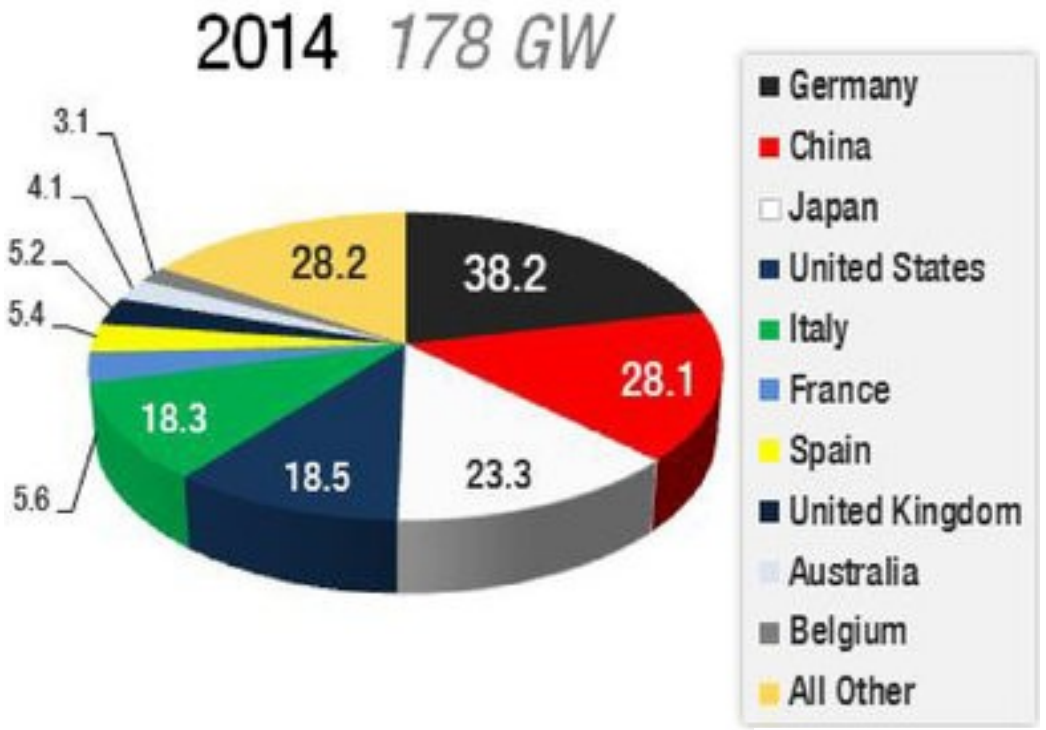
India - Installed Power Capacity Mix (%)

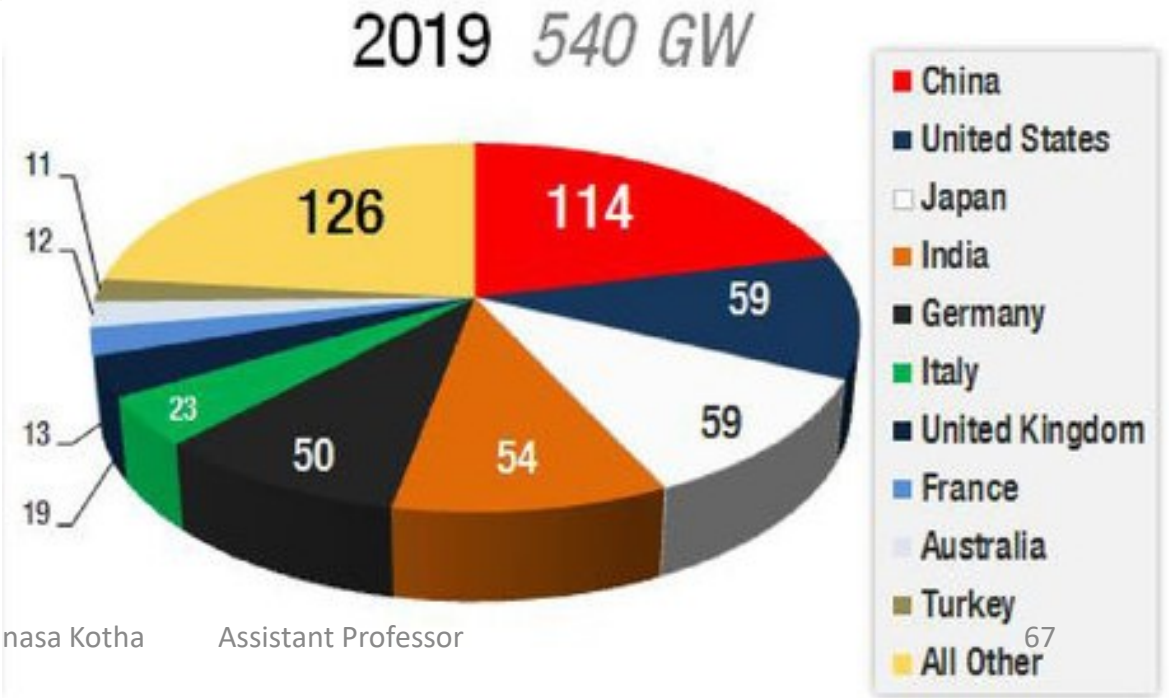
Renewables comprise 16.1% of India's total installed capacity, with solar accounting for 2.9%. Among renewables, solar accounts for almost 18.2% of the installed capacity



Source: MNRE, CEA *(Intalled Capacity as on 31 Jan 2016)* Mercom Capital Group


Small Hydro Power 6%
Solar Power 34%
Wind Power 47%
Bio Power* 13%
Installed base = 74.1 GW


2014 178 GW
3.1
4.1
5.2
5.4
5.6
28.2
38.2
28.1
18.3
18.5
23.3
Germany
China
Japan
United States
Italy
France
Spain
United Kingdom
Australia
Belgium
All Other


2019 540 GW
11
12
13
19
126
114
59
59
54
50
23
China
United States
Japan
India
Germany
Italy
United Kingdom
France
Australia
Turkey
All Other

Advantages of Renewable Resources

- Wide availability
- Lower running cost
- Decentralized power production
- Low pollution
- Available for the foreseeable future

Disadvantages of Renewable Resources

- Unreliable supply
- Usually produced in small quantities
- Often very difficult to store
- Currently per unit cost of energy is more compared to other types

Non Renewable Resources

- A non renewable resource is a natural resource that cannot be re-made or re-grown at a scale comparable to its consumption.
- NUCLEAR ENERGY
- COAL, PETROLEUM, AND GAS
- FOSSIL FUELS

NUCLEAR ENERGY, COAL, PETROLEUM, AND GAS

- Nuclear fission uses uranium to create energy.
- Nuclear energy is a non renewable resource because once the uranium is used, it is gone!
- Coal, petroleum, and natural gas are considered non renewable because they can not be replenished in a short period of time. These are called fossil fuels.

Disadvantages of Non-Renewable Resources

- When coal is burnt it produces carbon dioxide that causes global warming.
- Since coal contains impurities like S and N, it produces toxic gases during burning which causes acid rain and air pollution.
- Traces of mercury and radioactive compounds are also released when coal is burned.
- Severe human health threat.(lung disease)

Advantages of Non-Renewable Resources

- Available in highly concentrated form
- Easy to store
- Reliable supply
- Lower cost per unit of energy produced as the technology is matured