GOVERNMENTPOLYTECHNIC,DHENKANAL

Programme:DiplomainMechanicalEngineering

Course:EnvironmentalStudies(Theory)

CourseInstructor'sName:Abinash Mishra
E-mail- abinash.mishradkl@gmail.com
Contact no- 8018153311
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Unit1:TheMultidisciplinarynatureofenvironmentalstudiesDefinition –

Environmental studies are an interdisciplinary subject examining the interplay between the social, legal, management, and scientific aspects of environmental issues.Interdisciplinary means thatissues are examined frommultiple perspectives.

Scopeofenvironmentalstudies-

Theenvironmentalstudiesdisciplinehasmultipleand multilevelscopes.Thisstudyis important and necessary not only for children but also for everyone. The scopes are summarized as follows:

1. The study creates awareness among the people to know about various renewable and non-renewable resources of the region. The endowment or potential, patterns of utilization and the balanceof variousresourcesavailablefor futureuseinthe state of a country reanalysed in the study.

2. Itprovidesknowledgeaboutecologicalsystemsandcauseandeffectrelationships.

3. It provides necessary information about biodiversity richness and the potential dangers tothespecies of plants, animals, and microorganisms intheenvironment.

4. The study enables one to understand the causes and consequences due to naturaland main induced disasters (flood, earthquake, landslide, cyclones etc.,) and pollutionand measures to minimize the effects.

5. It enables one to evaluate alternative responses to environmental issues before deciding on an alternative course of action.

6. The study exposes the problems of overpopulation, health, hygiene, etc. and the roleof arts,scienceandtechnology ineliminating/ minimizingthe evils fromsociety.

inherited from our ancestors to the younger generating without deteriorating their quality.

Importanceofenvironmentalstudy-

- Environmental study is based upon a comprehensive view of various environmentalsystems.Itsaimstomakethecitizenscompetenttodoscientific work and to find out practical solutions to current.
- environmental problems. The citizens acquire the ability to analyse the environmentalparameterslikeheaquatic,terrestrialandatmosphericsystems and their interactions with the biosphere and anthroposphere.

Importance

• World population is increasing at an alarming rate especially in developing countries. The natural resources endowment in the earth is limited.

• Themethodsandtechniquesofexploitingnatural resourcesareadvanced.

• The resources are over-exploited and there is no foresight of leaving the resources to the future generations.

• The unplanned exploitation of naturalresources leads to pollution of alltypesand at all levels.

• The pollutionand degraded environment seriouslyaffectthe healthof all livingthings on earth including man.

• The people should take a combined responsibility for the deteriorating environment and begin to take appropriate actions to space the earth.

• Educationandtrainingareneededtosavethebiodiversityandspeciesextinction.

• Theurbanarea,coupledwithindustries,ismajorsources ofpollution.

• The number and area extinct under protected area should be increased so that the wild life is protected at least in these sites.

• Thestudyenablesthepeopletounderstandthecomplexitiesoftheenvironmentand need for the people to adapt appropriate activities and pursue sustainable development, which are harmonious with the environment.

• Thestudy motivatesstudents togetinvolvedincommunityaction,andtoparticipate in various environmental and management projects.

• Itisahightimetoreorienteducationalsystemsandcurriculatowardstheseneeds.

Needforpublicawareness–

- Increasing population, Urbanization and poverty have generated pressure on thenaturalresourcesandleadtoadegradationoftheenvironment.ToPrevent theEnvironmentfromFurtherDegradation,thesupremecourthasorderedand initiated environmental protection awareness through government and non-government agencies to take part in protecting our environment.
- Environmental pollutioncannot bepreventedby lawsalone. Publicparticipation is equally important with regard to environmental protection.
- Climate change,lossofbiodiversity,declining fisheries, ozonelayerdepletion, illegal trade of endangered species, destruction of habitats, land degradation, depleting ground water supplies, introduction of alien species, environmental

pollution, solid waste disposal, storm water and sewage disposal pose a serious threat to ecosystems in forest, rural, urban and marine ecosystems.

- Both formal and informal education on the environment will give the interested individual the knowledge, values, skills and tools needed to face the environmental challenges on a local and global level.

Unit2:NaturalResources

Renewableandnonrenewableresources:

RenewableResources

Theresourceswhichcannotbeexhaustedevenaftercontinuousutilizationaretermed as renewable resources. Examples of renewable resources are the sun, wind, and tidal energy.

Non-RenewableResources

The resources which cannot be immediately replaced once they are depleted are calledNon-renewableresources.ExamplesofNon-renewableresources includefossilfuels,suchascoal,petroleumandnaturalgasandraremineralstypically found in meteorites.

a)Naturalresourcesandassociatedproblems– Forest Resources -

Forest is important renewable resources. Forest vary in composition and diversityand can contribute substantially to the economic development of any country.Plantsalong with treescover large areas,producevarietyof productsand providefood for living organisms, and also important to save the environment.

Overexploitationofforests

Forestscontributesubstantially tothenational economy. With increasingpopulationincreased demand of fuel wood, expansion of area under urban development andindustrieshasleadtooverexploitationofforest.Atpresentinternationallevelwearelosing forest at the rate of 1.7 crore hectares annually. Overexploitation also occursdue to overgrazing and conversion of forest to pastures for domestic use.

Deforestation

1. Forest are burned or cut for clearing of land for agriculture ,harvesting for wood and timber , development and expansion of cities .These economic gains are short term where as long term effects o deforestation are irreversible
2. Deforestationrateisrelatively lowintemperatecountriesthanintropics If present rate of deforestation continues we may losses 90% tropical forest in coming six decades
3. For ecological balance 33% area should be under forest cover but our nation has only 20.6% forest cover.

CausesOfdeforestation-

Forestareainsomedevelopedareahasexpanded.Howeverindevelopingcountries area under forest is showing declining trendparticularly in tropicalregion. Maincausesofdeforestation are

a) *Shiftingcultivationorjhumcultivation*
b) *Commerciallogging*
c) *Needforfuelwood*
d) *Expansionforagribusiness*
e) *Developmentprojectsandgrowingneedforfood*
f) *Rawmaterialsforindustrialuse*

CaseStudies-

Jhum Agriculture or shifting agriculture has destroyed large number of hectare offorest tracts in North-Eastern states and Orissa. Jhum agriculture is subsidenceagricultureinwhichtractof forest land is cleared bycutting treesand it isusedforcultivation.

After few years, when productivity of the land decreases, cultivators abandon theland and clear next tract. As a result of this practise, combined with increasingpopulation thereisrapid deforestationasmoreand morecultivatorsclear foresttocultivate land. Also, with increase in population there is cultivators are forced toreturntopreviousstracts.shortageoffirewoodandtimber,duelargescaletreecutting. Increasedtraffic volumes onthese roads leads to increasedpollutioninthe area.

Timberextraction

There has been unlimited exploitation of timber for commercial use. Due toincreased industrial demand; timber extraction has significant effect on forest andtribal people.

Logging

- Poorloggingresultsindegradedforestandmayleadtosoilerosion especially on slopes.
- Newloggingroadspermitshiftingcultivatorsandfuelwoodgatherersto gain access to the logging area.
- Lossoflongtermforestproductivity
- Speciesofplantsandanimalsmaybeeliminated
- Exploitationoftribalpeoplebycontractor.

Mining

Majoreffects ofminingoperationsonforestandtribalpeopleare:

- Mining from shallowdeposits is done by surface mining while that from deepdepositsisdonebysub-surfacemining. Itleadstodegradationof lands and loss of top soil. It is estimated that about eighty thousands hectareland is under stress of mining activities in India
- Miningleadstodryingupperennialsources of watersourceslikespring and streams in mountainous area.

- Mining and other associated activities remove vegetation along with underlying soil mantle, which results in destruction of topography and landscape in the area. Large scale deforestation has been reported in Mussoorie and Dehradun valley due to indiscriminating mining.

- **Effectsofdamsonforestsandtribalpeople**

Pandit Jawaharlal Nehru referred dam and valley projects as "Temples ofmodern India". These big dams and rivers valley projects have multi-purposeuses.However,thesedamsarealsoresponsibleforthedestructionof forests.

- Theyareresponsiblefordegradationofcatchmentareas,lossoffloraandfauna, increaseofwaterbornediseases,disturbanceinforestecosystems,rehabilitati on and resettlement of tribal peoples.

- India has more than 1550 large dams, the maximum being in the state ofMaharashtra(morethan600),followed byGujarat(more than 250) and Madhya Pradesh (130).
- The highest one is Tehri dam, on river Bhagirathi in Uttaranchal and the largest in terms of capacity is Bhakra dam on river Satluj in Himachal Pradesh. Big dams have been in sharp focus of various environmental groups all over the world, which is mainly because of several ecological problems including deforestation and socio-economic problems related to tribal or native people associated with them.
- The Silent valley hydroelectric project was one of the first such projectssituatedinthetropicalrainforestareaofWesternGhatswhich attracted much concern of the people.
- The crusade against the ecological damage and deforestation caused duetoTehridamwas ledby Shri. Sunder LalBahuguna, theleader of Chipko Movement.

WATERRESOURCES:

- Water is the most abundant, inexhaustible renewable resource. It covers70%of the globe in the form of oceans, rivers, lakes, etc. Of this 70%, only3% is available as freshwater.
- From this 3%, roughly 2% is frozen in polar icecaps and only a fraction ofthe remaining1% is used as drinking water (potable). 90% of the water isutilized for agricultural purposes in India.

USEOFSURFACEANDGROUNDWATER

- Consumptiveuse:Insuchuses,wateriscompletelyutilizedandcannotbe reused. Ex:Domestic, industrial and irrigation
- Non-consumptive use: In such uses, water is not completely utilized andis reused Ex:Hydropower plant

Otheruses:

1. Waterisusedfordomesticpurposeslikedrinking,bathing,cooking,washing.etc.
2. Waterisusedincommercialestablishmentslike hotels,theaters,educational institutions, offices, etc.
3. Almost60-70%offreshwaterisusedforirrigation
4. 20-30%of water is usedfor industrial operations byrefineries, iron &steelindustries, paper&pulpindustries,etc.
5. Waterplaysakeyroleinsculptingtheearthssurface,moderatingclimateanddiluting pollutants.

OVER-UTILIZATIONOFSURFACE&GROUNDWATER

Therapidincreaseinpopulationandindustrialgrowthledtoseveredemandonwaterresources. After using all availablesurface water resourcesto the maximum, humanbeings began using groundwater to meet their needs.

1. Theincreasedextractionofgroundwaterfarinexcessofthenaturalrechargeledtodecreasedgroundwater level. The erraticand inadequate rainfall caused reduction instorage of water in reservoirs. This also led to decrease of groundwater.
2. Buildingconstructionactivitiessealpermeablesoilzoneandreducetheareaforpercolation of rainwater thereby increasing surface runoff.
3. Ifgroundwater withdrawal rateis higherthan rechargerate,sedimentsinaquifersget compacted resulting in sinking of overlaying land surface. This is called landsubsidence whichleadstostructuraldamageinbuildings,fractureinpipesandreversestheflowof canalsleadingtotidalflooding.
4. Over-utilizationofgroundwaterinaridandsemi-aridregionsforagriculturedisturbs equilibriumofreservoirintheregioncausingproblemslikeloweringofwatertableand decreasedpressureinaquiferscoupledwithchangesinspeedanddirectionof waterflow.
5. Overutilizationofgroundwaterincoastalareasleadstorapidintrusionofsaltwaterfrom the sea thereby rendering it unusable for drinking and agriculture.

6. Over-utilization of groundwater lads to decrease inwater level thereby causingearthquake, landslides and famine.

Drought

- Waterisaverybasicnecessityforthe survivalof life onearth.Imagine lifewithinsufficient amount of water, it will be impossible to do the daily activities ofcleaning, cooking, drinking etc.
- Life will turn out to be a miserable chaos. Water cycle has helped in maintainingthe quantity of water on the surface of earth. About50 litters of water is neededper day per person in order to sustain a healthy life.
- Therearemanyareaswherepeopledonotreceivethisbasicquantityofwater.Areas that do not receive adequate amount of rainfall and have dry soil sufferfrom droughts. Whereas areas which receive heavy rainfall and have marshysoil generally get flooded.
- Drought conditions result from a lack of precipitation and this has many effectson the surrounding land and weather conditions. Drought conditions canworsen after prolonged periods of no rainfall, especially in areas where thewater supply is short.

Causesdrought?

Lackofrainfall(orprecipitation): Droughtscanoccurwhenthereisthe lackof'expected' precipitation (rain and snow).

Notethatwesay'expected' becausethe lack ofrainalonedoesnotmean adrought.

FLOOD

ReasonsofFlood

- Rains: Each time there are more rains than the drainage system can take,there can be floods. Sometimes, there is heavy rain for a very short periodthat result in floods. In other times, there may be light rain for many daysand weeks and can also result in floods.
- River overflow: Rivers can overflow their banks to cause flooding. Thishappens when there is more water upstream than usual, and as it flowsdownstreamtotheadjacent low-lyingareas (alsocalledafloodplain),thereis a burst and water gets into the land.
- Strong winds in coastal areas: Sea water can be carried by massive windsand hurricanes onto dry coastal lands and cause flooding. Sometimes thisismadeworseifthewindscarryrainsthem. Sometimeswaterfromthesearesulting from a tsunami can flow inland to cause damage.
- Dam breaking (Dams are built along the side of a river and are used toprevent high water from flooding bordering land). Sometimes, too muchwaterheldupinthedamcancauseittobreakandoverflowthearea.Excessw ater can also be intentionally released from the dam to prevent it frombreaking and that can also cause floods.

Conflictsoverwater(international&inter-state).

Conflict through pollution: Rivers are also used for industrialpurposes. Theyactasreservoirsforsupplyoffreshwaterandalsoareceptorofwastewater

and rubbish from the industry. Water crossing borders that has been pollutedby wastes from one country develops into an international conflict.

Managementofwaterconflicts

1. Concerted efforts are required to enforce laws that check these practices tocontrol water pollution.

2. Inordertoovercometheproblemofsharingriverwaterinacountry,theconcept of interlinking of rivers has been suggested.

3. RiversshouldbenationalizedtheNationalWaterAuthorityandRiverBasinAuthority should be given powers to ensure equitable distributionof basin water

Foodresources:

Worldfoodproblems,changescausedbyagricultureandovergrazing,effects ofmodernagriculture,fertilizer-pesticideproblems,waterlogging,salinity,case studies.

FoodResources:

- Almostentirelyfromagriculture,animalhusbandryandfishing.AlthoughIndi a is self-sufficient in food production, it is only because of modernpatterns of agriculture that are unsustainable and which pollute ourenvironment with excessive use of fertilizers and pesticides.
- TheFAOdefinessustainableagricultureasthosewhichconservesland,wate r and plant and animal genetic resources, does not degrade theenvironment and is economically viable and socially acceptable.
- Most of our large farms grow single crops (monoculture). If this crop ishit by a pest, the entire crop can be devastated, leaving the farmer withno income during the year. On the other hand, if the farmer usestraditional varieties and grows several different crops, the chance ofcomplete failure is lowered considerably.
- Many studies have shown that one can use alternatives to inorganicfertilizers and pesticides. This is known as Integrated CropManagement.

Worldfoodproblems:

Ourfertilesoilsarebeingexploitedfasterthantheycanrecuperate.

• Forests, grasslands and wetlands have been converted to agricultural use, which has led to serious ecological questions.

• Ourfishresources,bothmarineandinland,showevidenceofexhaustion.

• Therearegreatdisparitiesintheavailabilityofnutritiousfood.

Some communities such as tribal people still face serious food problems leading to malnutrition especially among women and children. These issues bring in new questions as to how demands will be met in future even with a slowing of population growth

Foodsecurity,lossofgeneticdiversityandalternatefoodsources

(fisheries):

Changescausedbyagricultureandovergrazing:

Agriculturehasboth primaryand secondaryenvironmentaleffects.Aprimaryeffect is aneffectonthearea wheretheagriculturetakesplace i.e.on-siteeffect. Asecondary effect, also called an off-site effect, is an effect on an environment away from the agriculturalsite.Theeffectsofagricultureontheenvironmentcanbebroadlyclassified into three groups, viz. global, regional and local:

(1) GlobalEffects:Theseincludeclimatechangesaswellaspotentiallyextensive

changes in chemical cycles.

(2) RegionalEffects:Thesegenerallyresultfromthecombinedeffectsoffarming

practices in the same large region. Regional effects include deforestation, desertification, large scale pollution, increase in sedimentation in major rivers and in the estuaries at the mouths of the rivers and changes in the chemical fertility of soils over large areas. In tropical waters, sediments entering the ocean can destroy coral reefs.

Effectsof modernagriculture-FertilizerPesticideproblems,Waterlogging, Salinity

Agriculture is an art, science and industry of managing the growth of plants and animalsforhumanuse.Agricultureincludespreparationofsoilforcultivation ofcrops, harvestingcrops,breeding and raising livestock, dairying and forestry. Thetwo major

typesofagricultureare:

1. Traditionalagriculture
2. ModernorIndustrializedagriculture

MODERN AGRICULTURE

Modernagriculturemakesuseofhybridseedsofsinglecropvariety,technologically

advanced equipment, fertilizers, pesticides and water to produce large amounts of single crop.

Problemsusingfertilizers

1. Micronutrientimbalance
2. Nitratepollution
3. Eutrophication

WATERLOGGING

Ifwaterstandsonlandformostoftheyear,itiscalledwaterlogging.Inwaterlogged

conditions,pore-voidsinthesoilgetfilledwith waterandsoil-airgetsdepleted.Insuch aconditiontherootsofplantsdonotgetenoughairforrespiration.Water loggingalso leads to low mechanical strength of soil and low crop yield.

CAUSESOFWATERLOGGING

1. Excessivewatersupplytothecroplands
2. Heavyrain
3. Poordrainage

MEASURESTOPREVENTWATERLOGGING

1. Avoidandpreventexcessiveirrigation
2. Sub-surfacedrainagetechnology
3. Bio-drainagebytreeslikeEucalyptus

SALINITY

Waternotabsorbedbysoil,isevaporatedleavingbehindathinlayerofdissolvedsalts in the top soil. This is called salinity of the soil. Saline soils are characterized by accumulation of soluble salts like sodium chloride, calcium chloride, magnesium chloride, sodium sulphate, sodium carbonate and sodium bicarbonates. Saline conditions are exhibited when pH is greater than 8.0

PROBLEMSINSALINITY

Saline soils yield less crop In order to remedy the condition of saline soils the following two techniques may be used:

1. Saltdepositisremovedbyflushingwithgoodqualitywater
2. Byusingasub-surfacedrainagesystem,thesaltwaterisflushedoutslowly.

CASESTUDIES

CanalirrigationinHaryanaresultedinrisingwatertablefollowedbywaterloggingand salinity causing low crop productivity thereby huge economic losses. Similarly, the "Indira Gandhi Canal Project" in Rajasthan converted a big area into a "water soaked waste land". In Delhi, accumulation of pesticides and DDT in the body of mothers caused premature deliveries or low birth weight infants. Food centre at Centre for ScienceandEnvironment(CSE)IndiareportedPepsiandCoca-Colacompaniessold soft drinks with apesticidecontent 30-40times higher than EU guidelines permit.

Energyresources:

Renewableandnon-renewableenergysources–

Energyisbroadlyclassifiedintotwomaingroups:RenewableandNon-renewable.

RenewableEnergy

Renewable energy is the energy which is generated from natural sources i.e. sun, wind,rain, tides and can be generated again and again as and when required.

ProsandConsofRenewableenergy:

• The sun, wind, geothermal, ocean energy are available in the abundant quantity and free to use.

• The non-renewable sources of energy that we are using are limited and are bound to expire one day.

• Renewable sources have low carbon emissions, therefore they are considered as green and environment friendly.

• Renewable helps in stimulating the economy and creating job opportunities. The money that is used to build these plants can provide jobs to thousands to millions of people.

• Youdon't havetorelyon anythirdcountryforthesupplyof renewable sourcesasin case of Non-renewable sources.

• Renewable sources can cost less than consuming the local electrical supply. In the long run, the prices of electricity are expected to soar since they are based on the prices of crude oil, so renewablesources can cut your electricity bills.

Non-RenewableEnergy

Non-Renewable energy is the energy which is taken from the sources that are availableontheearthinlimitedquantityandwillvanishfifty-sixtyyearsfromnow.Non-renewable sources are not environmental friendly and can have serious affect on our health.

USEOFALTERNATERENEWABLEENERGYSOURCES

1. Solarenergyisrenewableanddoesnotcauseenvironmentalpollution

2. Energy sources that create minimum pollution, are safe not prone to security threats and have universal availability have the best chance oflarge-scale utilizationin future.

3. Hydro-electricpowergenerationisexpectedtotheexistingecologicalbalance.

4. Apart from generating heat, hydel power plants critically endanger aquatic and terrestrial biotic.

5. Radioactive pollutants released from nuclear plants are chronically hazardous. Commissioning of Boiling Water Power Reactors (BWRs) result in accumulation of large number of radionuclides in water

6. Dangerous radioactive waste cannot be buried in/land without the risk of polluting soil and underground water. The waste cannot be dumped in rivers as it poisons aquatic life and human beings.

7. Burning of coal, oil, wood, dung cakes and petroleum products have well established environmental problems. The smoke produced causes respiratory and digestive problems leading to lung, stomach and eye diseases.

CASESTUDIES

Wind energy India is generating 1200 MW electricity using wind energy. The largest wind farm is in Kanyakumari in Tamil Nadu, which generates 380 MW electricity. Hydrogen-Fuel cell car General motor company of China invented experimental cars that run on electric motors fuelled by hydrogen and oxygen. These cars produce no emission and the only waste products being water droplets and water vapour. Commonly known alternative energy sources.

LANDRESOURCES

- In India, land is generally called as "MOTHER LAND". It is because of our life depend on it for food, fibre , fuel and other basic amenities. Therefore, it is the valuable gift of nature to human beings. Top layer of the land is called soil, which is renewable resource and essential for survival of life.
- Land available for cultivation is approximately 14 million hectares. But it is reducingdaybyday.Itisduetomismanagement.Theearthismadeupofthree principal layers cores, mantle and crust. Cores are inner most fluid layers.
- Land isclassified in to 9 categories .
  They are (i) forests,
  (ii) landputtonon-agriculturaluse
  (iii) barrenlandunculturableland
  (iv) permanentpasturesandothergrazinglands
  (v) misc.treecropsandgroves
  (vi) culturablewaste
  (vii) fallowland
  (viii) currentfallow
  (ix) netareasown.

LANDSUITABLEFORCULTIVATIONANDOTHERUSES:

- Therearefourclassoflandwhicharesuitableforcultivationandother purposes. Their details & limitations are as
- SoilsinclassIhaveveryfewornolimitationsthatrestricttheiruse.
- Thistypeoflandisnearlylevelandtheerosionhazardislow.
- soilsaredeep,well-drained,easilyworked,holdwater wellandareeitherfairly well supplied with plant nutrients or are highly responsive to the application of fertilizers. Thesoils are not subject to damage because of overflow.
- Soils in this class are suited to a wide range of plants, may be used for cultivated crops, pastures, forests and wild life, food and cover.

The limitations of soils in class II may result from the effects of one or more of the following factors : (i) a gentle slope,

(ii) aslightsusceptibilitytoerosion,

(iii) lessthanidealsoildepth,

(iv) occasionaldamagingoverflow,

(v) wetness which can be corrected by drainage, but existing permanently as amoderate limitation,(vi)slightto moderate salinityorsodium, easilycorrected but likely to re-occur, and

(vii)aslightclimaticlimitationonsoiluseandmanagement.

Limitations of soils inclass III mayresultfrom the effects of oneormore ofthefollowing factors :

(i) moderatelyslopingland.
(ii) moderatelysusceptibletowaterorwinderosion.
(iii) frequentoverflowaccompaniedwithsomecropdamage,
(iv) veryslowpermeabilityofthesubsoil,
(v) wetnessorcontinuingwater-loggingafterdrainage,
(vi) shallowsoildepthuptothebedrock,hard-panorclay-panwhichlimitsthe rooting-zone and the water storage,
(vii) lowmoistureholdingcapacity,
(viii) moderatesalinityorsodium,and
(ix) moderateclimaticlimitation.

Thesoilscanbeused forraising cultivated crops,pastures,forestsand wild- life food and cover.

Theuseofthesesoils forcultivatedcrops is limitedasaresultofthe effectofone or more permanent features, such as

(i) steepslopes,
(ii) severesusceptibilitytowaterandwinderosion,
(iii) severeeffectofpasterosion,
(iv) frequentover-flowaccompaniedwithseverecropdamage,
(v) excessive wetnesswithacontinuinghazardofwater-loggingafterdrainage,
(vi) severesalinityorsodium,and
(vii) moderatelyadverseclimate.

Thesesoilscanbeusedforcrops,pastures,forestsandwildlifefoodandcover.

LANDDEGRADATION

- Thetotallandunderagriculturaluseisaround58.4%i.e.grossedcroppedarea is 167.41 million hectares. The land not fit for cultivation i.e. barren land is around 9.9%. The area under forest is 21.6%, but it needs to be raised.
- land resources are the precious resources. Food security depend on conservation and proper utilization of all resources.
- Due to use and over exploitation land resources are degraded. It is due to the more & more pressure with increasing population.
- Land degradation is a real alarm. Because soil formation is a very slow process. In millions of years we have a layer crust of fertile soil. In general, formation of 1.0 cm soil crust from parent material take 300 - 400 years.

- Fertile soil have high percentage of organic matter vis-a-vis microorganisms. Each gram of fertile soil have 30 billion micro-organisms.

Significanceoftheproblem:

- In India, green revolution brought about technological breakthrough, which led totheuseofshortduration high yieldingvarieties helpingintenseuseof landin a year, increasing area brought under irrigation and more use of Chemicals such as fertilizers and pesticides.
- India, being vastly agriculture oriented. Development of agriculture would lead to overall development of the nation and help eradication of poverty.
- It has been of late recognised that the increasing efforts to raise agricultural growth has cost us clearly in theform of land & water degradation

LANDSLIDES

A landslide is a sudden collapse of a large mass of hillside. There are many different typesof landslides wherenot onlyearth,butrock, mud, anddebrisflowdown theside of a slope. Since the beginning of the monsoon season in June India has been hit by heavy rains and landslides affecting in particular, Arunachal Pradesh, Assam, and Bihar states

Landslidesmostlyoccur

1. Wherelandslideshaveoccurredbefore.
2. Onsteepslopes.
3. On benches.
4. Wheredrainageiscausingaproblem.
5. Wherecertaingeologicconditionsexists.

Typesoflandslides

1. Shallow, disrupted landslide-Example of this type is the Santa Susana Mountains and the mountainsnorth of the Santa ClaraRiver Valley. Heremorethan 75%of the slope area was denuded by landslides triggered by strong shaking,

2. Deep. Coherent Landslides. These triggered by the earthquake were far less numerous than disrupted slides, they contributed significantly to the total volume of landslidematerialbecausetheytendedtobemuchlarger.Someofthese landslides are

Maninduceslandslides:

Man can also cause slides by mining the earth, underground draining groundwater levels or overdeveloping hillsides. Man induced landslides are generally done for the developmentpurposesi.e.industrial,formingroads,agriculturaluse,homes,etc.They use heavy explosives for that. In this case no serious casualties or damage occur because proper warned earlier to shift in safer places. affected

Effects:

Noheavydamageoccur inmaninducedlandslidesbutthousandsofandkilleddueto landslides. Many houses can be damaged and the loss of public properties is also noticed. Roads and rail communication may remain cut off from rest of the regions. Thunder storms cause debris flows on hill slopes leading to deposits of mud. Heavy rains at the same time may worsen the situation.

Soilerosion:

Soilerosion meansthe removalofmaterialfrom thesurface ofthe soilby theagency of running water, wind or even by gravity. Since the superficial layers of the soil are the richest in plant valuable plant nutrients and if it becomes sufficiently intense, may leadto the complete destruction of the soil as theseat of plant growth.

- Normal or geologic erosion. Geologic erosion takes place steadily but so slowly that ages are required forit to makeany markedalteration in the major features of the earth's surface. There is always an equilibrium between the removal and formation of soil, so that unless the equilibrium is disturbed by some outside agency, the mature soil preserves, more or less, a constant depth and character indefinitely.
- Accelerated soil erosion. The removal of the surface soil from areas denuded of their natural protective cover as a result of human and animal interference takes place at a much faster rate than that at which it is built up by the soil-forming processes.
- Wind erosion. Wind erosion takes place normally in arid and semi-arid areas devoid of vegetation, where the wind velocity is high.
- The soil particles on the land surface are lifted and blown off as dust-storms. When the velocity of the dust-bearing winds is retarded, coarser soil particles are deposited in the form of dunes and thus fertile lands are rendered unfit for cultivation.
- Sheet erosion. Sheet erosion removes a thin covering of soil from large areas, often from entire fields, more or less, uniformly during every rain which produces a run-off.
- Rill erosion. When sheet erosion is allowed to continue unchecked, the silt-laden run-off forms a well-defined, but minute finger-shaped grooves over the entirefield. Such thin channelling is known as rill erosion.
- Gullyerosion.Whenrillerosionisneglected,thetinygroovesdevelopintowider and deeper channels, which may assume a huge size. This is called'gully'erosion.

DESERTIFICATION

- Desertification is a process by which productive potential of arid or semiarid land falls. The decrease in productivity is varies from 10%-50%. Thus, desertification leads to the conversion of irrigated crop land to desert (where productivity is minimum).
- It is characterized by de vegetation loss of vegetal cover, depletion of ground water, salinization and soil erosion.
- Draught in three consecutive years in Central India in recent years has accelerated the process of wind erosion and desertification.
- In Rajasthan and Kutch-Saurashtra area, extension in the area of desert is assumingserious proportion.Climatic change andanthropogenicactivitiesare also responsible for desertification.
- During last so many years large area has destroyed (agriculture land) by SaharaDesert.InIndia,also,somanyplaceswhichaffectedbydesertification.
- Deforestationis also oneofthe causesof desertification.The increasing cattle population heavily graze in grasslands or forests and denude the land area, which is not suitable for seed germinations. Thus, overgrazing is also one of the causes for desertification.

RoleofanindividualinconservationofNaturalresources:

- Planning of a suitable strategy for the conservation of our natural resources and most judicious execution of planned strategies is called as Conservation Management.
- Environmental planning, evaluation, monitoring, and impact assessment are methods of conservation management. The Indian philosophy of conservation is to keep “Harmony with Nature”.

1. People should at once stop the over utilization of natural resources instead they must be properly used.

2. Instead of deforestation, representation should keep in mind. We should take help from the Govt. for plantation programmes. Everybody should take part in plantation and care the plants.

3. Weshouldprotectwildlife.Thoughhuntingisnotallowedeventhenthepersonsare doingso. For these educated young should teach thelesson of wild life act.

4. Mixed croping, crop rotation, and proper use of fertilizer insecticide, pesticides should be taught to farmers. Encourage the use of manures, biofertilizers organic fertilizers.

5. Weshouldmakehabitforwastedisposal,composeandtorestorebiodiversity.

6. Trytoeducatelocalpeopleforttheprotectionandjudicioususeofnaturalresources.

7. Weshoulduselight,fansandotherdomesticapplianceswhenitisneeded.

8. Maintainabalancebetweenresourcesandhumanneeds.

9. Maintaintheessentialecologicalprocessesandthelifesupportsystems.

10. Installrainwaterharvestingsysteminhouses,colonies.

We know “collecting drop-drop-drops form a big ocean”, similarly if each of uswill awareaboutthejudicioususeofnaturalresources,allofuswillconservethenature.

EquitableuseofresourcesforsustainablelifeStyle:

- The equal distribution of natural resources should be for all irrespective of rich orpoor.Theremustbebalancebetweentheneedandconsumptionparticularly for drinking water, food, fuel etc.
- The developed countries are utilizing more resources as compared to developingcountries.Thisimbalanceisresponsible forrich becomericherand poor gone poorer.
- Thisis due to sharp increase in population indeveloping countries. But it does not mean that people of developed countries are rich and having good life style, and less developed countries people are poor.
- Less developed countries also have rich and poor both but facing the problem of population and available natural resources.
- Developed countries like USA, Canada, Japan, Australia etc. have 22% of world'spopulationutilising86%ofnaturalresources.Thusitisneededtodivert theresources topoor countries to narrow down thegap between the two.

- To achieve sustainable life style, there should be equal distribution of global resources and income to meet everyone's need. But in the long process of economic development only the powerful and strong people exploited most of the environmental resources even at the cost of migration of poor people already using those resources.

Unit3:Systems

CONCEPTOFECOSYSTEM

Now, we can say Ecology deals with interrelationships between the biotic and abiotic compounds of an Ecosystem. The term ecosystem was first coined by A.G. Tausley 1935. It is derived by two words “eco' means environment and'system' implies a complex of co-ordinated units.

An ecosystem concept is that the living organisms of a community not only interact among themselves but also have functional relationship with their non-living environment. This structural and functional system of communities and their environment is called an ecosystem.

FUNCTIONINGANDTYPESOFECOSYSTEMS

Depending upon the species, diversity and the manner in which they are organised, are of following types

1. Permanent and Natural ecosystem. These operate under natural conditions withoutany interference(evenby human beings).These canbe furtherclassifiedin to

(i) Terrestrialecosystem(ii)Aquaticecosystem

TerrestrialecosystemsoperateonlandhenceForest,DesertandgrasslandandAgro-ecosystemincluded inthistype.WhileAquatic ecosystem operatesin water.Itcanbe devided in two

(a) Freshwaterecosystem

(b) Marineecosystem

Freshwater ecosystems are usually named after the size and nature of the fresh water body such as pond, lake & river.

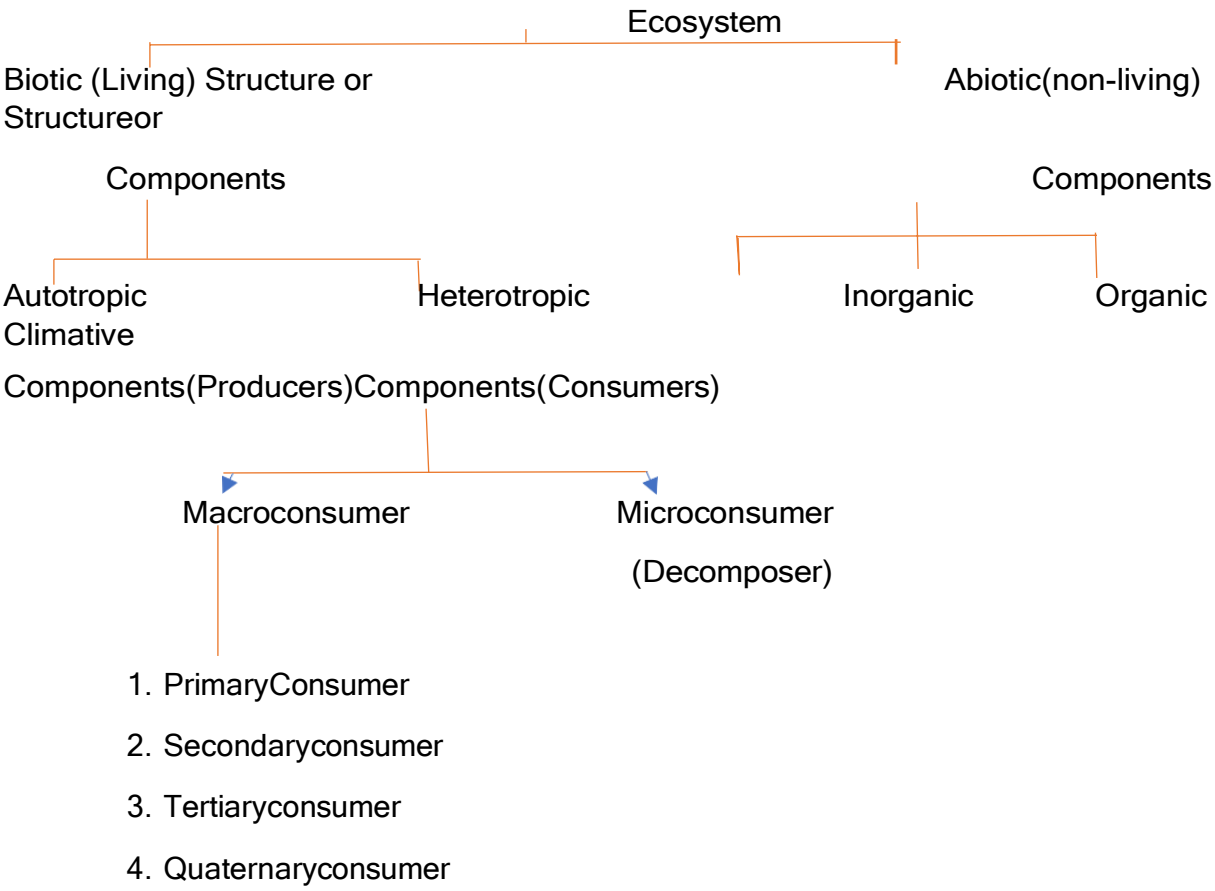
Marine ecosystem is largest ecosystem on earth, which consists of several sub-divisions each having its physico-chemical and Biological characteristics. For example, in the deepest ocean producers are absent but in many other organisms survive which dependent for food on the dead organic matter coming from the upper layers of the ocean.

2. Temporaryand Naturalecosystems. Theseareshortlivedbutoperateunder natural conditions.

3. Artificial or Anthropogenic ecosystems. Theseareman-madelikefisherytanks dams, croplands and space ecosystems also. Fish aquarium is also come under this head.

STRUCTUREOFANECOSYSTEM

It is a description of the species of organisms that are present (including information on their life histories, populations and distribution in space). The structure of ecosystem provides information about the range of climatic conditions that prevail in the area, composition and organization of Biological Communities and Abiotic compounds constitute the structure of an ecosystem. According to Odum, from the trophic (Food) point of view, an ecosystem has thefollowing components:



1. PrimaryConsumer
2. Secondaryconsumer
3. Tertiaryconsumer
4. Quaternaryconsumer

1. BioticStructure.

Producers,consumersanddecomposersarecomponentsofbioticecosystem.Living organisms exchange, expel, convert, assemble, disassembles, organise and otherwisemanipulatetheconstituentsofearth,airandwater.Bioticstructureincludes plants, animals and microorganisms present in an ecosystem. We have identified producers, decomposers and consumers are the basic components of biotic ecosystem. These can be distinguished on the bases of their source of energy and material

(a) Autrotrophiccomponents(Autotrophic=selfnourishing)

In which the fixation of light, energy, the use of simple inorganic substances and manufacture of complex material predominates. Theseare also called producers.

(b) HeterotrophicComponents(Heterotrophic=othernourishing)

Theseutilizes,rearrangesanddecomposesthecomplexmaterialssynthesizedby the autotrophs.The mostintenseheterotrophicactivitytakes place wherethe organic matter accumulates in the soils andsediments. Theseare also called consumers.

PRODUCERS

All green plants are producers. They are also called “converters" or "transformers”.“Theyarelivingmembersoftheecosystemthatutilizesunlightastheir energy source and single inorganic rich chemicals as their own food. Producers are largelyphotosyntheticplantsandtheirkindvarieswiththekindofecosystem.Indense forest the trees are the most important producers. In lakes and ponds, the producers arerooted or largefloating and microscopic plants(phytoplankton) usually the algae.

CONSUMERS

As we have seen earlier, consumers are heterotrophs, the living organisms which ingestother organism.Theyderivetheir food directlyor indirectlyfrom the producers. The food is then digested i.e. broken down to simple substances which are metabolized in the consumers body and released the waste product to the environment. Consumers are of following types---

(1) PRIMARY CONSUMERS- These are also called'HERBIVORES' which feed directly on the producers. They vary with the kind of ecosystem. For example a deer and giraffe is a primary consumer in forest ecosystem, while cow or a goat is in a grasslandorcropecosystem.Protozoans andcertaincrustaceanswhichfeedfloating algae are also primary consumers.

(ii) **SECONDARY CONSUMERS**- They are also called “CARNIVORES" (meat eaters). For example insects gamefish in a pond eat primary consumers.

(iii) **TERTIARYCONSUMERS**. - In most of ecosystem some organism that eat other carnivores like they are tertiary consumers.

(iv) **OMNIVORE**--Apersonoranimaleatingplantsandanimalsiscalledomnivores.

(v) **TOP CARNIVORES**- Some ecosystem have animals like lion and vulture, which arenot killed or rarelykilled and eaten by other animals arecalled top carnivores.

(vi) **DETRITIVORES**- These are the bottom living which subsist on the rain of organicdetritus from autotrophic layers e.g. beetles, termites, ants crabs etc.

3. DECOMPOSERS- They are also the living components, mainly bacteria and fungi which breakdown complex compounds of dead protoplasm of producers and consumerstosimpleorganiccompoundsandultimatelyintoinorganicnutrients.Inall the ecosystems, this biotic structure prevails.

2. **ABIOTIC STRUCTURES OR COMPONENTS**. - The physical and chemical components of anecosystem constitute its abiotic structure. It includes twothings

(i) MATERIALS OR CHEMICAL FACTOR-The materials are like water, minerals, atmospheric gases and other inorganic salts. They also include some organic matter suchasaminoacids,decayproducts,lipids,carbohydrates,proteinsetc.Thequantity of abiotic materials like the minerals present at any given time in an ecosystem is termed as the 'standing state' or 'standing crop.

(ii) ENERGY OR PHYSICAL FACTOR. This is in the form of light, heat and stored energyinchemicalbonds.Annualrainfall,windlatitudeandaltitudeetc.arealsosome physical factors, which have a strong influence on ecosystem. For proper functioning of an ecosystem there must be a continuous 'flow of energy' and 'cycling of minerals' among the organisms of the ecosystem.

ENERGYFLOWINTHEECOSYSTEM

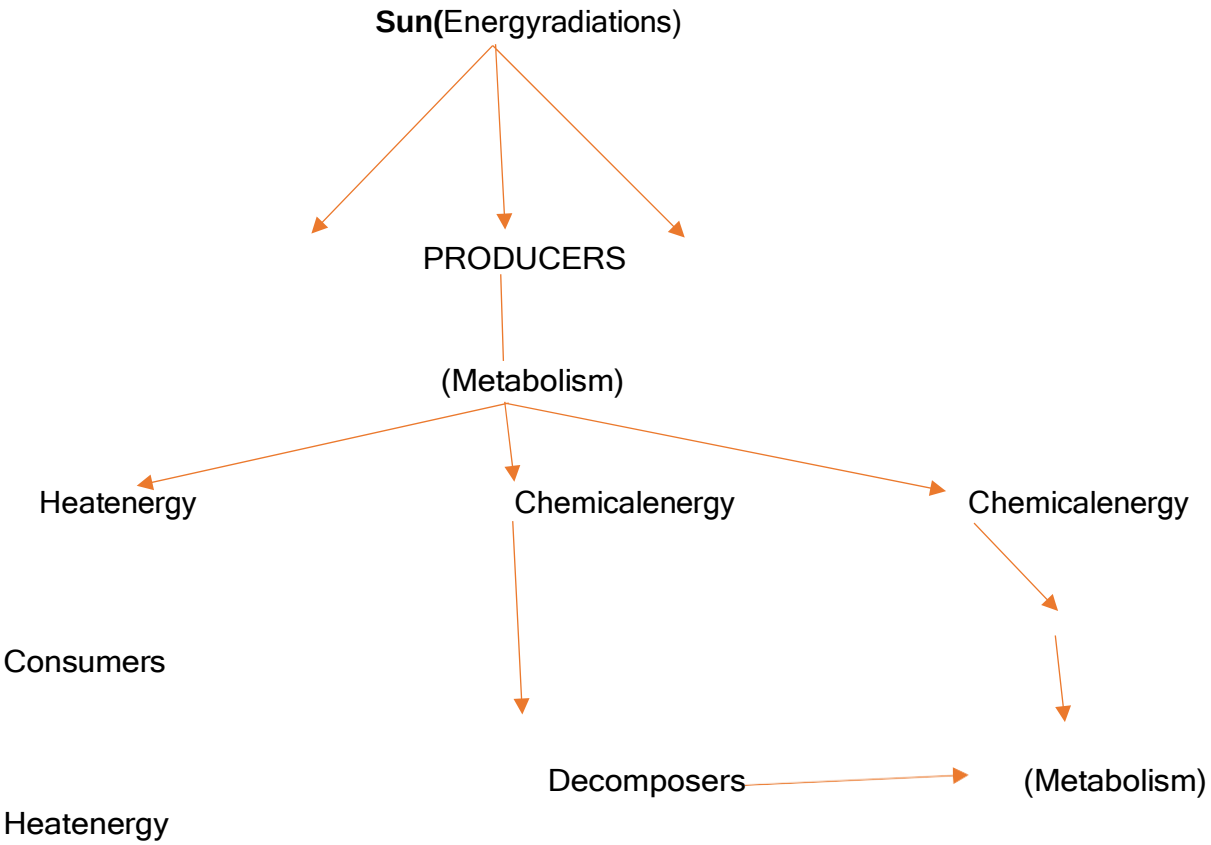
Energy is needed for every biological activity. Solar energy is transformed in to chemicalenergyby aprocessofphotosynthesis.Thisenergy is stored inplant tissue andthen transformed into mechanical andheat form during metabolic activities.

Theflowofenergyfollowsthetwolawsofthermodynamics.

1st law of thermodynamics: The law states that energy can neither be created nor be destroyed but it can be transformed from one form to another. Similarly , as we havereadearlierSolarenergyutilizedbygreenplantsinphotosynthesisconvertedin tobiochemical energy of plants and later in to that of consumers.

2nd law of thermodynamics. The law states that energy transformation involves degradationordissipationofenergyfromaconcentratedtoadispersedform.Wehave seen dissipation of energy occurs at every trophic level. There is loss of 90% energy, only 10% is transferred from one trophic level to the other.

SUN AS THE SOURCE OF ENERGY. Sun is the source of energy which extends radiationsfromhighfrequencytolowfrequency.Approximately99%oftotalenergyis inthe region between UV and IR. The visible spectrum spreadsover 0.38 u to 0.77 u involving about 50% of solar p radiations. Some autotrophs however utilize energy released from oxidation processes for the synthesis of organic food.



ENERGYFLOWMODELS

As we have seen that there is unidirectionalflow of energy from sun to the producers and then various types of consumers. Therefore, behaviour of energy in ecosystem can be termed Energy flow. About 34% of the sunlight reaching the atmosphere is reflected back in to its atmosphere . 10% is held by ozone layer, water vapours and other atmospheric gases. Rest 56% reaches the earth surface. Out of this 1-5% is used by green plants for photosynthesis.

$6CO_2+6H_20$ ——sunlightandchlorophyll—→ $C_6H_{12}O_6+60_2$

Restis absorbedasheat bygroundvegetationorwater.Theflowofenergy inan can be explained with the help of various energy flow models ecosystem

1. ODUM'SENERGYFLOWMODEL

E.P. Odum 1963 explained flow of energy involving three trophic levels with the help ofhis universalenergy flowmodel. Asthe flowof energytakes place, there isgradual loss of energy at every level thereby resulting in less energy available at next trophic level.

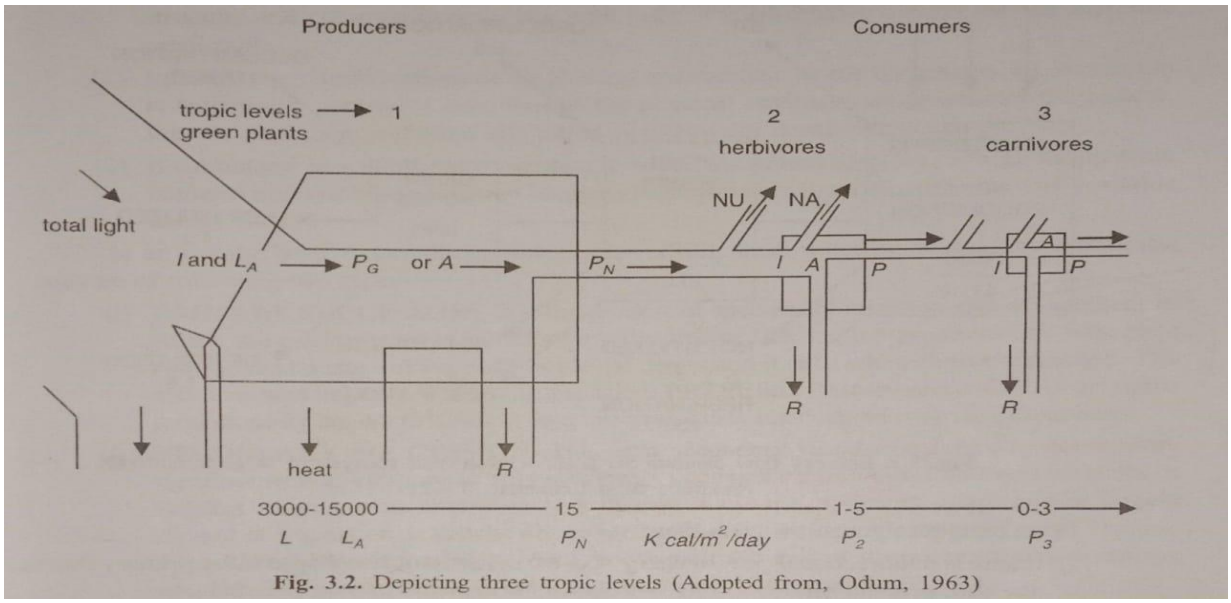


Fig. 3.2. Depicting three tropic levels (Adopted from, Odum, 1963)

Out of total3000 K Cal of light falling (L) on producers level, only 50% i.e. 1500 KCal is absorbed by autotrophs with an efficiency of energy capture is only 0.1 - 1%. As reported 21%ofthisenergyisconsumedinmetabolicreactionsofautotrophsfortheir growth, development, maintenanceand reproduction. Thusgradual decline inenergy atthesecondtrophic leveli.e.herbivoresand thenatthirdtrophicleveli.e.carnivores in grazing food chain is observed.

2. LINDEMAN'SENERGYFLOWMODEL

Lindemanin1942gavetheunidirectionalenergyflowmodeloffreshwaterecosystem.
Model shows that out of total 118,872 g.cal/cm²/year incident solar radiations, producers can utilize only 1% (111.0 g cal/cm²/year) in their photosynthesis.

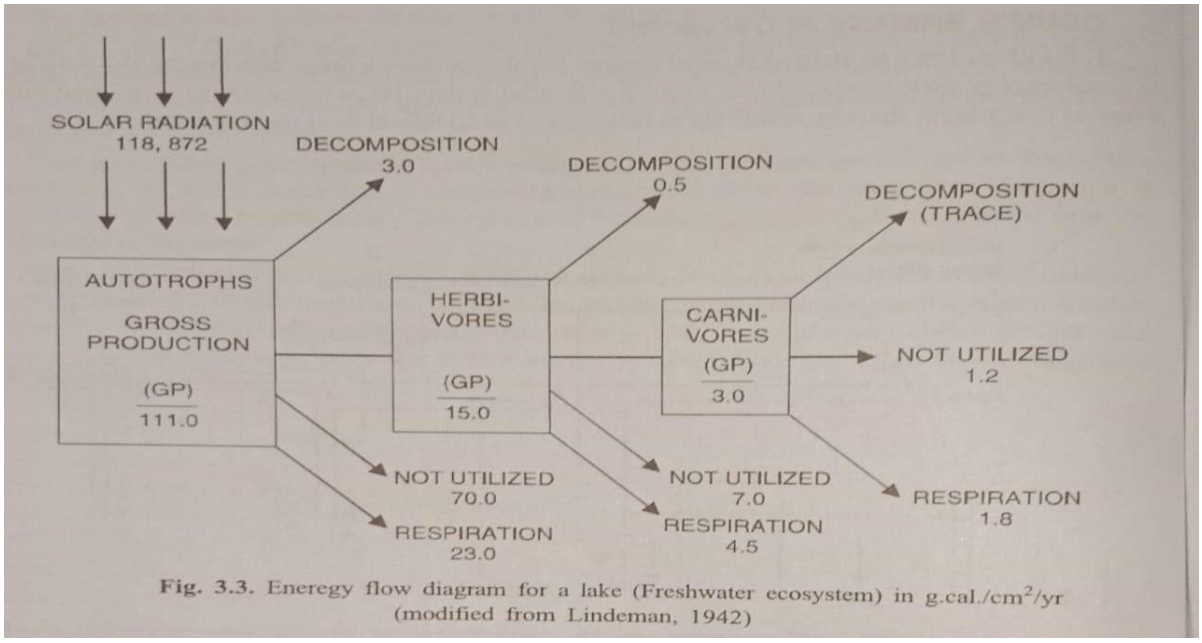


Fig. 3.3. Eneregy flow diagram for a lake (Freshwater ecosystem) in g.cal./cm^2/yr (modified from Lindeman, 1942)

- About 21% of this gross production (GP) is utilized in metabolic functions of producers, 3% is utilized in decomposition and 63% remains unutilized in decomposition and 63% remains unutilized.
- Thusonly13-14%i.e.15g.cal/cmp/yearofGPisavailabletoherbivores.At this level about 30% of it (i.e.15 g.cal/cm²/year) is utilized in metabolic functions i.e.respiration,growthandreproductionetc.
- This is more than the autotrophs consumed i.e. 21%. Again 3% of it is utilized in decomposition while 47% is remains un-utilized. Thus only 20% energy of the autotrophs is available (i.e. 3 g.cal/cm²/year) to carnivorous.
- It is also reported that about 70% energy is available for carnivores, which is notutilizedandonly28-6%ofnetproductionpassestocarnivorous.Carnivores utilized 60% energy at this level in metabolic activities and rest is remains as un-utilized.

Frombothfiguresitisclearthat

1. There is unidirectional flow of energy i.e. the system would collapse if the primary source, the sun were cut off.

2. Progressivedecreaseinenergyateachtrophiclevel.

3. There is also a corresponding decrease in biomass. But there is no correlation between biomass and energy.This relationship maydiffer according to situations.

ECOLOGICALSUCCESSION

Successionisthe“birth"ofanecosystem,andsubsequent"agingprocessofitsabiotic and bioticfeatures. ODUM (1971) hasrightly included the following three parameters in his definition of ecological succession.

(1) It is an orderly process of community development that involves changes in species structure and community processes with time, it is reasonably directional and therefore predictable.

(2) It results from modifications of the physical environment by the community, i.e. succession is community controlled even though the physical environment determinesthe pattern, the rateof change and often setslimitsasto how for developmentcan go.

(3) It culminates in a stabilized ecosystem in which maximum biomass (or high information content) and symbiotic function between organisms are maintained per unit of available energy flow.

In any of the basic environments such as terrestrial, fresh water or marine, the succession may be of following two types

(i) PRIMARYSUCCESSION.Itistheprocessofspeciescolonizationandreplacement inwhichtheenvironmentisinitiallyvirtuallyfreeoflife,i.e.theprocessstartswithbase rockor sand deme or river delta or glacialdebris and it ends when climax is reached. The sere involvedin primary successioniscalledPRESERE.Primary succession

occurswhenacommunitybeginstodeveloponasitepreviouslyunoccupied byliving organisms.

(ii) SECONDARY SUCCESSION. The term secondary succession refers to community development on locations or sites previously occupied by well developed communities. It occures where a community has been disrupted and the surface is completely or largely devoid of vegetation. It may be due to earthquake, fire or even clearing of forests by man. In each case organism modify the environment in a way thatallowonespeciestoreplaceanother.Thesereinvolvedinsecondarysuccession is called SUBSERE.

Dependingon the moisture contents, the primaryand secondary successionsmay be of the following types

(A) HYDRACH or HYDROSERE. The succession when starts in the aquatic environment such as ponds, lake, streams, swamps, bogs etc.

(B) MESARCH OR MESOSERE. It is an intermediate type with adequate moisture. Thesuccession when begin in such an area is called mesarch.

(C) XERACH OR XEROSERE. The succession when starts in Xeric or dry habitat havingminimumamounts of moisture,such asrocks,drydeserts etciscalled xerach. A temporary community in an ecological succession on dry and sterile habitate is called Xerosere. It may be of three types

(i) LITHOSERE.i.e.successioninitiatingonrocks.

(ii) PSAMMOSERE.i.e.successioninitiatingonsand.

(iii) HALOSERE.i.e.successioninitiatingonsalinewaterorsoil.

Sometimes succession is alsoclassified into twoonthebasis ofcommunity metabolism.

(a) AUTOTROPHIC SUCCESSION. It is characterised by early and continued dominance of autotrophic organisms like green plants. It begins in a predominantly inorganic environment and the energy flow is maintained indefinitely.

(b) HETEROTROPHIC SUCCESSION. It is characterised by early dominance of heterotropssuchasbacteria,actinomycetes, fungiandanimals.Itbeginsinaorganic environment and thereis a progressive decline in energy content.

GENERALPROCESSOFSUCCESSION

The complete process of a primary autotrophic ecological succession involves the following sequential steps which follow one another.

1. NUDATION. The process of succession begins with the formation of a base area or nudation by several reasons such as volcanic eruption, flood, landslide, erosion deposition, fire, disease etc. Some base areas are also created by man e.g. walls, burning, digging etc.

2. INVASION. The invasion is the arrival of the reproductive bodies or propagules of various organisms and their settlement in the new or base area. Plants are the first invaders (pioneers) in any area because the animals depend on them for food. It include the three steps

(1) Dispersal or migration. It is the process in which propagule leaves the parent plant and arrives the bare area. The seeds, spores or other propagule of the species reach the barearea through the agency of air, water or animals.

(ii) ECESIS. This is the successful establishment of migrated plant species in to new area. It includes germination of seeds, growth of seedlings and starting of reproduction.

(iii) AGGREGATION. This is the final stage of invasion where immigrant species increase their number by reproductionand aggregate in a large population in the area.

3. COMPETITION. As the number of individuals grows, there is competition both interspecific (between different species) and intra specific (within the same species) for space, water and nutrition. They influence each other in a number of ways known as COACTION.

4. REACTION. When living organism grow, use water and nutrients from the substratum in turn they cv have a strong influence on the environment which is modified to a large extent and known as reaction. When they become unsuitable for the existing species,favour somenew one, whichreplace them. Thus,reaction leads to several seral communities.

5. STABILIZATION OR CLIMAX. Eventuallyastage isreached when afinalterminal community becomes more or less stabilised for a longer period of time and it can maintainitselfintheequilibriumorsteadystatewithclimateofthatarea.Thislastseral stage is mature, self maintaining, self reproducing through development stages and relatively permanent. This final stable community of the sere is the CLIMAX COMMUNITY and the vegetation supporting it is the CLIMAX VEGETATION.

FOODCHAINS

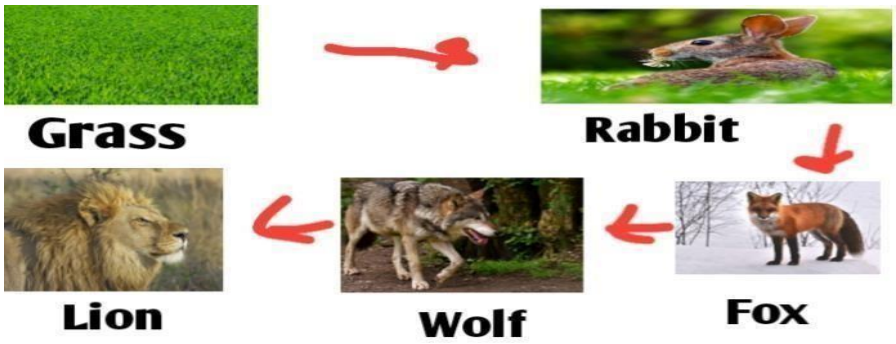
- SmallherbivorousorganismssuchasCaterpillarsfieldmiceetc.Consumethis 'vegetable material and convert it to animal material, which serve as food to meat eating animals. They are eaten by larger carnivores.
- This sequence of eating and being eaten, with the resultant transfer of energy is known as FOOD CHAIN.
- Thusinfoodchainsorganismsofanecosystemarelinkedtogether.Eachstep is known as trophic level and the study of the energy flow through these steps is called trophic ecology.Food chains arenot isolated from each other.
- Primary producers trap radiant energy of sun and transfer that to chemical or potential energy of organic compounds such as carbohydrates proteins and fats.
- When herbivore eats a plant and these compounds are oxidised. As we have read earlier the energy liberated is just equal to the amount of energy used in synthesizing thesubstances. Whenthis animal is eaten byanother one, along

with transfer of energy from a herbivore to carnivore a further decrease in energy occurs as the carnivore oxidise the organic substances for the first to liberate energy to synthesize its own cellular constituents. Such transfer of energy from organism to organism sustains the ecosystem.

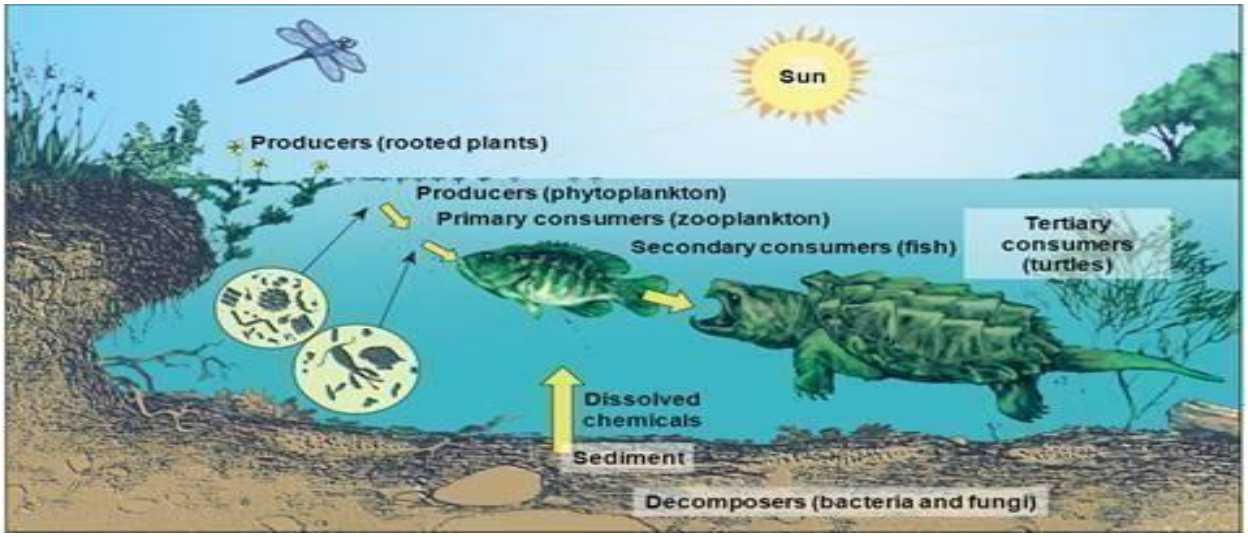
- The energy flows from primary producer to primary consumers, from primary consumer to secondary consumers and from secondary consumer to tertiary consumers and so on . This simple chain of eating and being eaten away is known as food chain.

Examplesoffoodchainsare:

1. Grass→Rabbit→Fox→Wolf→Lion. (Grasslandecosystem)



2. Phytoplankton→Waterfleas→Smallfish→Tuna.(Pondecosystem)



3. Litchens→Reinder→Man.(Arctictundra)

Innaturewecandistinguishtwotypesoffoodchains.

1.GRAZINGFOODCHAIN

This type of food chain starts from green plants and ends carnivores by passing throughherbivoresTheprimarycarnivoresorsecondaryconsumers eatherbivoresor primary consumers of the ecosystem. And likewise, secondary carnivores or tertiary consumerseatprimarycarnivores.Thetotalenergyassimilatedbyprimarycarnivores orgrosstertiaryproductionanditsdispositionintorespiration,decayandfurther

consumption by other carnivores is entirely analogous with that of herbivores. Thus much of theenergyflow in these chains can bedescribed as follows

PrimaryproducerPrimaryConsumerSecondaryConsumerTertiaryconsumer

DETRITUSFOODCHAIN

The term detritus is given to organic wastes, exudates and dead matter derived from grazing food chain. The energy contained in this detritus is not lost to the ecosystem as a whole, rather it serves as the source of energy for a group of organisms (Detritivores), they differ from grazing food chain called the detritus food chain. Such foodchains operates inthe decomposing accumulated litter in atemperateforest.

Insomeecosystems,considerablymoreenergyflowsthroughthedetritusfoodchains than through the grazing food chains. The organisms of the detritus food chains are, algae, bacteria, slime molds, fungi, actinomycetes protozoa, insects, mites, crustaceans, molluses worms, nematodes etc. Some species are highly specific in their food requirements and some can eat almost anything. All these are detritus consumers. Heald (1969) and Odum (1971)have studied the detritus food chain of mangroveleavesofsourthenFlorida.Conclusively,we ca nddetritu chain as follows.

FOODWEBS

In nature simple food chain occur rarely. The same organism may operate in the ecosystem at more than one trophic level i.e. it may derive its food from more than onesource.organismmaybeeatenbyseveralorganismsof ahighertrophiclevelor anorganismmayfeed uponseveraldifferent organismsof lowertrophic level.In this way individual food chains interconnect to form a complex network with several linkages and are known as food web. Thus food web is defined as –"**A network of food chains where different types of organisms connected at different trophic levels,so that thereareanumber ofoptionsof eating and being eaten ateach trophic level.**

The following five types of food chains are interconnected to form food web in this figure.

(1) Grass→Grasshopper→Predatorybird(Hawk)

(2) Grass→Grasshopper→Lizard→Hawk.

(3) Grass→RabbitHawk(orvultureorman)

(4) Grass→Mouse/Rat→Hawk

(5) Grass→Mouse/Rat→Snake+Hawk.

This shows, food chains in natural conditions never operate as isolated sequences butare interconnected with each other forming some sort of interlocking pattern .

ECOLOGICALPYRAMIDS

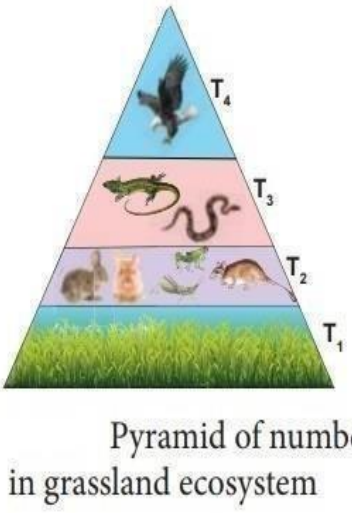
Charles Elton in 1927, noted that the animals at the base of the food chain are relatively abundant, while those at the end are relatively few in number i.e. there is progressively decrease in between the two extremes. Secondly, there is some sort of relationship between the numbers, biomass and energy content of the primary producers, consumers of the first and second orders and so on to top, Carnivores in any ecosystem.

Ecologicalpyramidsareofthreegeneraltypes

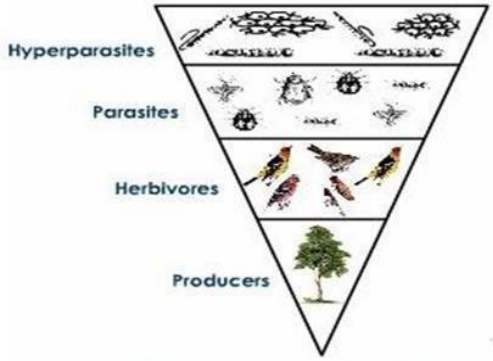
1. Pyramidofnumbers-(Basedonnumberoforganismsateachlevel.)
2. PyramidofBiomass-(Basedonbiomassoforganisms)
3. Pyramidof energy-(Showing therate ofenergyflowand/orproductivity at successivetrophic levels.)

Thepyramidsofnumbersandbiomassmaybeuprightorinverteddependingofthe food chain in the particular ecosystem whereas pyramids of energy are always upright.

1. **Pyramid of numbers.** This deals with the relationship between the number of producers, herbivores and carnivores at successive trophic levels. At the base of such figure (pyramid) is always the number of primary producers and the subsequent structures on this base are represented by the number of consumers at successive levels. a grassland ecosystem, the producers which are mainly grasses are always many in number. This number then shows a decrease towards apex, as the primary consumers or herbivores like rabbits are less in



Pyramid of numbers in grassland ecosystem



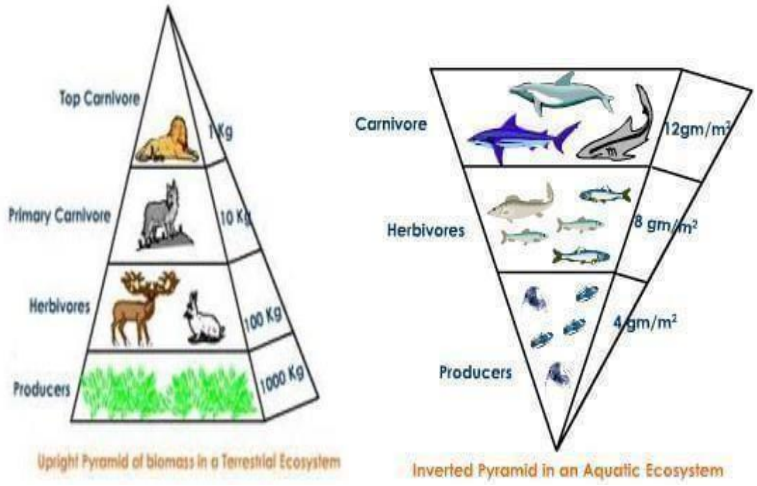
Inverted pyramid of number

(Upritepyramid)

numberthanthegrasses.Thesecondaryconsumersarelesserinnumberthan primary consumers. Finally the top consumers (tertiary)like hawksor other animals

areleastinnumber.Thusthepyramidbecomesupright.Inapondecosystem,the pyramid is also upright.

2. **Pyramid of Biomass**. Pyramid of numbers of biomass is given where the weightofprimaryproducersformsthebase.Theecosystem,wherethepyramid of biomass is upright. The biomass of one tree is very high. The biomass of a numberofbirdsfeedingupon the tree isfar lessthan thatof the tree. Similarly, the biomass of even a very large number of parasite in and on the body of the birds is far less.



3. **Pyramidofenergy**

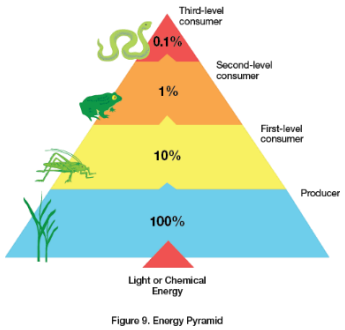
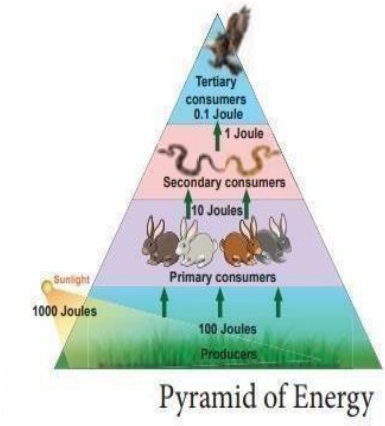


Figure 9. Energy Pyramid

- Generally three types of ecological pyramids, the energy pyramid give the best picture of overall nature of the ecosystem. As against the pyramids of numbers and biomass the shape of the pyramid of energyis always upright, because in this the time factor is always taken in to account.
- The pyramid of energy represent the total quantity of energy utilized by different trophic level organisms of an ecosystem per unit area over a set period of time. The population of phytoplanktons in aquatic ecosystem also complete sets of new generation in every few hours or days.
- The cumulative energy content of these generations of phytoplanktons trap in course ofa year is certainly much more than thatofonly a few

generationsofherbivorefishes in thecorresponding time andspace. Theenergycontentoftopcarnivores (utilizedinoneyear)istheleast.



Pyramid of Energy

Therefore, the pyramid of energy is upright. The ratio of the amount of energy absorbed and the amount of energy which would be retained in biomass is known as ecological efficiency.

SOMEMAJORECOSYSTEMS

Therearethreetypesofecosystemsinnature..

1. Terrestrialecosystem
2. Freshwaterecosystem
3. Marineecosystem

A large geographical are with its specific and complex flora and associated fauna is called a biome. The physical factors like, nature of soil, rainfall, temperature, light etc. effects the vegetation of a biome. The ecological characteristics of some major ecosystems are given.

Terrestrialecosystems

TheterrestrialecosystemsmaybeLatitudinalbiomeoraltitudinal.Itconsistsof

(i) Forestecosystem

(ii) Grasslandecosystem

(iii) Desertecosystem

FORESTECOSYSTEM

Roughly 40% of the land is occupied by forest. But in India it is one-tenth. In India, tropical rain forests are found in Western Ghats, Andamans and North-East Himalayas. So these have maximum bio-diversity. The different components of a forest ecosystem are as:

Abiotic Component : These are the inorganic & organic substances present in the soil& atmosphere. In addition totheminerals present intheforests, wefind the dead

organic debris. The light conditions are different due to complex stratification in the plant communities.

Biotic Component: The living organisms present in the food chain occur in the following order

1. Producers. These are mainly trees that show much species diversity and greater degree of stratification specially in tropical moist deciduous forest. In northern coniferous forest needle leaved evergreen tree, specially the spruces, firs and pines are with poor development of shrub and herb layers. Deciduous forest is greatly modifiedbymanandmuchof itisreplacedbycultivated andforestedgecommunities

2. Consumes. Theseareasfollows

(a) Primary Consumers ; These are the herbivores that include the animals feeding leaves as ants, flies, beetles, leafhoppers bugs, spiders etc. Many of the larger herbivorousvertibratessomeanimals likeelephants,nilgai, deer, moles, flying foxes, fruitbats, mongoosesetc. are like moose, snowshoe have grouse are found on broad leaveddevelopmentalcommunities.Similarly on shoots and/orfruits. ontree grazing

(b) Secondary Consumers : These are the carnivores like snakes, birds, lizards, foxetc. feeding on herbivores. lion, tiger etc. that eat carnivores

(c) Tertiary Consumers: These are the top carnivores like lion,tiger etc. that eat carnivores of secondary consumers level.

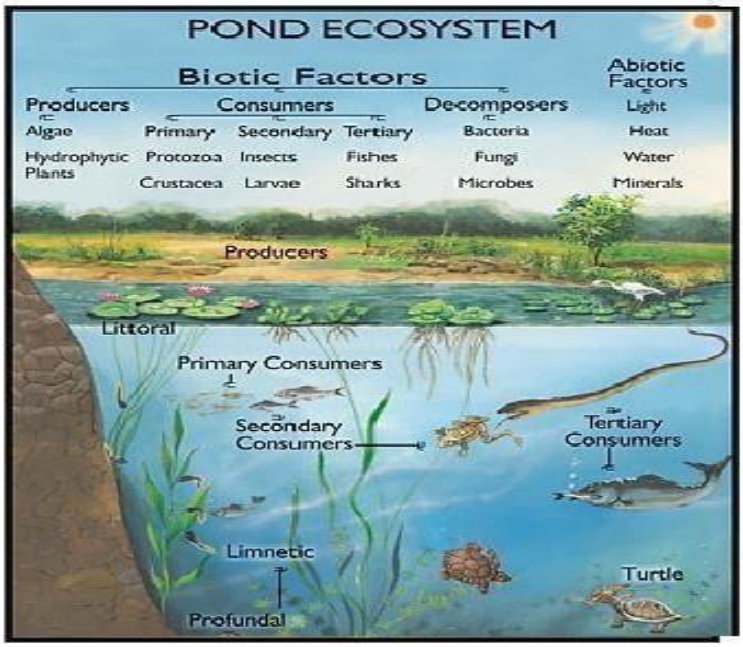
3. Decomposers. These are wide variety of micro-organisms like actninomycetes(streptomyces) , bacteria (Bacillus, clostridium, Pseudomonas etc.), Fungi(speciesofAspergillus,Coprinus,Polyporus,Fusarium,Trichodermaetc.).Rate of decomposition in tropical and subtropical forests is more rapid than that in the temperate ones.

AQUATICECOSYSTEMS

Morethan70%ofthelandiscoveredbywater.Theimportantecosystemsare….

PONDECOSYSTEMS.

Ponds are small bodies of water in which the littoral zone is relatively large and the limnetic and profundal regions are small or absent. Stratification is of minor importance .Pondsmaybefoundinmostregionsofadequaterainfall.Theyarecontinuallybeing formed, as a stream shift position, leaving the former bed isolated as a body of standing water where organic materials are accumulated.



Temporary ponds are dry for part of the year are specially interesting and support a unique community organisms in such ponds must able to survive in a dormant stage during dry period.

Ponds play an important role in the villages where most of the activities like washing clothes, bathing, swimming, cattle bathing etc. are centre around ponds. We may study the pond as an ecosystem.

Abiotic Component. Apart from heat, light the basic inorganic and organic compounds,elementsarewater,CO2,oxygen,calcium,nitrogen,phosphorus,amino acids etc.Theamountoftheminerals present at anytimeinthephysicalenvironment ofthepond."Standingstate"maybeestimatedbyappropriatemethods.Lightintensity and turbidity index of water at different depths can also be measured by lux- photometer and Sechhi disc respectively.

BioticComponentsTheyareasfollows

1. Producers. These are autotrophic, green plants and bacteria. They fix radiant energy and with the help of minerals from water& mud form complex organic substanceslikeCarbohydrates, proteins&lipids.Producers areofthefollowing types

(a) Macrophytes. These are mainly rooted larger plants which include partly or completely submerged floating and emergent hydrophytes. The common species of the plants are Trapa, Typha, Sagittaria, Nymphaea, Chara, Hydrilla, Utricularia, Marsilea, Azolla, Sylvinia, Spirodella, Lemna etc…

(b) Phytoplankton.Theseareminute,floatingorsuspendedlowerplantslikeUlothrix, Spirogyra, Cladophora, Oedogonium, Cosmarium, Eudorina Pandorina, Volvox, Chlamydomonas etc. and some flagellates. Biomass is estimated as weight of standing crop per unit area or volume. Generally, biomass and energy content of the vegetation decreases from the margin of the pond towards its centre. Energy content is generally expressed in terms of cal/gm dry wt.

2. Consumers. Most of the consumers are herbivores except insects and some largefish. But generally are heterotrophs. In pond consumers are distinguished as

(i) Primary Consumers. These are herbivores, also known as "primary macro consumers" feeding directlyon living plants.Theymaybe large or insmallsize.They are further differentiated as

(a) Benthos. These are the animals associated with living plants labelled as 'a' in fig andthosebottom formswhichfeedupon the plantsremainsat thebottom labelledas 'b' in fig. Benthic population include fish, insect larvae, mites, molluses, crustaceans etc.Besides theresome animals like cows, buffaloes andbirds alsovisit thepond.

(b) Zooplanktons.Thesearechieflytherotifers,(Brachionus,Lecaneetc.), protozonas (Euglena, Coleps etc.) and Crustaceans (Cyclops, Stenocypris etc.). They feed on phytoplanktons .

(ii) Secondary Consumers. These are Carnivores like insectsand fishwhich feed on primary consumers (herbivores) like Zooplanktons.

(iii) TertiaryConsumers.Thesearesomelargefishfeedonsmaller fish. In

pond fish may occupy more than one trophic levels.

3. Decomposers. These are microconsumers, which absorb only a fraction of the decomposed matter. They decompose organic matter of both producers as well as microconsumersin simpleforms.Thus theyplayan importantrole inreturnofmineral elements again to pond. The bacteria, actinomycetes and fungi (species Aspergillus, Cladosporium, Pythium, Penicillium, Circinella etc.) are most common decomposers in water and mud of the pond.

MARINE(OCEAN)ECOSYSTEM

The marine environment ofseasand oceans islargeoccupying70%ofthe earth surface.Thevolume of thesurfaceareaofmarineenvironmentlightedbysunissmall in comparisonto thetotalvolumeofwaterinvolved.

Thebioticcomponentsofanoceanareasfollows

1. PRODUCERS

These are autotrophs, which are mainly the phytoplanktons. They trape radiant energy from sun through their pigments. A number of macroscopic seaweeds (Brown and red algae) are also come in this category. They are in distinct zones at different depths of water.

2. CONSUMERS

These are heterotrophic macroconsumers being dependent for their nutrition on the primary producers. These are directly on producers

(i) The herbivores like Crustacions, molluscs, fishes etc.which feed are called primary consumers. called secondary.

(ii) Thecarnivoresfisheslikeshad,herringetc.feedingonherbivoresaresecondary consumers

(iii) Thetopcarnivoresfishes likecod,haddock, halibutetc.thatfeed onarecalled tertiary consumers.

3. Decomposers. The microbes active in the decay of dead organic matter are chiefly and some fungi.

ESTUARIES(ESTUARINEECOLOGY)

Estuarine is derived from the word aestus means tide. Pritchard in enclosed coastal body of water, which has a free connection with the open sea. It is thus strongly affected by tidal action and within it sea water is mixed with fresh water from land drainage.Rivermouths,coastalbays,tidalmarshesandbodiesofwaterbehindbarrier beaches are examples To illustrate estuaries, the different classifications will be represented based on

(1) Geomorphology
(2) WaterCirculationandstratification
(3) Systemsenergetics.

According to Pritchard 1967, four subdivisions of estuaries are from zeomorphological point of view

(i) Drownedrivervalleys

(ii) Fjordtypeestuaries

(iii) Bar-builtestuaries

(iv) Estuariesformedbytectonicprocesses.

River - delta estuaries found at the mouths of large livers such as Mississippi or the Nile. It is different from formers. On hydrographic basis esturaries can be placed in three broad categories.

(a) Highlystratifiedorsaltwedgeestuary.

(b) Thepartiallymixedormoderatelystratifiedestuary.

(c) Thecompletelymixedorvertically homogenousestuary

The Hypersaline estuary is a special type.

PhysicoChemicalAspectsofEstuaries:

- Current and salinityboth are important here. Estuarine currentsresult from the interactionofaonedirectionstreamflowwhichvarieswiththesessionandrain fall with oscillation ocean tides and with wind. The salinity varies vertically and horizontally and fluctuates amazingly between 0.5 to 0.35%.
- Thesessionaland tidal cycles causes changesin nutrient concentration in the estuary.Any how, all estuaries have high productivity.
- The concentration of nutrients and fix carbon is The sessional and tidal cycles causelevel of production within the detritus food chain.

LAKEECOSYSTEM

Lakes are inland depressions containing standing water. They vary in size and depth (fewfeetto5000feet).Somelakeswaveoutletstreams.Inlaketherearethreetofive well recognized horizontal strata namely.

(i) Littoralzone

Shallow water near the shore forms this zone. - Different zone of a deep freshwater lake. It contains upper warm and oxygen rich circulating water layer, which is called epilimnion. It include rooted vegetation.

(i) **Sublittoral zone**. It extends from rooted vegetation to the non circulating cold water with poor oxygen zone i.e. hypolimnion.

(iii) **Limnetic zone.** It is the open water zone away from the shore. It is up to thedepthofeffective lightpenetration where rateof photosynthesis is equal to the rate of respiration. (iv**) Profundal zone.** It is the deep water area beneath limnetic zone and beyond the depth of effective light penetration.

(v)**Abyssal zone.** Itisfoundonly indeep lakes sinceitbeginsatabout2000 meter from the surface.

Kinds of lakes. Based on the physical factors, productivity etc. different classifications of lakes are given. Based on temperature, Hutchinson (1957) classified into dimictic, monomictic and polymictic. Based on Humic acid contents,thelakes areclassifiedintoclearwaterlakes andBrownwaterlakes.

Physico-chemicalpropertiesoflakes

Lakes have the tendency to become thermally stratified during summar and winter to undergo definite seasonal periodicity in depth.Light too penetrates only to a certain depth,depending on turbidity.

BioticCommunitiesoflakes

Organismsdependingon substratumarecalledpedonicformsand thatarefreefrom itcalled limnetic forms. The lakes have several type of organisms.

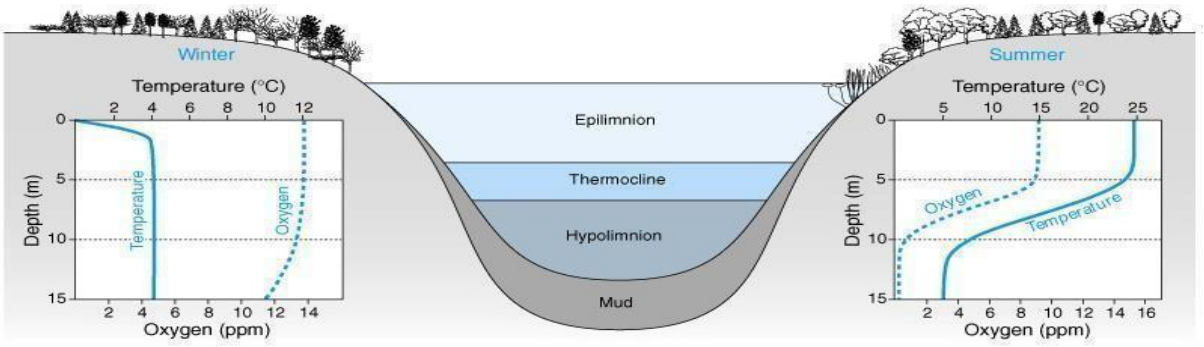
(1) **Neuston.** Theseincludingfloatingplants such as duckweeds and many type of animals.

Animals are called epineuston while others including insects called hyponeuston.

(ii) **Plankton**. These are small plants and animals whose powers of self locomotionisverylimited.Certainzooplanktonsareveryactivesomeplanktons arecalled as nektoplanktons,(iii) **Nekton.** These animals are swimmers.

(iv) **Bethos.**These includes the organisms living at the bottom of the water mass. These living above the sediment water interface are termed benthic epifauna and those living in sediments itself aretermed as infauna.

Stratificationinlakes.



- During the summer the top water become warmer than the bottom waters,asaresultonlythewarmtoplayercirculatesand itdoesnotmix with the more viscous colder water, called thermocline.
- The upper water layer is epilimnion. Colder noncirculating water is the hypolimnion. Subtropical lakes having surface temperatures that never fallbelow4°C.In termsof water circulation patternsmostof the lakesof theworldcanbeconvenientlyassignedtooneofthefollowingcategories (Hutchinson 1957).

(a) Dimictic(mictic=mixed)Twosessionalperiodsoffreecirculation.
(b) Cold monomictic. Water never above 4°C (polar regions), seasonal overturninsummer.(c)Warmmonomictic.Waterneverbelow4°C.Oneperiod of circulation in winter.
(d) Polymictic. More or less continually circulating with only short, if any, stagnation period. (e) Oligomictic. Rarely mixed.
(f) Micromictic.Permanentlystratified.

STREAMS

Bioticcommunity instreamsisquitedifferent fromthatofponds.Moststreams in the vicinity of urban areas are polluted. Streams are fresh water aquatic systems where water current is a measure controlling factor, oxygen and nutrientsareinwater. Differencesbetween streamsand pondsrevolvearound a triad of conditions.

ZONATIONINSTREAMS

- In streams zonation is longitudinal. In streams we find zones increasingly older stages from source to mouth. Charges are more pronounced in the upper part, because of gradient, volumes offlowandchemicalcomposition charges rapidly.
- The change in composition of communities is likely to be more pronounced in the first mile than in the last fifty miles . The longitudinal distribution of fish in a stream may be selected as a specific example. Thompson & Hunt found that the number

Unit4:Biodiversityandit'sConservation

INTRODUCTION

Biodiversity may be defined as, "Biological diversity means the variability among living organisms from all sources including, interalia, terrestrial, marine andotherecosystemsandtheecologicalcomplexesofwhichtheyarepart,this includes diversity within species between species and of ecosystem.

GENETIC,SPECIESANDECOSYSTEMDIVERSITY

Biodiversity is usually analysed at three levels i.e. species, genetic and ecosystem, each of which has its own significance.

1. **DiversityofBioticCommunitiesandEcosystems**:
   - Depending largely Upon the availability of abiotic resources and conditions of the environment an ecosystem develops its own characteristic community of living organisms.
   - A small pond, for example, constitutes an ecosystem and possesses a set of flora and fauna different from a river which is another type of ecosystem. Different types of forests, grass-lands, lakes, ponds, rivers, wet-lands etc. represent diverse ecosystems each with a characteristic biotic community.

2. **Diversity of Species Composition within a Community**: The biotic componentin anecosystemmaybecomposed ofafewspecies onlyoralarge number of species of plants, animals and microbes, which react and inter-act witheach otherand with theabiotic factorsof theenvironment.Therichnessof species in an ecosystem is usually referred to as Species diversity.

3. **DiversityofGeneticOrganizationwithinaSpecies:**
Within aspeciestherareoften foundanumberofvarietiesorracesorstrains whichslightlydifferfromeachotherinone,twooranumberofcharacterssuch as shape, size, quality of their product, resistance to insects, pests and diseases, ability to withstand adverse conditions of environment etc.

BIOGEOGRAPHICALCLASSIFICATIONOFINDIA

India is one of the 12 mega biodiversity countries in the world. The country is divided in to 10 biogeographic regions. The wide variety in physical features and climatic conditions have resulted in a diversity of ecological habitats like forests, grasslands, wetlands, coastal and marine ecosystems and deserts which harbour and sustain immense biodiversity.

Thefollowing13biogeographicalregionshavebeenidentifiedinIndia:

1. Himalaya
2. TheDesert

3. DeccanPeninsula
4. Malabar
5. AndamanIslands
6. NicobarIslands
7. GangeticPlanes
8. LaccadiveIslands
9. Maldive/ChagoasIsland
10. WesternGhats
11. Burman/Bangalianforest
12. MarineCoast
13. CoromondalMahanandian

Floristic(Botanical)RegionsofIndia

Thecountryhasbeendivided intothefollowingninefloristic regionswith respect to floral diversity :

(i) Western Himalayas : It extends from Kumaon to Kashmir and has annual rainfall up to 200 cm. Correspond to three climatic belts, there are three zones of vegetation.

(a) Submontane zone. It is constituted of tropical and sub tropical parts and extends up to 1500 meters altitude. It comprises mostly of Siwalik ranges. Snowfall does not occur. The plants like Shorea robustica, Dalbergia sissoo, Cedrela toona, Eugenia jambolano, Acacia Catechu, Butea monosperma (Dhak) Zizyphus etc. are found in this region.

(b) Temperate Zone. Above submontane zone extend temprate zone forests up to 3500 meter altitude. They are dominated by plant species like Acer, Ulmus, Rhododendron, Betula, Salix, Populus, Cornus, Bumus, Pinus, Taxus, Picea etc.

(c) Alpine Zone. It extends from 3500 - 4500 metres altitudes and is characterized with alpine forest vegetation. Most common tree species are Betula, Juniperus, Rhododendrous etc. and herbs like Primula, Potentilla, Polygonum etc.

(ii) Eastern Himalayas. It includes regions of Sikkim and NEFA and is characterised by more rainfall, less snow and higher temperature. This is also divided into the following three zones altitudinally.

(a) Tropical zone. Upto 1800 metres altitudes, this zone has tropical semi-evergreen or moist deciduous forests. These forests comprise the plants like Shorea robusta, Acacia catechu, Delbergia sissoo, Terminalia, Albizzia, Cedrela, Dendrocalamus (bamboo) etc.

(b) Temperate zone. Thiszoneextendsbetween1800 metresto 3800 metres altitudes and has typical montane temperate forests which are dominated by oaks like Michelia, Quercus, Pyrus, Symplocos, Eugenia, etc., at lower levels and by conifers as Juniperus, Cryptomeria, Abies, Pinus, Larix.

(c) Alpine zone. Beyond the temperate zone, extends alpine zone upto 5000 meters altitudes. It has alpine vegetation including Juniperus and Rhododendron with its other typical flora.

(iii) Indus plains. This zone includes the arid and semiarid regions of Punjab, Rajasthan,Kutch,partofGujaratandDelhi.Therainfallislessthan70cm.The vegetationistropicalthornforest insemi-arid regionand istypicaldesert in the arid region.

(iv) Gangetic plains. This region extends over Uttar Pradesh, Bihar, Bengal andpartofOrissaandischaracterisedbymoderateamountofrainfallandmost fertile (i.e., alluvial) soils.

(v) Central India. It comprises Madhya Pradesh, parts of Orissa and Gujarat. The rainfall is 150–200 cm and its vegetation is thorny, mixed deciduous and teak type. The chief plants of this region are Tectona grandis, Madhuca, Diospyros,Butea,Dalbergia,Terminalia,Carissa,Zizyphus,Acafia,Mangifera, etc.

(vi) Malabar (west coast). This region include western coast of India from Gujarat to Cape Comorin and has heavy rainfall. The forests are tropical evergreen in extreme west, semievergreen towards interior subtropical or montane temperate evergreen forests in Nilgiris and mangroves near Bombay and Kerala coast.

(vii) DeccanPlateau. ThisregionextendsalloverpeninsularIndia(i.e.,Andhra Pradesh, Tamil Nadu and Karnataka) and has rainfall upto 100 cm.

(viii) Assam. This region is characterised by heavy rainfall (200 to 1000 cm). The vegetation iseither denseevergreen forestor sub-tropical. The evergreen forests include trees like Dipterocarpus macrocarpu, Mesua ferrca, Shorea robusta, Ficus elastica, etc., bamboos as Bambusa pallida, Dendrocalamus hamiltonii, etc., grasses like Imperata cylindrica, Saccharum sp., Themedasp., insectivorous plants asNepenthes sp.,and alsoepiphytes (ferns and orchids).

(ix) Andmans. This region possesses a varied type of vegetation: mangroves and beech forest at its coasts and evergreen forests of tall trees in the interior, ImportantplantspeciesofthisislandareRhizophora,Mimusops,Calophyllum, Lagerstroemia, etc.

VALUESOFBIODIVERSITY

Biodiversity is a valuable natural resource for the survival of man kind. Man has domesticated a number of economically important plants and animal species. Old traditionalvarietiesandthemidrelativesofdomesticatedplantsandanimalsconstitute a vital genetic resource for us

Consumptivevalue.

- Mostofthedevelopingcountriesobtainfuelwoodfromforests.Stillmore than 1500 million people cook their food by burning wood. About 1000 million cubic meter wood is used for fuel across theglobe.
- This imposes heavy pressure on forests. Hunting of wild life, use of grass with some commercially important plants as fodder are of only comptive. fully depend on forests (biodiversity) for their habitation and livelihood.

SOCIAL VALUES : Social value is one of the instrumental values where some thing has as a means to another's end. Materialistic uses of biodiversity are the core of instrumental values by ecosystems

(1) Provisionoffood,fuelandfibber.
(2) Provisionofshutterandbuildingmaterials.
(3) Purificationofair andwater.
(4) Detoxificationanddecompositionofwastes.
(5) Generationandrenewalofsoilfertility,includingnutrientcycling.
(6) Controlofpestsanddiseases.
(7) Stabilizationandmoderationofearth'sclimate.
(8) Maintenanceofgeneticresources askeyinputstocropvarieties.
(9) Livestockbreeds,medicinesandotherproductsetc.

Ethical values : Ethicalorreligious values is alsooneofthe indirect values of biodiversity. The ethical and religious value of biodiversity is rooted in the understanding that huminity is part of nature and that we are just one species among others. All species have an inherent right to exist. Future generations alsohavean inherent right to knowthem and to havethe choiceof using them or not.

Aesthetic value : The aesthetic value of biodiversity has been expressed in manywaysthroughart, poetry,songs, literature,musicand dance.Forestsare closely linked with our relegion and culture. Human race has a great evolutionary attachment with forests as our ancestors lived in forests

OPTION VALUES: Biological resources existed in this biosphere are very importantforhumanbeings.Theoption value ofbiodiversitysuggests thatany species may prove to be a miracle species. It is the precious gifts of nature presented to us. Option value is the indirect value of a species to provide an economic benefit to human society at some point in near future.

BIODIVERSITYATGLOBAL,NATIONALANDLOCALLEVELS

BiodiversityatGloballevel

Itisestimatedthatthereexists5–30millionspeciesoflivingformsonourearth and of there only 1.5 million have been identified and include 300000 species of green plants and fungi, 800000 species of insects, 40,000 species of vertebrates and 3,60,000 species of microorganisms.
Thecountriesidentifiedare

1. Brazil
2. Colombia
3. Venezuala
4. Peru
5. Ecquador
6. Indonesia
7. DemocraticRepublicofCongo(Zaire)
8. India
9. China
10. Malaysia
11. Australia
12. Mexico.

BIODIVERSITYATNATIONALLEVEL

- The Indian landmass extending over a total geographical area of about 3029 millionhectares, isboundedbyHimalayas inthenorth,thebayof Bengalinthe east, the Arabian sea in the west, and Indian Ocean in the South. The wide variety in physical features and climatic situation have resulted in a diversity of ecological habitats.
- This richness in biodiversity is due to immense variety of climatic and altitudinal conditions coupled with varied ecological habitats.
- The Indian region having a vast geographical area is quite rich in biodiversity with a sizable percentage of endemic flora and fauna.
- These vary from the humid tropical Western Ghats to the hot desert of Rajasthan, from the cold desert of Ladakh and the icy mountain of Himalayas to the warm costs of peninsular India.

BIODIVERSITYATLOCALLEVEL

Thebiodiversityatlocallevelcanbewellunderstandbydemarcatingthepoints, places, zonesrichin biodiversity.Thiscanbe understoodascompositionali.e. richin plants & animals of same habitats and genetic make up.

Wecanalsostudythelocalbiodiversityonfollowinglines

1. Richnessofspeciesatagivenplace.

2. Physicalcharacteristicsofhabitatandvegetationinparticulararea.
3. Changeinspeciescompositionacrossdifferenthabitats.
4. Local diversity based on climate, geographical, ecological and other processes responsible for creation.
5. Rateofchangeacrossgradients andconditions.

It is said that environmental variables are responsible for diversity but temperatureplayanimportant roleinaffectingthebiodiversityof anarea.Thus local areas arewell affected in heterogenious andhomogenious habitats.

THREATSOFBIODIVERSITY

- OneofthemeasurethreattoBiodiversityisspace,foodandrawmaterial for expanding human and plant establishment. Since 1600 there have been over 1000 recorded extinctions of plants and animal species.
- Probably early humans were directly responsible for extinction of many large and smaller mammals But the elimination of species is a normal process of the natural world. When species die or extinct, they will repiace by others. Due to human population and its impact on ecosystems,thousandsofspeciesandsubspeciesbecomeexinctevery year.
- According to E.O.Wilson, we are losing 10,000 organisms a year i.e 27 per day. It is studied that 99% of all species of fossile that ever existed are now exinct.

The following are the measure causes and issues related to threatsto biodiversity.

HABITAT LOSS : Habit loss due to human activities and other disturbances are wellknown factor. Varying human disturbances are changing ecosystems and are thus threatening the biodiversity. Due to habitat degradation wild populations become more volnerable to predators and diseases. This is especially true for wild life, which suffer due to habitat loss and fragmentation.

POACHING OF WILDLIFE

Poachingisanotherthreattowildlife.Asanancientperiod,hunters,collectors, and smugglers (traders) are the measure threat to a number of species including endangered speices. They collected furs, hides, horns, tusks, and some live specimens, herbal products and smuggled to others for millions of dollars.

MAN-WILDLIFECONFLICTS

Strugglefor existance.Thisis applicable forboth,manand wild animal. Dueto habit loss animals come out of the forest and destroy the crops later on they become danger to human being. Villagers and affected people killthem.

Unit5:EnvironmentalPollution

AIRPOLLUTION

"Air pollution may be defined as the presence in the atmosphere of one or more contaminants in such quantities and of such duration as may be, or may tend to be injurious to human, plant or animal life, or property, or which unreasonably interfere with the comfortable enjoyment of life, or property, or theconduct of business."

CLASSIFICATIONOFAIR-POLLUTANTS

Theairpollutantsmaybeclassifiedindifferentwaysasfollows:

(a) Accordingtoorigin:

(i) Primary pollutants which are directly emitted into the atmosphere and are found such as e.g., CO, NO_2, SO_2, and hydrocarbons.

(ii) Secondarypollutantswhicharederivedfromtheprimarypollutantsduetochemical or photo-chemical reactions in the atmosphere, e.g., Ozone, Peroxy-acyl nitrate (PAN), Photo-chemical smog, etc.

(b) Accordingtochemicalcomposition:

(i) Organicpollutants,e.g.,-Hydrocarbons,aldehydes,ketones,aminesandalcohols.

(ii) Inorganicpollutants

Carboncompounds(e.g.,COandcarbonates)

Nitrogen compounds (e.g., NO_X, and NH_3)

Sulphur compounds (e.g., H_2S, SO, SO, and H2SO4)

Halogencompounds(e.g.,HF,HClandmetallicfluorides)

Oxidising agents (e.g., 0_3)

Inorganicparticles (e.g.,flyash,silica, asbestosanddustsfromtransport,mining, metallurgical and other industrial activities).

(c) Accordingtostateofmatter:

(i) Gaseous pollutants which get mixed with the air and do not normally settle out, e.g., CO, NO_X, and SO_2.

(ii) Particulate pollutants which comprise of finely divided solids or liquids and often exist in colloidal state as aerosols, e.g.,- smoke, fumes, dust, mist, fog, smog and sprays.

Biochemicaleffectsofsomeimportantairpollutants

1. OxidesofSulphur(SO_x)

- SO_X, comprises of SO_2, and SO_3. They are Colourless, heavy water soluble with pungent and irritating odour. SO_Xpollution is due to volcanic activity, combustion of fuels, Coal fired power stations, transportation, Refineries, metallurgical operations, chemical plants and other natural and human activities.
- In atmosphere, oxidation of SO_2, in to SO_3, by photolytic and Catalytic processes (in presence of O_3, NO_X, or hydrocarbons) giving rise to the formationofphotochemicalsmog.InhumidconditionsoftheatmosphereSO 3, reacts with water vapours to produce droplets of H_2SO_4 aerosols, give rise to the so called "Acid Rain".

$$SO_2 + 0_3ƛ \rightarrow SO_3 + O_2$$

$$SO_3 + H_2O ƛ \rightarrow H_2SO_4$$

Biochemical effects: Absorbs quickly and irritates the upper respiratory tract. Reacts with cellular constituent chemicals e.g., enzymes. The H $_2SO_4$formedlowersPH,impairs enzymatic functions and destroys various functional molecules. Leadsto bronchial spasms, breathlessness, impaired pulmonary function via airway resistance, impaired lung clearance and increased susceptibility for infection.

2. OxidesofNitrogen(NOx)

Characteristics: NOx mostly comprises of NO, NO_2, and N_2O. NO is colourless gas and is slightly soluble in water. NO_2, is reddish brown gas, somewhat water-soluble, oxidizingagent,canreactwithwatertoformHNO$_3$,whichisapowerfuloxidizingagent and capable of reacting with almost all metals and many organic compounds. NO_2, can travel into the respiratory system. It is also involved in the formation of ozone in the atmosphere.

Biochemical effects: Oxidises cellular lipids, Forms bonds with haemoglobin and reduces the efficiency of oxygen transport. Disrupts some cellular enzyme systems. Higher levels and prolonged exposures may cause pulmonary fibrosis, inflammation of lung tissues and lead to death. Causes nitric acid mediated effects some of which are similar to that of H_2SO_4. NO can form addition compound with haemoglobin, if it enters the blood stream.

3. Carbonmonoxide(CO)

Characteristics : Colourless, odourless, toxic gas, slightly water soluble but still is extremely dangerousbecause it hasa greater affinity forhaemoglobinthanthatof O_2.

Biochemical effects : It competitively inhibits combination of O, and haemoglobin. It attacks haemoglobin and displaces o, to form carboxyhaemoglobin, and thus reducingthe oxygen carrying capacity ofblood.

(Undernormalconditions):o_2+Hb$\lambda \rightarrow o_2$Hb(oxyhaemoglobin)

(InpresenceofCO):O_2Hb+CO$\lambda \rightarrow$COHb+O_2(Carboxyhaemoglobin)

TheimmediateresponsetoCO-poisoningislossofjudgment,whichisresponsiblefor many automobile accidents. Further exposureto higher levelsof CO leads to various metabolic disorders such as asphyxiation and causes death. CO-poisoning can be cured by providing fresh O_2' which reverses the above reaction.

4. Ozone (O_3) and other photochemical oxidants such asperoxyacetyl nitrate (PAN) present in photochemical smog.

Characteristics : Ozone is a pale blue gas, fairly water soluble, unstable, sweetish odour. Very reactive oxidizing agent capable of combining with many organic compounds in cells and tissues as well as with rubber and other materials. $O_3$and PAN are harmful to plants, animals and humans.

Biochemical effects : Oxidize cellular constituents. PAN and ozone toxicity is produced via generation of free radicals. The free radicals produced may damage DNA and thus alter cellular genetic integrity too.

The toxic effects of ozone are manifested after inhalation and absorption in the lungs causingaccumulationoffluidsinthelungs(pulmonaryedema),naginglungcapillaries and mortality if continued or high level exposures occur

5. Hydrocarbons(andothervolatileorganiccompounds)

Characteristics: Very reactive. React with many kinds of compounds yielding many kinds of products. Volatile hydrocarbons and other organic compounds participate in atmospheric reactions generating ozone.

Biochemical effects : Some of these compounds can react with the constituents of the cells. Carcinogenic hydrocarbons like benzopyrene can react with DNA causing mutations and cancer.

6. ParticulateMatter

Characteristics : Solid particles or liquid droplets including fumes, smoke, dust and aerosols. Solid particular can adsorb various chemicals.

Biochemical effects : Effects vary with the nature of the particles. Carbon particles and other particles cause scarring of lungs via complex walling off and fibrogenic reactions leading to a disease condition known as “pneumoconiosis”. Particles carrying absorbedmutagens lead todamage of DNA in the lungs and elsewhere.

EffectsofAirPollutantsonManandhisEnvironment

(1) Damage to materials. The materials that may be affected by air pollutants include metals; building materials, rubbers, elastomers, paper, textiles, leather, dyes, glass, enamels and surface coatings. The types of possible damage to these materials by air pollutants include corrosion, abrasion, deposition, direct chemical attack and indirect chemical attack.

(2) Damage to Vegetation. Air pollutants, such as sulphur dioxide, HF, particulate fluorides, smog, oxidants like ozone, ethylene (from automobiles), NO, chlorine and herbicideandweedicidespraysexerttoxiceffectsonvegetation.Thedamageusually manifests in the form of visual injury such as chlorotic marking, banding, silvering or bronzing of the underside of the leaf. Retardation of plant growth may also occur in somecases.

(3) Damage to farm animals. Arsenic, lead and fluorides are the main pollutants which cause damage to livestock. These air-borne contaminants accumulate in vegetation and forage and poison the animals when they eat the contaminated vegetation.

(4) Darkening of sky and reduction in visibility. Sky darkening may be caused by heavy smoke and fog or by dust storms. The reduction in visibility may be due to smoke, fog and industrial fumes which contain particulates in the size range of 0.4 to 0.9u m that scatter light.

(5) Effect on human health and human activities. The effects of air pollution on humans, animals and vegetation has already been discussed in earlier sections. Air pollution can effect the health of workers within the industrial premises, causing absenteeism, sickness and drop in production

MEASURESTOCHECKAIR-POLLUTION

It is not easy to control/check air pollution at resonable cost, because it is not so simple. Our every life style/amentities of modern life is facing for air pollution. But we can check it or prevent by careful planning for industries, better design, operation of equipmentsandgeneralawarenesstodothis.Thefollowing arethegeneralmethods of air pollution control :

1. Controllingtheairpollutionatsource.
2. Siteselection/Zoning
3. Controllingairpollutionbydevices/equipments/processmodification.
4. Airpollutioncontrolbygrowingvegetation.
5. AirpollutioncontrolbyFuelselectionandutilization.

1. ControllingofAirPollutionatSource

This is the best to check air pollution at source. This can be achieved by : (i) Modifyingtheprocessinsuchawaythatpollutantsdonotformatallbeyondthepermissible limits.

(ii) Before release the pollutants, they should be reduced to telerable levels by methods equipments to destroy, alter, trap or so.

To control or minimised air pollution at source, the following steps should be strictly follow :

(a) This step can also be done in two ways, Ist we should select the raw material in such a way to release minimum pollutants. The supplements may also be used if needed.Secondlyusesuitablefuelsavoidingsulphurfuels.Non-essentialingredients are removed before processing of the raw material.

(b) Air pollution can easily be checked by using modified procedure or new process. Timely it should be monitored.

2. SiteSelection/Zoning

- Toinstaltheindustry,siteselectionisimportant,whichresultsintheproduction of single source of pollution. Control measure based on the knowledge of the mechanics of the atmosphere is called "Zoning".
- Whilesettingthefactoriesthemeterologicalandmicro-meterologicalconditions should be considered. Other factors such as facilities for as material supply, transport labour and market for products are also important for selecting the site of industry.

ControllingofAirPollutionbyDevices/Equipments/ProcessModifications

Large number of factories/industries release various types of gases, along with particulates which are measure source of air pollution. In order to prevent these pollutants two types of methods are used.

(A) Methods/Equipments used to Control gaseous Pollutants

Forgaseouspollutants,followingmethodsaregenerallyused:

(i) Absorption
(ii) Adsorption
(iii) Combustion
(iv) Coldtrappingorcondensers
(v) (v)Others.

Butthefirstthreeareincommonuse.

(i) Absorption: Scrubbers are mostly used for the removal of gaseous pollutants. They have suitable liquid as absorbent to remove or modify one or more of the pollutants present in the stream. Through scrubbers gaseous effluents are passed. The efficiency of gas absorption depend upon the following factors:

(a) ChemicalActivityofthegaspollutant.

(b) Theextentofthesurfaceforcontact.

(c) Thecontacttime.

(d) Theconcentrationoftheabsobingmedium.

ThistechniqueisusedforremovalofNO_x,H_2S,SO_2,SO_3 fluoridesetc.

(ii) Adsorption : Here, the gaseous effluents are passed through porous solid adsorbenttakeninsuitablecontainers.Theefficiencyofadsorptiondependsuponthe surface area per unit weight of the absorbent. Constituents of the gas effluents are held at the interface of the adsorbent by chemisorption. When the effluents have higher concentration of Nox, Sox etc. the gases can be recovered economically and used for the manufacture of acids, i.e., HNO, & H.SO, etc.

(iii) Combustion : The flame combustion or catalytic combustion of organic gaseous pollutantsconvertthemintoH2O&CO2.Flamecombustionincludefumeincinerators, steam injection while catalytic combustion is resorted where lower temperature is needed.

(B) Methods/EquipmentsusedtoControlParticulateEmission

The particulate collection devices are based on the size, shape, properties of the particulate, which are generally originate from stationary and mobile sources.

Thevariousmethodsare:

(ii) Filtration
(iii) Mechanical
(iv) Precipitators
(v) Scrubbers.

WATERPOLLUTION

INTRODUCTION

Water is essential for the survival of any form of life. On an average, a human being consumes about 2 litres of water everyday.. About 80% of the earth's surface is covered by water. Some of water is available for drinking, agriculture, domestic and industrial consumption. The rest of the water is locked up in oceans as salt water, polarice-capsandglaciersandunderground.Owingtoincreasingindustrializationon one hand and exploding population on the other, the demands of water supply have beenincreasingtremendously.Moreover,considerablepartof thislimitedquantityof waterispollutedbysewage,industrialwastesandawidearrayofsyntheticchemicals. The menace of water-borne diseases and epidemics still threatens the well-being of population, particularly in under-developed and developing countries. Thus, the quality as well as the quantity of clean water supply is of vital significance for the welfareof mankind. About 70%of allthe available water in our Countryis polluted

Municipal water is mainly used for drinking, cleaning, washing and other domestic purposes. Thewater that is fitfor drinking purposes is calledpotable water.

Characteristicsofpotablewater

1. Itshouldbecolourless,odourlessandtasteless.
2. Itshouldbefreefromturbidityandothersuspendedimpurities.
3. Itshouldbefreefromgerms,bacteriaandotherpathogenicorganisms.
4. It should not contain toxic dissolved impurities , such as heavy metals, pesticides, etc.
5. ItshouldhaveapHintherange7-8.5.
6. It shouldbe moderatelysoft,having hardnesspreferablyinthe range 50-100 PPm. Its hardness should not be above 150 PPm.
7. Itshouldbeaestheticallypleasant.
8. Itshouldnotbecorrosivetothepipelines andshouldnotcauseanyincrustations in the pipes.
9. Itshouldnotstainclothes.

Water PollutantsandtheirSources

Thevarioustypesofwaterpollutantsare:

(a) Oxygen-demanding wastes. These include domestic and animal sewage, bio-degradable organic compounds and industrial wastes from food-processing plants, meat-packing-plants, slaughter houses, paper and pulp mills, tanneries etc., as well as agricultural run-off. All these wastes undergo degradation and decomposition by bacterialactivityinpresenceofdissolvedoxygen(D.O.).Thisresultsinrapiddepletion of D.O. from the water, which is harmful to aquatic organisms.

(b) Disease-causing wastes. These include pathogenic microorganisms which may enter the water along with sewage and other wastes and may cause tremendous damage to public health. These microbes, comprising mainly of virusesand bacteria, can cause dangerous water-borne diseases such as cholera, typhoid, dysentry, polio and infectious hepatitis in humans. Hence, disinfection is the primary step in water pollution control.

(c) Synthetic Organic Compounds. These are the man-made materials such as synthetic pesticides, synthetic detergents (syndets), food additives, pharmaceuticals, insecticides, paints, synthetic fibres, elastomers, solvents, plasticizers, plastics and chemicals. These chemicals may enter the hydrosphere either by spillage during transport and use or by intentional or accidental release of wastes from their manufacturingestablishments.Mostofthesechemicalsare potentiallytoxictoplants, animals and humans.

(d) Sewage and agricultural run-off. Sewage and run-off from agricultural lands supply plant nutrients, which may stimulate the growth of algae and other aquatic weeds in the receiving water body. This unwieldy plant-growth results in the degradationofthevalue ofthewater body, intendedforrecreational and other uses.

(e) Oil. Oil pollution may take place because of oil spills from cargo oil tankers on the seas, losses during off-shore exploration and production of oil, accidental fires in ships and oil tankers, accidental or intentional oil slicks and leakage from oil pipe-lines, crossing waterways and reservoirs. Oil pollution results in reduction of light transmission through surface waters, thereby reducing photo-synthesis by marine plants. Oil pollution in Seas has been increasing due to the increase in oil based technologies, massive oil shipments, accidental oil spillages etc.

(2) Inorganic Pollutants

Inorganic pollutants compriseofmineralacids, inorganic salts, finely divided metals or metal compounds, trace elements, cyanides, sulphates, nitrates, organometallic compounds and complexes of metals with organics present in natural waters. The metal-organic interactions involve natural organic species, such as fulvic acids and synthetic organic species, such as EDTA. The heavy metals such as Hg, Cd and Lead, metalloids such as As, Sb and Se are most toxic. The water pollution by heavy metals occurs mostly due to street dust, domestic sewage and industrial effluents. Polyphosphates from detergents are also water pollutants.

(3) Suspended solids and sediments

Sediments are mostly contributed by soil erosion by natural processes, agricultural development, strip mining and construction activities. Suspended solids in water mainly compriseofsilt, sand and mineralseroded from the land. Soil erosion by water, wind and other natural forces are very significant for tropical countries like India. It is estimated that 5.37 million Tonnes of NPK fertilizers are washed away in to the sea. Sediments and suspended particles exchange cations with the surrounding aquatic mediumand act as repositories for trace metals such as, Cu, CO, Ni, Mn, Cr, and Mo.

(4) Radioactive Materials

The radioactive water pollutants may originate from the following anthropogenic activities:

(a) Mining and processing of ores, e.g., Uranium tailings.

(b) Increasing use of radioactive isotopes in research, agricultural, industrial and medical applications, e.g., I^{131}, P^{32}, Co^{60}, Ca^{45}, S^{35}, C^{14}, Ir^{132} and Cs^{137}.

(c) Radioactive materials from nuclear power plants and nuclear reactors, e.g., Sr^{90}, Cs^{137}, Am^{241}, Pu^{248}.

(d) Radioactive materials from testing and use of nuclear weaponry, e.g. Sr^{90}, Cs^{137}.

(5) HEAT. Considerable thermal pollution results from thermal power plants, particularly the nuclear-power-based electricity generating plants. In such industries, where the water is used as a coolant, the waste hot water is returned to the original water bodies. Hence the temperature of the water body increases. This rise in temperature decreases the DO content of water, which adversely affects the aquatic life.

Someimportanteffectsofvarioustypesofwater pollutantsareas:

(i) Tannery effluents contain several constituents which are deleterious, irrespective of the

factthatwheretheyaredischargedviz.,intoriver,stream,sewer,landorsea.

(ii) Itimparts persistent dullbrown colour tothe receiving water causingaestheticand other problems described earlier.

(iii) Highly repulsive odour is imparted to the receiving water. The dissolved constituents like proteins are purifiable.

(iv) The acidic or alkaline effluents are corrosive to concrete and metal pipes. (v) Excess NaCl in the effluent is also corrosive and renders the receiving water unsuitable for irrigation

(vi) Theeffluentsmaycontainpathogenicbacteria.

(vii) The dissolved chromium present is toxic to fish and aquatic life and thus affects the natural self-purification property of the stream.

(viii) Thesuspendedsolidssuch ashair,flesh,CaCO,'etc.interferewithaerationand photosynthetic activities of the aquatic flora.

(ix) If the wastewater is discharged into sewer, the suspended impurities such as CaCO3, hairs etc. may choke the sewerage pipes. The sulphides present in the wastewater cause "crown corrosion" to the concretestructures, etc.

(x) The chromium and sulfides present in the waste water being toxic to microorganisms disrupt the biological treatment operation such as trickling filtration. The suspended lime etc. also interfere with the biological activities in the sewage treatment plants.

(xi) The presence of excessive salt and Cr in the wastewaters may deteriorate the quality of the ground water in the affected areas.

CONTROLOFWATERPOLLUTION

The control of water pollution is difficult, but we may try for its prevention and minimisations.IndustrialisedandDeveloping countriesspendahandsomeamountof their GNP (GrossNational Product) on pollution controlmeasures, but the problem is goingto be worsening day by day. Thebefore water pollution control are:

1. Howpurethewatershouldbe?
2. Howtoprohibittheeffluentsanddischargeintowater?
3. Towhatextentwaterqualitybeimproved?
4. How to create public opinion against water pollution? Therefore, we should adopt the respective safety measures to achieve acceptable water quality at the least cost. Some of these are :

1. Scientific techniques are necessary to be adopted for the environmental control of catchment areas of rivers, lakes, ponds or streams.

2. Industrialplantsshouldbebasedonrecyclingoperations.

3. The possible reuse or recycle of treated sewage effluents and industrial wastes should be emphasized and encouraged.

4. Instead of throwing wastesin to water, the recycling shouldbe done for better use. Gobar gas plant, composting, manufacture of hardboard, paper etc. such examples where respective waste can be used.

5. Minimum, appropriate quantity and concentration of Fertilizers, pesticide& insecticides should be used, because excess will cause pollution.

6. Thereshouldbepropagandaforwater pollutioncontrol,onradio,TV,Newspapers etc. because public awareness is a must.

7. Treatment plants should be constructed and Govt should also help by funding for domestic, sewage and industrial effluents.

8. Local authorities, Industrialists, Govt officials, with public participation should co-ordinate to finds ways to control water pollution.

9. Waterresourcesshouldbeusedinthebestpossibleeconomicway.

10. To conduct seminars and training courses for helping those, who are directly or indirectly engaged in water management and water pollution control.

SOILPOLLUTION

INTRODUCTION

Soilisaveryimportantconstituentsofthelithosphere.Theword"Soil"isderivedfrom a Latin word"Solum" which means earthy material in which growth of plants takes place. "Soil" may be broadly defined as the weathered layer of the earth's crust with living organisms and their products of decay.

Theearth'scrustbasicallyconsistsofthefollowing threerocktypes.

1. Igneous rocks: These are formed by cooling and solidification of molten rock material called 'Magma'. Ex:- Basalt and Diorite.

2. Sedimentary rocks : These are developed as a result of gradual accumulation, consolidation and hardening of products of weathering of mineral materials brought about by wind or waters. These rocks are characterized by the presence of distinct sedimentary layers. Ex :Limestone, sand stone and shale.

3. Metamorphicrocks: Theseareformedasresultofmetamorphosisofigneousand sedimentary rocks under the influence of high pressure and intense heat. Ex:- Quartzite, Slate, Marble and Schist.

SourcesofSoilPollution

Soil pollutiondiffersfrom water pollutionorairpollution,because the pollutantsremain in direct contactwith the soil for relatively longer periods and hence alter the chemical and biological properties of the soil. The hazardous chemical can also enter the human food chain from soil or water plants.

EFFECTSOFSOILPOLLUTANTS

“Soil Pollution” was originally defined as the contamination of the soil system by considerable quantities of chemical or other substances, resulting in the reduction of its fertility or productivity with respect to the qualitative and quantitative yield of the crops.

Themajoreffectsofvarioustypesofpollutantsaregivenbelow:

(a) Effectsofmodernagriculturalpractices:

Synthetic Fertilizers : Synthetic fertilizers are employed to increase the soil fertility and crop productivity. Excessive and indiscriminate use of chemical fertilizers may result in the following undesirable effects:

(i) Wheat, maize, corn, etc. grown on soils fertilized with NPK fertilizers may result in considerable reduction in protein content of the crop.

(ii) Excessiveuseofnitrogenousfertilizersleads totheaccumulationofnitratesinthe soil which may contaminate the ground water. Nitrate concentrations exceeding 90 ppm in drinking water may lead to diarrhoea, blue Jaundice (Cyanosis) in children, "methemoglobinemia” (or blue baby syndrome) in infants. Further, the nitrates and nitrites entering the human body may be eventually converted nitroso amines and compounds which are suspected to cause stomach cancer.

iii)Vegetationgrowthinnitrate-richsoilsmayexerttoxiceffectsincattle.

(iv)Excessive use ofchemicalfertilizers may enterthewaterbodies andcontribute to "eutrophication”. (Eutrophication is the excessive growth of algae and aquatic plants to undesirable levels).

(vi) Excessive use of chemical fertilizers may reduce the ability of plants to fix nitrogen.

(vii) Excessivequantitiesofpotassiumfertilizers insoilsmay reducethequantities of valuable ascorbic acid and carotene in fruits and vegetables grown in such soils.

(vii) Thelarge-sizedfruits andvegetables growninhighly fertilizedsoilsmaybe more vulnerable to attacks by pests and insects.

Pesticides

Pesticides pose potential hazard to animals, humans and aquatic life deleterious effectonsoil fertilityandcropproductivity.Pesticidesappliedtocropsareretainedinthesoil in considerable quantities. They enter into cyclic environmental processes such as absorption by soil, leaching by water, etc, and contaminate both lithosphere and

biosphere.Pesticidesincludingherbicides,fungicidesandrodenticides,arepersistant pollutants.

Thefollowingtypesofpesticidesarecommonly used:

(a) Chlorinatedhydrocarbons(eg.DDT,Aldrin,Dieldrin,Lindane,BHCetc.)

(b) Carbamatecompounds(eg.CarborylorSevin,Zectrionetc.)

(c) Organo-Phosphorouscompounds(eg.Methylorethylparathion,melathion, guthion etc.) (d) Inorganic compounds (eg. As_2O3, PbO_2, NiCl, $CuSO_2$, etc)

(e) Miscellaneouscompounds(eg,Organicmercurials,2.4D;2.4,5Tetc)

Some of the adverse effects of pesticides are given below:

(i) Somearsenicpesticidesmayrenderthesoilpermanentlyinfertile.

(ii) Pesticide residues in soil may be taken up by plants and cause phyto-toxicity. They may enter the aquatic environment and enter the food chain.

(iii) Pesticidessuchas,endrin,dieldrin,DDT,hepachloretc.mayseepthroughthesoil and contaminate groundwater and surface waters. They may eventually contaminate drinking water supplies.

(iv) Fruit,vegetables,rice,wheat,barley,maizeetc.areknowntocontainconsiderable quantities of toxic pesticide residue such as of DDT, BHC and other organochloro pesticides.

(v) Polychlorinated biphenyls (PCB) having half-life periods of about 25 years in soil areamongthemosthazardoussoilpollutants.Theymayaccumulateinsoilandplants when they eventually enter the animalor human body, they may cause severe health disordersincludingeyedamage,skinproblems,nervousdisorders,foetusdeformities and liver or stomach cancer.

(vi) Irrigated water from pesticide contaminated soils may evaporate and spread the toxic pesticide vapours in the atmosphere.

vii) DDT can enter the food chain and accumulate in human fats and may lead to disorders such as impotency.

viii) Persistant pesticides can damage human tissues and interfere with the normal metabilic activities by disturbing enzymatic functioning.

ix) Chlorinated pesticides and herbicides are hazardous soil pollutants which can affect the soil texture and damage the ecosystem.

x) HuntingbirdsfeedingongrainscontaminatedwithDDTare threatenedofextinction.

xi) Organophosphate pesticides may cause muscular disbilities, tremors, and dizziness.

xii) Excessive use of synthetic pesticides may lead to defoliation to forests and adverse effect o fauna and flora.

xiii) Farm animals drinking stagnant water in fields sprayed by pesticides developed toxic symptoms and some mortalities were reported.

xiv) Farmers and farm workers are particularly prone to pesticide poisoning because of greater exposure while handling and spraying.

xv) Volatilepesticidesmaycausepollutionofairinthesurroundingareas.

(b) EffectsofIndustrialeffulents

Solid, liquidandgaseouschemicalsfromvariousindustriessuchaspaperand pulp, iron and steel, fertilizers,dyes, automobiles, pesticides, tanneries, coal- based thermal power plants etc. contain a variety of pollutants such as heavy metals, solvents, detergents, plastics, suspended particulates and refractory chemicals.

(c) Effectsofurbanwastes

Millions tones of urban waste are produced every year from critically polluted cities. The inadequately treated or untreated sewage sludge not only pose serious health hazards but also pollute soil and decrease its fertility and productivity.Other waste materials such as rubbish, used plastic bags, garbage, sludge, dead animals, waste medicines, hospital wastes, skins, tyres, shoes, cans, etc.

Controlofsoilpollution

The major sources of soil pollution are the domestic wastes, industrial wastes and agricultural wastes including those toxic chemicals (eg. Pesticides) arising from modern agricultural practices. The various approaches to control soil pollution are as follows

(1) Implementingstringentandpro-activepopulationcontrolprogrammes.

(2) Launchingextensiveafforestationandcommunityforestryprogrammes.

(3) Implementingdeterrentmeasuresagainstdeforestation.

(4) Formulation of stringent pollution control legislation and effective implimentation with powerful administrative machinery.

(5) Imparting informal and formal public awareness programmes to educate peoples at large regarding the health hazards and undesirable effects due to environmental pollution. Mass media, educational institutions and voluntary agencies should be involved to achieve these objectives.

(6) Banning the use of highly toxic and resistant synthetic chemical pesticides or atleast

regulating/restrictingtheiruseonlyforspecialpurposesunderthoroughmonitoring.

(7) Encouragingtheuseofbio-pesticidesinplaceoftoxicchemicalpesticides.

(8) Conservation of soil to prevent the loss of precious top soil from erosion and to maintain it in a fertile state for agricultural purposes.

MARINEPOLLUTION

Seas are the main source of food and earnings for persons living in coastal areas. When the marine water is polluted it effects the animals and other food chain components. Researches shows that many marine animals secrets the medicinal chemicalswhichareusefultomankindandotherlivingorganisms.Whenwater willbe polluted it will effect the animals present in seas.

SourcesofmarinePollution

Themainsourcesofmarinepollutionare:

1. Riversarethemainsourceofmarinepollution.Theycarrywastesin theirdrainage and joins the sea/ocean. The drainage include sewage sludge, industrial effluents, detergents, agrochemicals, plastics, metal scraps etc.

2. Manybigcitiesandindustriesaresituatedalongthecoastline.Everylargeamount of wastes from hotels, wastes effluents mixed with detergents, sewage from corporations and industries, other wastes from human activities are mixed in sea water.

3. Ships which carry toxic substances, lubricating oil, paints heavy oils, fuels, automotive materials and other chemicals from one place to another, some times by accident or by leakages pollute the marine water.

4. Testing of atomic weapons, space aircrafts, missiles (generally developed country do this) and other radioactive wastes when dumped in seas, causes heavy loss to aquatic biota.

5. Harmfuleffluents fromnuclear power stations orfromother scientific organizations likeBARCinIndia,chemicalindustries,fertilizers,Pesticideandinsecticideindustries whenmixed in marine water causes harmful effects to marine life.

6. Marine pollution also caused by oil drilling in seas, tourism activities and heat released from industries. etc.

Effectsofmarinepollution:

Themajoreffects ofmarinepollutionareasfollows:

1. Oil is most dangerous pollutant when afloat on sea or mixed with water a great threat to marine life specially fish, birds, invertebrates and algae. Thousands of birds killed every year because once they oiled, seldom survived despite efforts to clean themselves.

2. Oil of sea also effects sensitive flora and fauna, phytoplankton, zooplankton and other animals. In Alaska, Brittany (France), Elbe (Germany) thousands of birds died by oil spillage.

3. Plastic or plastic materials when dumped into sea by commercial ships or from drainage, animal take it through their food in stomach. It causes ulcer and reduces hunger.

4. Marine pollution effects the food chain in seas. Serious diseases like cancer are the caused when affected animals are taken by man from ocean.

5. Detergents, either from cleaning up the spills or from drainage, also responsible for high mortality of marine life.

6. Heavy metals (like lead and mercury), factory materials, mineral oils, acids and other biocides are also measurethreatto marine life whenmixed with sea water.

Controlofmarinepollution:

Thecontrolofmarinepollutioncanbe studied infollowingtwo steps:1. Stepsalready in operation pollution

(i) Port authorities are alert and introduced antipollutant measures by creating pollution cell.Butdeepercheckthe insea coastalguardsaredoingthisjob.

(ii) Various research organizations, institutions are working in this field to marine pollution

(iii) In most of the countries (India too), the monitoring and survey in operation to control the marine pollution.

(iv) Authorities are taken care of effective measures to check the oil leakage from ships and tankers.

(v) Urban and coastline corporations are trying to check the dumping of wastes from human activities& Municipal etc. solid waste management is helping to recycle or reuse.

Suggestingstepstocontrolmarinepollution

(1) Dumping of oil ballest, hazardous and toxic substances, gases from radioactive labs into sea,should be banned orshouldbe properlytreated beforedumping.

(2) Drainage, sewage sludge and effluents from industries should not be discharged in to rivers which joins sea.

(3) Developmentalactivitiesoncoastalareasshouldbeminimised.

(4) Toxic pollutants from industries and treatment plants should not be discharged into sea.

(5) Shipsandportsshouldhavecertainfacilitiesforreducingpollution.

(6) Certain biological and other methods should be followed to restore species diversification and ecobalance in the water body to prevent pollution.

(7) Effective measures should be developed to check the leakage in ships and oil tankers.

(8) Nuclearexplosionsandothernuclearactivitiesinseashouldbeminimized.

(9) Wastes from municipal, industries, sewage and thermal power stations should be recycledfor reutilization. Such plants shouldbedeveloped. Some are in operation.

(10) Weshoulddevelop awareness in peopletoreducethe amount of wastein their daily life.

(11) Drillingshouldnotbeallowedincoastalareas.

NOISE(SOUND)POLLUTION

The term 'noise may be defined as an unwanted sound at a wrong time and a wrong place. Wheather a given sound is wanted or unwanted may depend upon the person involved,the loudness, the rhythm,and the lengthoftimefor whichone isexposed to it.

SoundintensitymeasuredDecibel(dB)=10log$^{\frac{Soundintensity\ measured}{Referencesoundintensity}}$

EffectsofNoise

(a) PhysiologicalEffects:

Theacuteeffectscausedbynoisedependuponthepressureandfrequencyabout.At high levels of about 150 dB, immediate permanent hearing impairment may be caused. At sound levels in the range of 120-150 dB, effects on respiratory system, dizziness,disorientation,lossofphysicalcontrol,otherphysiologicalchangesresulting from stress, nausea and vomiting may be caused.

(b) Psychologicaleffects

Although there is little specific evidence regarding the onset of mental or nervous illnesscausedbynoise,somereportsareavailabletoindicatetemporaryeffectssuch as deterioration inconcentration and evenmental disorientation athigh noiselevels.

(C) HearingLoss

Prolongedexposurestoloudnoisecancausetemporaryorpermanentlossofhearing. People working in noisy places such as industrial establishments, factories etc. often suffer from temporary loss of hearing. If the loudness of noise is moderate or the duration of exposure is short, the damage is only temporary.

(d) Other health effects of noise pollution: Loud noise is affects sleep, concentration and work or performance of an individual. Work which needs a high degree of skill and precision is considerably affected. It may cause headache, irritability and fatigue. It is interesting to note that our optical system is considerably affected by noise pollution.

PreventionandControlofNoisePollution

Loudnoiseistheformofpollutionwhichoftencausesmuchpublicconcern.Therefore, necessarysteps have tobe taken tocontrol the noise pollution. Some of these are :

1. Reductionofnoiseatthesourceofitsorigin: Oftenalittleprecautioncanreduce much of the noise pollution caused by loud noise. This can be achieved by replacement of noisy devices or machines with quieter ones. Noise level can be reduced effectively by replacement of noisy and rattling parts, providing better

cushioning to check the vibrations, proper oiling and greasing to ensure smooth running and using effective silencers etc.

2. Applicationofsoundproofingtechniquestomuffledownloudnoises: Sound wavesare absorbed by porous material such as perforated sheets and other objects. Just as putting cotton plugs in the ears reduces noise level for the individual concerned,soundbarriersplacedaroundthesourceoforiginofloudnoisesdrastically reducetheintensity of sound on the other side of the obstacle.

3. Keeping residential localities free of noisy industries, busy highways, aerodromes etc. Residential localities should be established away from noisy industries, busy highways, aerodromes or else these noisy establishments should be developedawayfromquietresidentialareas.Industrialunitscanbedisplacedtosome industrialareawhereasbypassesmaybedevelopedtodivertbusyrailwaytracksand highways away from domestic establishments. Only that part of traffic should be allowed toget into a residential area which is barely necessary.

4. Enactment of strict legislation and its effective compliance: In most of the countries our own, legal framework against noise pollution has been developed. However, in most of the cases little efforts are made to enf only effective compliance of theserules muchof thenuisanceof noisepollution shallautomatically becurtailed.

5. Noisecontrolmethodsinindustrialplants

Excessive noise is produced from various types of machines, petrol and diesel engines, electric motors, construction site equipment, pumps and pumping systems, compressed air systems, hydraulic systems, air distribution system, industrial fans, etc.It is alwaysadvantageous, economicaland effectiveto identifythe noise sources and noise problems right in the design and erection stages and incorporate the necessary noise control measures rather than attending to the problems at a later stage.

Thefollowingfourapproachesareavailablefornoisecontrol:

ApproachesNoiseControl

(1) Modifying some of the present practices and procedures in order to minimize the noise. Ex:Reducing automobile traffic, outlaying sirens, discouraging stereos without headsets, using glue instead of rivets, etc.

(2) Shieldingthesourcesofnoisegeneration.

Ex:Useofsound-absorbing motormountings,betterinstallation,betterdesign,useof motorenclosures,useofvibrationdampingorabsorbingmaterialsinautomobilesand dishwashers, etc.

(3) Shieldingthenoisereceiver.

Ex:Usingearplug,controlbooths,etc.(4)Shiftingnoisysourcesandthingsawayfrom peopleEx:Isolating airports,industrialcomplexes, etc.Obviously,someof the above measures can be implemented successfully only if they are mandatory.

THERMALPOLLUTION

ThetermThermalPollutionhasbeenusedtoindicatethedetrimentaleffectsofheated effluentsdischargedbyvariouspowerplants. Itdenotesthe impairmentof qualityand deterioration of aquatic and terrestrial environment. Various Industrial plants like thermal, atomic, nuclear, coal fired plants, oil field generators and mills utilize water for cooling purposes.

ThermalPollution:Itcanbedefinedas:

1. The warning up of an aquatic system to the point where desirable organisms are adverselyaffected.

2. Additionofexcessofundesirableheattowaterthatmakesitharmfultoman,animal, plantoraquaticlifeor otherwisecausessignificantdangersto thenormalactivitiesof aquatic communities in water.

3. Heatedeffluentseitherfromnaturalormanmadesources,contaminatedwithwater supplies, may be harmful to life because of their toxicity, reduction in Dissolved Oxygen (D.O.), aesthetically unsuitable and spread diseases.

4. Itreducesthenumberofaquaticspeciesanddestroysthebalanceoflifein streams as is evidenced by the biological indices of community and diversity. 5. It is a by- product of rapid and unplanned industrial progress and over population.

SOURCESOFTHERMALPOLLUTION

Theacceleratedpaceofdevelopment,rapidindustrializationandextensivepopulation densityhaveincreaseddemandofthermalpowerplants.Humanactivities,today,are constantly adding pollutants to air and water at a higher rate. The following sources contribute to thermal pollution:

1. Nuclear Power Plants: Nuclear power plants, including nuclear experiments and explosions,dischargealothaveunutilizedheatintonearbywaterstreams.Emissions from nuclear reactors and processing instruments are also responsible for increasing the temperature of water bodies. Heated effluents from power plants at 10°C higher than the coolant receptor and severely affect the aquatic flora and fauna discharges effluent having drainage from hospitals, institutes,discharged

2. Coal-fired Power Plants: Some thermal power plants ultimately temperature differenceof15°Cbetweeneffluentandwaterbody.TheThermalpowerplantsutilize coal as fuel and they constitute the major source of thermal pollutants. The heated coils are cooled with water from nearby like or river and discharge the hot water back tothereceptorwaterbodyandtherebyincreasingthetemperatureofthenearbywater. Theheatedeffluentdecreasesthecontentofdissolvedoxygen ofwater.Itresultsinto killing of fish and other marine organisms.

3. Industrial Effluents: Industries generating electricity, like coal asfueland Nuclear powered thermal plants, require huge amounts of cooling water for heat removal. Other industries like textiles, paper and pulp as well as sugar also release heat in water but to a much lesser extent.

4. Hydro-electric Power: The generation of hydroelectric power, sometimes, results in negative loading in water systems. Apart from electric power industries, various factories with cooling contribute to thermal loading. It has been reported that about 18%moreheat isgivento cooling pondsinnuclear power plantsthan anyother plant of equivalent size.

5. Domestic Sewage: Domestic sewage is commonly discharged into rivers, lakes and canals with or without waste treatment. The municipal sewage normally has a higher temperature than receiving water. The discharged water not only raises the stream temperature to a measurable extent but also creates numerous deleterious effects on aquatic biota.

EFFECTSOFTHERMALPOLLUTION:

Thevariouseffectsofthethermalpollution

1. Reduction in Dissolved Oxygen: Concentration of dissolved oxygen decreases with increase in temperature of water. For example, the D.O. content is 14.6 ppm in water at a temperature of 32°F and 6.6 ppm at 64°F. Thus cold-water fish, which requires about 6 ppm to survive, would not tolerate the high water temperatures. If theyremainedintheareatheywoulddieof oxygenstarvation. Sincetheaquaticbiota live acrobically, so a healthy stream should have an adequate supply of dissolved oxygen.

2. Change in Water Properties:A rise in temperature changes the physical and chemical properties of water. The vapour pressure increases sharply , while the viscosityofwaterdecreases.Thedecreaseindensity,viscosityandsolubilityofgases increases the settling speed of suspended particles, which seriously affect the food supply of aquatic organisms.

3. Increase-in Toxicity: The rising temperature increases the toxicity of the poison present in water. A 10°C rise in temperature doubles the toxic effect of Potassium cyanide,whilean80°Criseintemperaturetriplesthetoxiceffectof O-Xylenecausing massive mortality of fish. In

digestion, excretion and overall development of aquatic organisms. The temperature changestotallydisrupttheentireecosystem. Sharpchangesintemperatureareoften destructive. Because, the life of aquatic animals involves several chemical reactions and the rate of these reactions vary according to changes in temperature.

5. Interference with Reproduction: In fishes, several activities like nest building, spawning, hatching, migration and reproduction etc. depend on some optimum temperature. For instance, the maximum temperature at which lake trout will spawn successfully is 8.9°C. The warm water not only disturbs spawning but also destroys the laid eggs.

6. Variations in Reproductive Rate: Theincrease in temperatureriggersdepositionof eggs by female.The triggeringis particularlydramaticinestuarine fish,which spawn in four hours after the water temperature reaches critical level.

7. Changes in Metabolic Rate: Fishes show a marked rise in basal rate of metabolism with temperature to the lethal point. The respiratory rate, oxygen demand, food uptake and swimming speed in fishes increase.

8. Increased Vulnerability to disease: Activities of several pathogenicmicroorganisms are accelerated by higher temperature. Hot water causes bacterial disease in certain fishessuch that they fail to developeggs above critical temperature.

9. Invasion to destructive organisms: Thermal pollutants may permit the invasion of organisms that are tolerant to warm waters and highly destructive e.g. invasion of ship worms into New Jersey's Oyster Creek.

10. Undesirable Changes in Algae Population: The life in an ecosystem is greatly influenced by the algal growth. Excess nutrients from the washout waters from farmlands, thermal plants cause an excessive algal growth with consequent acceleration of eutrophic and other undesirable changes.

11. Destruction of Organisms in Cold Water: The volume of water required for cooling purposes from a stream is enormous. Unfortunately many of plankton, small fish, insect larvae that are sucked into the condenser along with cooling water are killed by the thermal shock, increased pressure and water viscosity.

12. Biochemical Oxygen Demand: When the temperature of stream carrying biodegradableorganicmatterrises,theintensifiedactionofaquaticorganisms causes B.O.D. to beaccomplishedat a lowertemperature. When thetemperatureof stream carrying biodegradable organic matter rises fish death may occur due to synergistic action, which is caused due to accelerated chemical or biochemical action.

13. Effect on Marine Life: Temperature plays an important role in affecting the physiology, metabolism, growth and development of marine animals. Sea organisms arepoikilothermici.e.theirbodytemperaturevarieswiththesurroundingwater.Some marine creatures cannot tolerate wide changes of temperature, so they die at higher temperature.

14. Effect on Bacteria: Due to the heated discharges from the industries and plants (industrial), the bacteria are severely damaged. The effect includes coagulation of bodyProtein, melting of cell fats, toxic action of metabolic products etc.

CONTROLOFTHERMALPOLLUTION

Heatmustberemovedfromthe condensercooling waterspriortotheirdisposalinto water bodies. Themajor principles involved in the process of heat loss are:

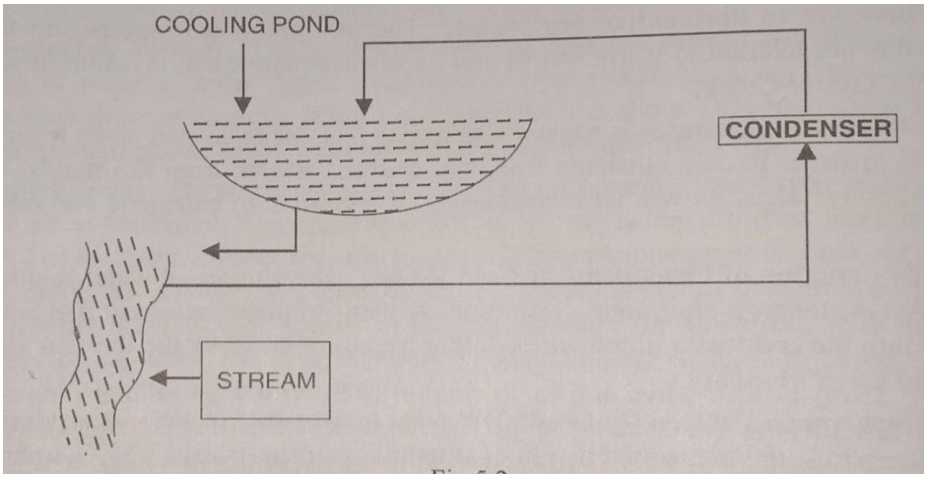
1. Conduction
2. Convection

3.Radiation

4.Evaporation

Thefollowing methodscanbeadoptedtocontrolhightemperaturecausedbythermal discharges:

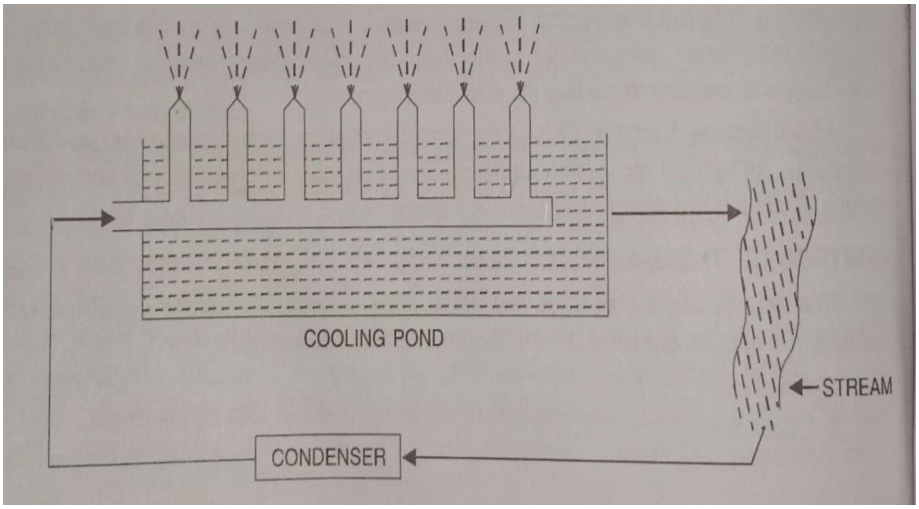
(1) COOLINGPONDS:



Thewaterfromthecondensersisstored intheearthlikepondswhere natural evaporation brings down the temperature. The water is recirculated again.

(2) SPRAYPONDS:

In spray ponds, the water is sprayed in the cooling ponds with the help of spray nozzelstoconvertitintofinedropletswhichprovidemoresurfaceareatofacilitateefficient heat transfer to atmosphere.



(3) CoolingTowers:

WETCOOLINGTOWERS:

In wet cooling towers, the heated water is brought in direct contact with continuously flowingair. The evaporation bringsdownthe temperature. To increase the surface

areaofcontact,the water isbrokendown into dropletsbyuseof spraynozzlesorby splashing it on the packing or baffles in the cooling towers.

(4) Tohandle large quantities of heatedeffluents, large tanksor reservoirs should be constructed to retain the water for a little longer time. When water cool down to a tolerable temperature, it may be released.

(5) The heated effluents discharged from the chemical industries and thermal power plantscanbeputintocertainbeneficialuses likegreen house,frost protection during colds, aquaculture, heating the buildings etc.

NUCLEARHAZARDS

- A number of atoms possess the ability to emit radiations and thereby cause radioactive pollution. Radiations originate from instability of the nuclei of an atom whichloses sub-nuclear particlesand energyto acquireastablestatei.e radioactivity. It is the state of nuclei which is responsible for the phenomenon. Neutrons and protons constitute the nucleus while electrons revolve round the nucleus (units outer orbits).
- When the number of protons are equal to number of electrons, the chemical properties shall remain the same. Neutrons and protons constitute the mass while electrons constitute charge to the element.
- ThusRadioactiveelement is defined to be thecollection radioactive mass with the same charge of the nucleus. The radioactive atom has the same charge of thenucleusandthesamemassiscalledRadioactiveisotope.TheRadioactivity of a radioactive substance is expressed by the number of nuclear transformations in unit time.

Aradioisotopeischaracterizedbythefollowingproperties:

(i) Halflifeperiod.
(ii) Modeofdecays.
(iii) Energyofradiations.
(iv) Definiteenergystate

Radiation is the emission of rays and particles or release of energy from the source (atom). There are two types of radiations ionizing and non-ionizing radiations. These radiations destroy the organic molecules of which the body cells are composed. If ion pairs enter into a living protoplasm, they damage it and the damage is proportionalto thenumberofion-pairsabsorbed.Thefollowingtypesofradiationsaregivenoutwhen an element transmutates or decays.

(1) Emission of alpha (a) particles. Alpha particles are nothing but Helium nuclei. Emission of alpha particle will change into elements of lower atomic number. These are deflected by electric and magnetic fields. They are to show moving, strongly ionizing, weakly penetrating and stopped by 80 mm of air.

(ii) Emission of Beta particles (Q) :- Emission of Beta particle changes into another element with a higher atomic number. Beta particles are high velocity electrons. Strongly deflected in electric and magnetic fields. The penetrating power of Beta particles varies with the energy of particles.

(iii) Emission of Gama rays ():- These are high energy electromagnetic radiations. Can penetrate several cm. of Lead sheet depending upon the energy. These are undeflected in magnetic fields.

Radioactivedecayisaspontaneousprocessarisingfromnuclearinstability.

SourcesofRadioActivePollution

Thetwomainsourcesofradioactivepollutionare,naturalandmanmade.

NATURALSOURCES

- The natural sources of radioactivity are considered mainly of the cosmic from thespace,andthenaturallyoccurringradioisotopespresentintheenvironment and those contained within the body of the organisms.
- The cosmic radiations are of extra terrestrial origin, which probably arise from the sun or even beyond it. They are consistedof particles of very high energy, primarily of protons and some heavy nuclei.
- Thesecosmicparticlescollidewiththegasmoleculesoftheupperatmosphere bringing about intense ionization in gases accompanied with the formation of secondary cosmic rays composed mainly of neutrons, mesons, and gamma rays. Eventually a complex mixture of particles reaches the earth as cosmic rays. These particles also form substantial quantities of ^{3}H and ^{14}C in the atmosphere.

Man-MadeSource

Man causes radioactive pollution by testing of nuclear weapons, establishment of nuclear power plants, mining and refining of plutonium, and thorium, and preparation of radioactive isotope.

1. Nuclearweapons

Testingofnuclear armscomprises:

(a) TheuseofUranium235andPlutonium239forfission.

(b) Hydrogenorlithiumasfusionmaterial.

Atomic explosions are uncontrolled chain reactions. They give rise to very large neutron flux conditions that cause other materials in the surrounding environment to become radioactive. Huge clouds of fine radioactive particles and gases are thrown up in the environment and are carried away to distant areas by the agency of wind. Gradually they settle down on earth as fall out or are brought down byrain.

2. AtomicReactorsandNuclearFuel

The most common fuel used for fission in the nuclear power plants are uranium, thoriumandplutonium.Uraniumundergoesseveralprocesses,rightfrom itsminingto its inception into the reactors. The spent materials obtained from the reactors, after the energy has been utilized, are reprocessed to recover unburnt uranium, plutonium and some other important isotopes, which can be used in medicine or for some other useful purposes.

3. RadioactiveIsotopes

Radioactive isotopessuch as125, 14cand 32, and their compoundsfind wide usage in scientific research institutions contain varying amounts of radioactive materials. When this waste water reaches the different water sources such as rivers, streams, lakes etc. through the sewers they cause water pollution. Radioactive iodine and phosphorusalsoenterthefoodchainthroughwaterandmayfinallyreachmanthrough fish etc.

4. OtherSources

During different medical treatments, varying concentrations of radiations enter the human body for instance, X-rays are common for detecting skeletal disorders, and therapyfor cancer patients often includes radium and other isotope radiations.

DamagestoaBiologicalSystem

Most of the damages caused by radioactive pollutants stem from their capacityto produce high energy radiations, which are very harmful to a living system. There are two main modes in which radioactive pollution can be dangerous to a biological system.

(i) Damagescausedbyradiationsfromoutsidesource.
(ii) Damagescausedbyradiationsfromsourcesinsidethebody.
(iii) DamagescausedbyRadiationsatdifferentlevels

(i) DamagesatMolecularlevel

Damages to macromolecules such as enzymes, DNA, RNA etc. through ionization crosslinkages within and between two affected molecules.

(ii) Damagesatsub-cellularlevel

Damages to cell-membranes nuclei, chromosomes such as fragmentation, mitochondria etc. **(iii) Damages at cellular level**

Inhibitionofcelldivisiondeath,decayandtransformationtomalignantstate.

(iv) DamagestoTissuesandOrgans

Disruption of such systems as central nervous system, loss of sight, inactivation of bonemarrowactivityresulting inbloodcancer malignancyandulcerationof intestinal tract.

(v) DamagestoanIndividualandwholepopulation

- Death or shortening of life due to radiations changes in characteristics due to mutations.Inhumanbeingsexposureofradiationsresultsinlittlevisibleeffects in early stages. But after 12-24 hours injury symptoms manifest themselves.
- Thisincludesreddeningofskin,anemia,anorexia.Vomiting,anddiarrhoeaand with heavy doses, blister formation, pigmentation of skin, burning sensation all overthebody, lossof sight etc.Itmust benotedthatforallthisthere isno cure available. Once a person is exposed to radiation he has to bear its consequences. Medical aid can do little.

HAZARDSASSOCIATEDWITHRADIOACTIVEPOLLUTION

Majorhazardsassociatedwithradio-activepollutioncanbesummedupasfollows:

(1) Nophysical, chemicalor biological processcan influence the process emissions. The unstable nuclei have to decay and acquire astable state.

(2) A number of radio-active isotopes have a very long half-life takes 14,0000,000,00 years to lose half of its radio-activity . Half of Uranium-235 (92 U23) takes 710,000 years to disintegrate. Half of Neptunium-237 (93 Np237) decays in 21,00,000 years. This makes theseradio-active wastes almost apermanent hazardfor thebiosphere.

(3) Mostoftheradiationshaveahighpenetratingpower.Thicksheetsofsteel,cement concrete walls etc, can not contain them. They can easily penetrate to deep seated organs and cause injury.

(4) Nucleic acids (DNA and RNA) effectively absorb these radiations. Even low level radiationswhichdonotcauseanyvisibledamagearecompletelyabsorbedbynuclear material which causes carcinogenic, mutagenic and teratogenic effects.

(5) A biological system is unable to distinguish between a radio-active and a normal isotope of an element as their physical and chemical properties are similar. Radio-active isotopes are therefore, absorbed and incorporated within the bodies of living organisms as normal isotopes are. This lodges a radio-active source within the body of the organism itself.

(6) Likeany other elementradio-active isotopes arealso absorbed,accumulated and biomagnified thousands of times. Thus the entire food chain becomes contaminated. Organisms at higher trophic levels may, therefore, receive a highly concentrated source of radio-active material through their food supply.

(7) Thereis noother way to dispose offthese hazardouswastes except to store them forthousandsormillionsofyearsawayfromlivingbeings.Thisistoolongaperiodon human scale of time. Even the safest burial places for radio-active wastes, which represent the best of human efforts, have shown signs of leakage. At present it appears very difficult, though not impossible to store radio-active wastes away from the biosphere for such long periods.

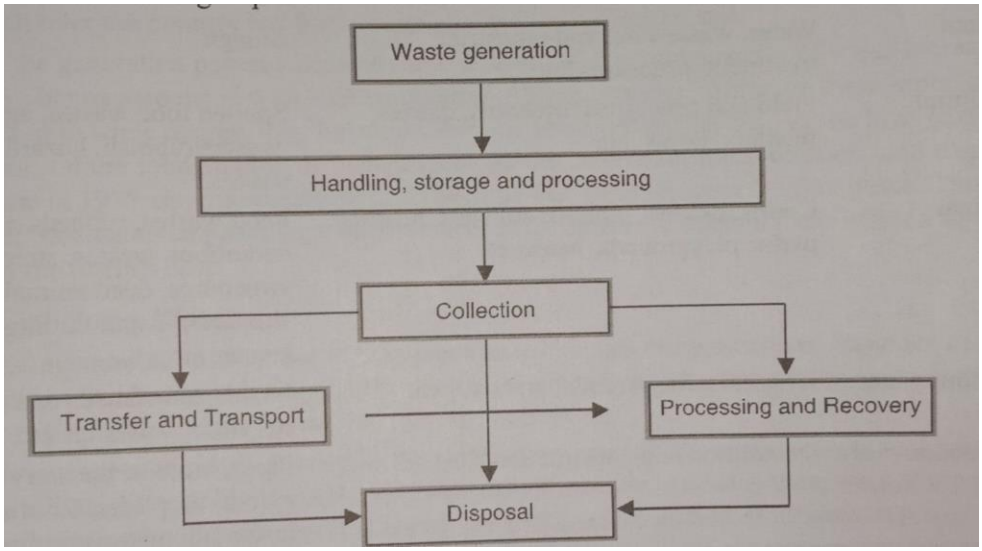
(8) In spite of all these hazards, nuclear reactors and tests are still continuing and an increasingly large amount of radio-active wastes is accumulating every day while no solution to the problem of their safe disposal is in sight till date

SOLIDWASTEMANAGEMENT

Anymaterialthat isthrownawayordiscarded asuselessandunwantedbyhuman or animal activities is considered as solid waste. In earlier period, the disposal of solid waste was simple but now a days it is a great challenge. The management of waste is the fundamental concern of the activities encompassed in solid waste management. Thepurposeofthestudyofsolidwastes

(i) Identifythevarioustypesofsolidwastesandtheirsources.
(ii) Examinethecompositionofwastes.
(iii) Considertheelementsinvolved intheirmanagement.

Theactivities involved withthemanagement ofsolidwastesfromthepointof generation to have been grouped in to six Functional Elements



'The total quantum of solid waste generated in an area depends upon its population and urbanization. Solid wastes generation is directly related with income. Higher the income greater is the waste generation.

Sourcesofsolidwastes

Sourcesof solidwastescanbeclarifiedintofollowingcategories:

1. Residential
2. Commercial
3. Municipal
4. Industrial
5. Openareas
6. Treatmentplants

7. Agriculture
8. Hazardouswastes
9. Constructionsites

TYPESOFSOLIDWASTES:

Garbage: Food wastes are the animal, fruit, or vegetable residues resulting preparation, cooking, and eating of foods. It is also known as garbage. Rubbish: Rubbish consists of combustible and non-combustible solid wastes of households, institutions,commercialactivities,etc,excludingfoodwastesorotherhighlypursuable materials. Paper, Cardboard, Leather etc.,

Ex, Combustible- Non-Combustible -Aluminium cans, tin cans, glass etc. Ashes and Residues:Materials remaining from the burning of wood, coal coke and other combustible wastes are categorized as ashes and residues.

DemolitionandConstructionwastes:

Wastes from buildings and other structures are classified as demolition wastes. Wastes from the construction, remodeling, and repairing of individual residences, commercial buildings, and other structures areclassified as construction waste.

Wastes such as street sweepings, roadside litter, catch basin debris, dead animals and abandoned vehicles are classified as special wastes.

AgriculturalWastes

Wastesandresiduesresultingfromdiverseagriculturalactivities-suchastheplanting and harvesting of roe, field, and tree and vine crops, the production of milk, the productionofanimalforslaughter,andtheoperationofteedlotsarecollectivelycalled agricultural wastes. **Hazardous wastes:**

Chemical,biological,flammable,explosives, orradioactivewastethatare harmfulto human, plant or animal life are classified as hazardous wastes.

CollectionofSolidWastes:

Collection of solid wastes in urban areas is difficult and complex because the generation of residential and commercial-industrial solid wastes is a diffuse process that takes place in every home, every apartment building, and every commercial and industrial facility as well as in the streets, parks, and even the vacant areas of every community. The mushroom like development of suburbs all over the country has further complicated the collection task.

EffectsofSolidWastes

- The accumulation of waste at any place is a bad and risky situation. Varieties of microorganisations like bacteria, fungi, viruses, worms etc creep in to the accumulated waste and start its decomposition. Later on they grow and increase in number.

- Varioustypesof germsdevelop inthe waste. Theyreachusthrough air, water and food. Most of the infectious diseases like cholera, diarrhoea, dehydration etc. spread in these ways.
- Air pollution, water pollution and soil pollution are caused due to the accumulation of different types of wastes. Harmful fumes from industries and other wasteeffectseyes,skin, historical momentsetc. Asbestos particles from Asbestos Industry causes Asbestosis. Accumulation of heavy metal particles causeserious health hazards. Mercury can cause Mina Mata disease.
- Wastes material when accumulated here and there disturbs the drainage system. Decomposing wastes reach underground and contaminate underground water and soil.

Special Wastes:: Management of solid waste Waste management is the collection, transport, processing or disposal of waste as to reduce their effects on local environment andcommunity . Because itcan notbestopped absolutely materials so

Methodsofsolidwastedisposal.

Therearefollowingmethods:

(a) Physical removal.- It is generally done by manual activities like, collection of wastes and sorting out in to reusable, decomposable and non decomposable. Then disposal becomes easy. Dustbins should be used in homes, offices and dispose accordingly i.e. to kabadi or for reuse, recycle. Some Municipals are also doing such jobs.

(b) Dumping-Transferofsolid waste fromplace ofcollection tothe siteof disposalis called dumping. Corporations and Municipal bodies collect and dump them on some suitable and safe site located far away from human habitation.

(C) Compaction and Bailing- The solid wastes are often spread on a plane and hand surface and later pressed by bulldozer. This is called compaction. These compacted layers are rolled and piled. This is called bailing. Now such compacted and bailed solid wastes are dumped for decomposition.

(2) 3RorReduce,ReuseandRecycleofsolidwaste

(A) Reduce of waste material-We should reduce the household waste by using maximum part of the goods. Before throwing out side, we should select the parts for Reuse/Recycle.Whenwepurchasethethings, avoidpolythene andheavypackages.

Hazardouswastecanbecontrolledbyreductionatsource.Weshouldsuggestfriends, relatives to save all clean papers and other various means to save paper. Gaseous wastes are generally removed through combustion, absorptions and adsorption techniques.Thereshouldbepropercooperationandco-ordinationamongindividuals, localbodies and Govt Institutions for proper waste management in an area. Reduced demandforanymetallicproductwilldecreasetheminingoftheirmetalandcauseloss production of waste. Thus, every individualhas a responsibility of creating less waste and managing its properly.

(B) Reuseofwastematerials.

After selecting the waste (which can be reused) use after the proper treatment.We should not use, cups, plates, utensils, napkins etc of paper. If they are of permanent nature, therefore, they can be reused after washing. Plastic bags, wrap, foils, rotten articles should not be used.

We should use refillable lighters, containers, and other usable items. We should discourage use and throw policy. Sell or donate goods instead of throwing them out. Furniture, clothes and other repairable articles should be reused after repair instead of throwing.Weshould develop quality of borrow, share and rent in ourselves.

(C) Recycling of waste materials. Sewar and other drainage systems are associated withsewagetreatmentdevicesthatcentralizetoxiceffectsofsewagebeforereleasing it to the local water systems. Principal operations of solid waste disposal incorporate composting, senitary, land filling, thermal process or incineration.

(1) Sewagetreatment.
Itisdonethroughfollowingsteps:

(a) Neutralizedsewage

(a) The sewage is sent through setting chambers, where lime is mixed with it. Thus it becom neutralized and most of the sediment is removed.

(b) Neutralized sewage is passed through Upflow Anaerobic Sludge Blanket (UASB). Here, decomposable material is decomposed through bacterial activities in absence of oxygen. After that water is passed through aeration tanks where air and bacteria are mixed.

(c) Dissolved substances are removed by processes like chlorination, evaporation, exchange technique and absorption.

Thetreatedwaterisusedaccordingly.

ii) Pulverisation:- The volume of solidwaste isreduced through grinding or smashingfor easy handling to transport and disposal.

(iii) Composting :-The process of making manure of decomposable waste with the help of microbial activities is called as composting. It is of two types Aerobic i.e. in presenceofair andAnaerobici.e.inabsenceof air.Forthisdifferentsizepits aredug inthe ground andallthe biodegradable solid, semisolid wastesaredumped and fully filled pits are covered with a layer of soil. Water is added time to time. The average time for composition is 1-6 months.

Sanitary Landfilling: In this process solid wastes are scientifically filled in to low lands. As all this wastescan not be recycled or burnt, these willbe always a need for land fill. In sanitary landfills, garbage and other waste is spread out in their layers, compactedandcoveredwithclayorplasticfoam.Theprocessoffillingisdoneinsuch a way that wastes can not create any type of hazard to public health.

(IV) Thermalprocess: Burningofsolidwasteundercontrolledconditionsiscalledas thermalprocess.Theheatproduced in this processmaybe utilized. Itiscarried outin both the presence and absence of air.

ROLEOFANINDIVIDUALINPREVENTIONOFPOLLUTION

Pollution and poverty are complimentary to each other. Some time people forced to go with the path of pollution. Illiteracy is another factor in the prevention of pollution. Unlimited desires, selfishness, urbanization, industrialisation, deforestation, to increase the life style etc. are some of big factors which are main cause of pollution. Forthattheneedistounderstandfirst,applythenbealessonforothers.Gandhijiwas not an environmentalist but was for the concept of sustainable development

Inshort,anindividualcandoasfollowingsafetymeasurestopreventthepollution–

(1) One should start first in the field of environmental awareness to protect the pollution.

(2) We should go place to place to teach the lesson of awareness and prepare volunteers.(3)Givethemessagetosaveenvironmentthroughpapers,magazines, T.V.andradio.

(4) Topromoteforplantationandconservationofforest.

(5) Toorganizeseminars,onthesubjectrelatedtopollution.

(6) One should go in rural areas during festivals, functions, local gatherings, and religious occasions to convince people for prevention of pollution.

(7) Awareness is very effective in childhood, hence we should go to schools, organize rallies to teach the lesson of environment.

(8) World forest day, world environmental day and other such function should be organizedfor general awareness. Onthese functions,Govt. should alsotake interest in this regard but we should not depend on Govt.

(9) Populationgrowthshouldbereduced.

(10) We should use and promote mass transport system. If possible go on foot or use bicycle for short distances.

(11) WeshouldnotusematerialscontainingCFCegRefrigerators,Cups,etc.

(12) We should discourage the use of more fertilizers insecticides and pesticides but should encourage the use of bio fertilizers.

DISASTERMANAGEMENT

FLOOD

- As floods are one of the very few well recorded natural phenomena, the catastrophic damages caused by them attracted focused attention in recent decades. With increasing population pressure and accelerated economic development, the adverse effects of floods are being increasingly felt now.
- The term Flood is generally defined as a relatively high flow or stage in a river andtheinundationof lowland whichmightresult therefrom.Inabroadersense

thetermflood is used toconveyalltheiroutfalls intomainrivers,outflowdueto jamming or blocking of rivers by landslides and inadequate drainage to carry away surface water speedily. Coastal floodings are also covered.

- In India vast stretches of land are submerged under water and other adverse effectsarecaused,suchasdestructionordamagetohouses,property,bridges roads and other means of communication lives lost etc. year after year.
- The disastrous floods of 1954 and the immediate succeeding years resulted in theinitiationoforganizedandcoordinatedfloodmanagementeffortstomitigate the problem.

CAUSALPHENOMENAANDCHARACTERISTICS

- Flood are natural phenomena characteristic of all rivers. As is known, the rainfallinIndiaislargelydependantonthemonsoonsandcyclonicdepressions. Most of the rainfall is received during the southwest monsoon season during which heavy spells of rain are often experienced in the catchment over the period of a few days at a time.
- It could therefore be said that high rainfall coupled with inadequate channel capacityleadsto flooding. Chokingof riversbedsbynaturalcausesor artificial obstructions aggravate the problem.

VULNERABILITY

- An extreme natural phenomenon capable of causing disaster (leading to loss of lives or damage to property) is known as a natural hazard. The process of identifying the probability of occurence of a natural hazard of a given intensity at a specific location, based on an analysis of natural processes and site conditions is termed Hazard assessment.
- Vulnerability indicate the conditions (physical, socioeconomic/political) which increasethecommunity'ssusceptibilitytodisasterorwhichadverselyaffect its ability to respond to events. It thus gives an idea of the expected degree of damage to a construction or an economic activity when exposed to a natural hazard of a given intensity.
- Risks are the probable losses in a given area or to an infrastructure system caused when the hazard materializes.The type and degree of flooding is influenced by many factors. The principalfactors can be classified to fallunder three groups.

(1) climatologicalconditions.

(2) hydrologicalandenvironmentalconditions

(3) localgeomorphologyoffthefloodplainIn addition,coastalfloodingalsodepends on the coastal configuration and tidal

ADVERSEEFFECTSOFFLOODS

All over the world, and throughout history, natural disasters have imposed human sufferingandextractedheavytolloflosses.Recentinstanceshaverevealedthatitis

not merely the developing countries that have so suffered. The loss in some of the highly developed Nations is mind boggling notwithstanding the high standards of construction and extensive protection measures that they had undertaken.

Apart from the casualties, injuries and disablement, many sections of the population get affected by the floods. Cropped area gets submerged, eroded and strewn with sand leading to loss of crop production and consequential disruptions. Many houses aredestroyedcompletely;othersaredamaged.Damageandlosstopublicandprivate utilitiesandindustrialdisruptionsoccur.Breakdownofeconomicactivitiesoccurswith corresponding loss of wealth.

The statistics compiled suffer from one disabilities and many suggestions for better compilation of flood damages have been also offered. Moreover damage figures compiled by interested parties or even the Govt. for other purposes may not indicate the precisepictureof losses. However the broad figuresasindicatedaboveservethe purpose of indicating the order of losses. In any case the exact assessment of the comprehensive loss to the economy of the Nation or to the individuals is a near impossible task.

EARTHQUAKE

- Earthquakes are considered to be one of the most dangerous and destructive natural hazards. The commencement of this phenomenon is usually sudden with little or no warning.
- It is not yet possible to predict earthquakes and to make preparation against damages and collapse of buildings and other man-made structures.
- Actually earthquake consists of a sudden shaking (vibrations)of ground causedby disturbances in the earth's crust.
- An earthquake generates a set of horizontal and vertical vibrations of the ground which are random in character.
- Earthquakes may be defined as a natural phenomenon which tends to create panicduetothetremblingvibrationsofsuddenundulationofaportionofearth's crust caused by splitting of a mass of rock (Tectonic) or by volcanic or other disturbances.

GENERALCHARACTERISTICS

ImpactofEarthquakesissuddenwithlittleor nowarning.However, followingamajor Earthquake, the after-shocks may give warning of a further earthquake. On some occasions, an earthquakemaybepreceded byaless intensetremors orforeshocks.

. It is not yet possible to predict magnitude, time and place of occurrence of an earthquake.

• Theonsetisusuallysudden.

• Earthquakeproneareasaregenerallywellidentifiedandwellknownonthebasisof geological features and past occurrences of earthquakes.

• Major effects arise mainly from ground movement and fracture or slippage of rocks underground. The obvious effects include damage (usually very severe) to buildings and infrastructures alongwith considerable casualties.

.On the average about 18000 people die each year dueto this disaster throughout the world.

• About200largemagnitudeearthquake(M>6.0)occurinadecade.a

• The world's earthquake problem seems to be increasing with the increased population, high rise buildings and crowded cities.

PRE-CURSORSINSTRUMENTAL ANDNON-INSTRUMENTAL

- We have already stated that it is not yet possible to predict earthquakes. However,sometimestherearesomeindicationthatwouldindicatethatperhaps an earthquake would occur. Such indicationsare called “precursors”.
- Therecouldbeeitherinstrumental,i.e.,thosethataremeasuredbyinstruments ornon-instrumental, i.e. those whichcan only be perceived and notmeasured. Needless to say, the non-instrumental precursors are more subjective.

VULNERABILITY

- Disasters result from vulnerable societies being exposed to a hazard. There canbephysicalvulnerability,socialvulnerabilityandeconomicvulnerabilityon account of an earthquake disaster.
- Physical vulnerability relates to buildings, infrastructure and agriculture. The vulnerability of buildings is dependent on their sets, shape, materials used, constructiontechniques,maintenanceandproximityofbuildingstoothers.The weightage attached to each factor will vary according to the characteristics of the particular earthquake.
- Infrastructure may be considered in three broad groups: transport systems (roads,railways.bridges,airports,portfacilities):utilities(water,sewerageand electricity); telecommunications; dams and flood protection embarkments.

SocialVulnerability

Recordsofpastearthquakedisasterssuggestthatthefollowinggroupsofpeopleare particularly at risk and require special attention:

• Singleparentfamilies:

• Women,particularlywhenpregnantorlactating.

• Mentallyandphysicallyhandicappedpeople:

• Children,and

• Theelderly.

Poor people are lessconcerned with infrequent hazards. If thereare groups whose livelihoods are at risk, living orworking in densely populated areas, with low

perceptions of risk and without institutional support, the cumulative effect would be high social vulnerability.

ECONOMICVULNERABILITY

- It measures the risk of hazards causing losses to economic assets and processes. It focuses only valuating the direct loss potential (i.e. damage or destruction of physical and social infrastructure and its repair or replacement cost, as well as crop damage and losses to the means of production); indirect loss potential (i.e. the impact on cost production, employment, vital services and incomeearning activities); and secondary effects (epidemics, inflation, income disparities and isolation of outlying areas).
- With the insights provided by economic vulnerability analysis, it is possible to estimate direct and indirect losses and to design ways and means to mitigate themin relation to the estimated costs ofrelief/recoveryactions and mitigation measures required.

IMPACTANDEFFECTS

Ingeneralterms,typicalimpactsandeffectsofearthquakedisasterstendtobe:

• LossofLife.

• Injury

• Damagetoanddestructionofproperty.

• Damagetoanddestructionofsubsistenceandcashcrops.

• Disruptionofproduction.

• Disruptionoflifestyle.

• Lossoflivelihood.

• Disruptiontoessentialservices.

•Damagetonationalinfrastructureanddisruptiontoadministrativeandorganizational systems.

• Nationaleconomicloss.

• Sociologicalandpsychologicalafter-effects.

The following problem areas need particular attention in case of Earthquakedisasters: Severe and extensive damage, creating the need for urgent counter measures, especially search and rescue, and medical assistance.

• Difficultyofaccessandmovement.

• Widespread loss of or damage to infrastructure, essential services and life support systems. • Recovery requirements (i.e., restoration and rebuilding) may be very extensive and costly.

.Occurrence of earthquakesin areas where such events arerather raremaycause problems due to lack of public awareness.

NATUREOFDAMAGE

Damages due to earthquakes are the related terms and depends upon various factors listed below:

(a) Natureofearthquake.

(b) Geologicalandsoilconditions

(c) Qualityofconstruction.

(d) Sociologicalfactors.

CYCLONE

- Cyclones are one of the most disastrous naturalhazards in the tropicsand are responsible for deaths and destruction morethan any other natural calamities. Cyclones bring with them extremely violent winds, heavy rain causing floods and storm tides causing coastal inundation.
- Cyclones form over the warm ocean waters (sea surface temperature of the order of 26°C or 27°C) little away from the equator within the belt of 30°N and 30°S. In our area, cyclones form in the Bay of Bengal and the Arabian sea. As they move westward or northwestward, those forming in the Bay of Bengal cometotheIndianterritorywhilethoseformingintheArabian Seagenerallygo away from India but sometimes they turn around to hit Gujarat.

RISKREDUCTIONPROCESSES

- Thepreventionoftropicalcycloneformationisnotwithintherealmofpossibility. However, the loss of human lives and destruction of properties can be minimized by adopting prescribed short and long term measures for risk reduction.
- While cyclone warning system is the most important constituent of short term risk reduction measures against cyclone disaster, the risk assessment of tropical cyclone falls under long term measures.
- As prevention of formation of tropical cyclone is not in the realm of possibility, some structural and non-structural preventive measures of long term nature canbe undertaken to mitigate the suffering of cyclone affected people.
- Structural measures like construction of cyclone shelters, embankments, dykes, reservoirs and coastal afforestation are some of the long-term risk reduction measures for cyclone disasters. Creation of proper awareness, training and education of people in the vulnerablecommunities, introduction of insurancecan be some of the non-structural measures.

EFFECTS

Severetropicalcyclones areresponsiblefor largecasualties and considerable damage to property and agricultural crop.

Thedestructionisconfinedinthecoastaldistrictsandthemaximumdestructionbeing within100 kmfrom the centreof the cyclones and on the right side of the storm track. Principal dangers from a cyclones are:

(i) verystrongwinds

(ii) torrentialrain,and

(iii) highstormtides.Mostcasualtiesarecausedbycoastalinundationbystorm tides.

(iv) Maximumpenetrationofstorm surgesvariesfrom10to20kminland fromthe coast.

(v) Heavyrainfallandfloodscomenestinorderofdevastation.

LANDSLIDES

- Oftenitisnotrealizedthat alargepart ofIndiaconsistsof mountainousterrain. In the north, there is the extensive Himalayan mountain system extending all along from the west to the east. Its lofty peaks rise to more than 8000 metres height.
- ThemiddlerangesoftheHimalayas5000metreshighontheaveragewhilethe foothills rise to about 6000 metres. The Himalayas abound in glaciers and are the origin of many rivers and streams. There is abundant rainfall and snowfall often accompanied by strong winds.
- ThepeninsularregionofIndiastartsfromthe Vindhyachalrangesandconsists of the Deccan Plateau which slopes eastwards.
- On its edges, this great plateau is bound by the mountain the Eastern Ghats and the Western Ghats. The Nilgiri mountains are in the southern parts of the rangesplateau. The west-centralpartsof the countryhavethe of rangesof the Aravali mountains.

LANDSLIDESININDIA

- Landslides affect the remotely located, often isolated, small communities in villages or hamlets in the mountain regions of the country where external assistancetakestimetoreachintimesofemergencywhenthenormallydifficult terrain and tracks may become almost impossible to negotiate.
- Many a times, even the information about the occurrence of such events and the damage done takes days to reach the district and state headquarters. Becauseofthesereasons,landslidesandsnowavalanchesassumethestatus of major natural disasters even though the affected area and population may be rather small.

IncidenceoflandslidesinIndia

Region	IncidenceofLandslides
Himalayas	Hightoveryhigh
NortheasternHills	High
High Western Ghats and the Nilgiris	Moderatetohigh
EasternGhats	Low
Vindhyachals	Low

KindandMagnitudeofDamage

Thereisnodoubtthatanythingthatcomes inthewaysofalandslidewillsuffersevere damage and may even by totally buried or wiped out . Anything located on top of a landslide willalso not survive when the rock or mudslips out from below it.

Landslides : More often, the major landslides are combinations of rockslide and rockfall. They all involve movement or mass (soil , debris or rock). The process of movement of mass may vary from slow soil creep to abrupt and sudden rockfall. Landslides, also known as landslips, range from low angle and rather slow slides to sudden vertical falls.

Based on the type of movement, relative rate of movement and kind of material involved, landslides can be designated into 5 kinds as follows:

- Slumpwithearthflow
- Debrisslide
- Debrisfall
- Rockslide
- Rockfall

Landslidesarealsoknowntoresultinblockingof streamsoroverflowingoflakesthus causing flash floods because large volumes of debris falling in a lake or reservoir cause its water to overflow or the temporarily blocked stream may suddenly release thehugequantityofimpounded watertocauseadevastatingflashflooddownstream.

ReliefandRehabilitation

Essentially,thereliefstepscomprisethefollowing:

(1) SearchandRescue

(2) Medicalassistancetotheinjured

(3) Disposalofthedead

(4) Foodandwater

(5) Emergencyshelterforthehomeless

(6) Openingupaccessroadsifblocked;andrestorationofcommunicationchannels

(7) Psychologicalcounselingofthesurvivorswhohavelosttheircloserelatives

(8) Repairofhousesandfacilities

(9) Assistance (technical and financial) to restart economic activity to restore regular work and income

(10) Reconstructionthroughproperplanning.

We have already discussed the relief steps in the preceding section. As regards the long-term measures, these will comprise the following:

(1) Reducingthehazardpronenessofthesitethroughengineeringmeasuressuch as strengthening or modifying the slopes, removing fragile and unstable portions, securing snow accumulations by snow fences, snow nets or by cribbing, and improvement of drainage.

(2) Stoppingindiscriminatequarryingandmininginmountainareas.

(3) Afforestation of zones prone to landslides so that trees and vegetation provide a binding force to prevent slippage of debris, rock, and snow.

(4) Creation of a voluntary, community based preparedness system of watch, monitoring and alert. This willnot only be usefulin times of a disaster but will provide enough self confidence (and thereby self reliance) which is an essential objective of an effective rehabilitation programme.

(5) Provision of assistance for economic rehabilitation by arranging work, employment loans, and grants.

In the extreme case of severe damage to a community by a landslide or snow avalanche,thesitemayberenderedtotallyunusable.Inthatcase,rehabilitationtakes the form of relocation and reconstruction. In such an event, the new site should be carefully chosen so as to minimize vulnerability and risks.

Unit6:SocialissuesandtheEnvironment

UNSUSTAINABLE TO SUSTAINABLE DEVELOPMENT

- More and more natural resources were consumed in the process of satisfying therapidlygrowingneeds ofthehabitat.Everydevelopmentactivity hassome impact on the environment.
- For meeting the needs, the human cannot live without the developmental activities. Consequently, there is need to continue developmental activities in such a way that environment should not polluted at least.
- Unsustainabledevelopmentmeansthedevelopmentofafewprivilegednations both in science and technology. Such developments are at the cost of our life supporting systems like air, water, soil and over exploitation of our natural resources which may lead to the collapse of the inter-related systems of the earth.

Therearetwoaspectsofsustainabledevelopment:

(i) Inter-generationalequity-Thisemphasizesthatweshouldstopover-exploitation of resources, reduce waste discharge and emissions and maintaining an ecological balance. It expects to hand over a safe healthy and resourceful environment to the future generations.

(ii) Intra-generational equity - This emphasizesthattechnologicaldevelopmentshouldsupporteconomicgrowthofthepoorcountriessoastoreducetheweather gas within and between the nations.

Measures for sustainable development - There arefollowing major measuresfor sustainable development:

1. To promote environmental education and awareness- From childhood, we shoulddevelopafeelingofbelongingnesstoearth.Thiscanbepossiblebyintroducing environment as a subject in education from primary stage. Media can also be helpful in developing such feelings.

2. Three 'R' approach - Three 'R' means, Reduce, Reuse and Recycle. We should reducethe excessiveuseof naturalresources,but use them againand againinstead of passing it on to the waste stream. Recycle the materialsto reducepressureon our existing natural resources.

3. Appropriatetechnology -Thetechnologyshoulduselessresourcesandproduce minimum waste.It isover whichlocallyadaptable, eco-friendly,resourceefficient and culturally suitable.

4. Toutilizeresourcesaspercarryingcapacityoftheenvironment-Sustainability of a system depends largely upon the carrying capacity of the system. If carrying capacity of a system crossed, environmental degradation status and continues till it reaches apoint of no return. Carrying capacityhas two basic components.

(i) SupportingCapacity-Itisformedofproductiveandprotectivesystems

(ii) AssimilativeCapacity-It isformedofthesystemswhichutilizethe wastes produced by human activities.

UrbanProblemRelatedtoEnergy

- Urban areas are developing very fast. In most of cities there is influx of populationsfromsurroundingareas,mostlyinsearchofemploymentandbetter living conditions. Therefore, it is difficult to accommodate all the industrial, commercialandresidentialfacilitieswithinlimit.Asaresult,citiesarespreading intosub-urbanortoruralareas.Uncontrolledpopulation,irregulardevelopment are the main factor for receding facilities in urban areas.
- Energy is required in every walk of life like industry, transport, defence, agriculture, trade, education, domestic etc. Cities are the main centres of economic growth. Hence, energyis themost important inputfor development.
- The energy requirements of urban population are much higher than that of rural ones. Energy problems become more severe due to the limited amount of non-renewable resources of energy.

Therearefollowingmaincausesofenergyproblems.

1. Increasinguseofenergyfordomesticandcommercialpurposes(duetoincreased population and industrialization).

2. Industrialplantsusingbigproportionofenergy.

3. Non-renewableresourcesofenergylikecoal, petroleumandnaturalgasare decreasing.

4. Increasingoftransportmeans.

5. DecreasingproductionofHydroelectricityduetoinsufficientrains.

6. Transmissionlossduetodefectedpowerdistributionsystem.

Therearefollowingstepstosolvetheenergyrelatedproblems.

1. Tocontrolurbanization.

2. Todevelop renewable resources of energylikesolarradiation, wind power, hydel power, nuclear power, bio mass etc. These are pollution free also.

3. Non-renewable energyresources should beusedonlywhen nonon-conventional source of energy is available.

4. Welcomingtheawarenessprogramstosaveenergy.

5. Effectivemeasuresfortransition lossandenergytheft.

WATERCONSERVATION

- Water isneededinalmosteverysphereofhumanactivity. Withoutwater lifeis not possible. In many aspects the properties of water are unique. It is called universal solvent. No other liquid can replace

- it.Theglobaldistributionoffreshwateronearth'scrustincludinggroundwater and water present as its vapours in atmosphere.

Water is required for direct consumption or indirectly for washing, cleaning, cooling, transportation or even for waste disposal. Important sectors of human activity, which require water can be grouped as:

1. Irrigation
2. Industries
3. Livestockmanagement
4. Thermalpowergeneration
5. Domesticrequirements
6. Hydroelectricgeneration,fisheriesnavigationandrecreationalactivities.

The following steps should be taken for conservation of water.

1. Water economy, Re-use and Recycling. If water meters are installed and charged properly, the consumption of water in domestic establishments, livestock management and industries shall drastically decline. The heated water from thermal power plants, wherelargeamountofwaterisneeded,maybeutilizedelsewhereafterproper cooling. The same is true for many industries, water used once may be used again for another purposes.

2. Agricultural runoffs from fields. This can be used to irrigate cropland down the stream, while an efficient use of water with conditions of proper drainage can significantly reduce the agricultural runoffs.

3. Efficient distribution system. Water resources are not distributed evenly. Some localities have plenty of water and others have little. Many river basins have plenty of water, which flows down un-used to the sea. Surplus of one basin can be used to make up the deficit at another.

4. Enhancement of surface storage capacity. About 27000 Cubic kms of fresh water which rush down to the oceans through stream and rivers are of no use to the mankind. We can store thiswaterintanks, reservoirs,damsfor furtheruse indrier seasons.

5. Reduce evaporation losses. Water losses through evaporation and seepage are enormous both from the reservoirs and distribution system. It should bereduced.

6. Improvement of underground storage capacity. The fresh water is stored in underground deposits. Every year about 10-15% of the total precipitation enters the ground water table. These deposits regularly feed streams and rivers during the drier periods. These deposits are cheap and easily obtainable.

7. Desalination of Sea Water. A huge store of water exists in our oceans. If the salt content of the seawater isremoved,we can useit. Thiscanbe done bydesalination plants.

8. Afforestation andReforestationofhillslopestochecklossofwaterinfloods.

9. ArtificialrainmakingandprecautionofwaterpollutionArtificialrainmakingandprecautionofwaterpollution.

RAINWATERHARVESTING

- Water is an essential natural resource for sustaining life and environment. So Conservation and preservation of water resources are urgently required to be done.Watermanagementhasalwaysbeenpracticedinourcommunities since ancient times, but today this has to be done on priority basis.
- The ministry of Water resources in India is endeavouring to make rain water harvesting a part of every day life in our villages and cities as a people's movement, and this will go a long way in the management of ground water as a sustainable resource.
- Government and the people join hands for creating awareness of the importance of rain water harvesting with the main objective of adopting these measures and techniques throughout the country.
- Ajudicious mixof ancient knowledge, amodem technology,publicand private investment, and above all, people's participation will go a long way in reviving and strengthening water- harvesting practices throughout the nation.

Rainwater harvesting is categorized into domestic rain water harvesting and rain water harvesting for agriculture, erosion control, flood control and aquifer replenishment.

Domestic rain water harvesting, also known as roof water harvesting or roof top rain water harvesting is the technique through which rain water is captured from roof catchments and stored in tanks or reservoirs.

Rainwaterharvestingsystems,bothsmallandlarge,consistsofsixbasic components.

(a) Catchmentarea/roof,thesurfaceuponwhichrainfalls.

(b) Guttersanddownspouts, thetransportchannelsfromcatchmentsurfaceto storage.

(c) Leafscreensandroofwashers,whicharesystemsthatremovecontaminantsand debris.

(d) Cisternsorstoragestanks,whererainwaterisstored.

(e) Watertreatment,thefiltersandequipmentaswellasadditivestosettle,filterand disinfect.

Themaincausesoffallingroundwaterlevelsare:

(a) Overexploitation or excessivepumping either locallyor over large areastomeet increasing water demands.

(b) Non-availability of other sources of water.Therefore, sole dependence is on ground water.

(c) Unreliabilityofmunicipalwatersuppliesbothintermsofqualityandquantity, driving people to their own sources.

(d) Misuse of ancient means of water conservation like village ponds, baolis, percolationtanks and therefore, higher pressure of ground water development.

Themaineffectsofoverexploitationofgroundwaterresourcesare:

(a) Drasticfallingroundwaterlevelsinsomeareas.

(b) Dryingupofthewells/borewells.

(c) Enhanceduseofenergy.

(d) Deteriorationingroundwaterquality.

(e) Ingressofseawaterincoastalareas.

Themethodandtechniqueinclude:

(a) Roof top rain water harvesting and its recharge to underground through existing wellsor borewellsor byconstructingnew wells,borewells,shafts,spreadingbasins, storm water drains etc.

(b) Harnessing runoff in the catchments by constructing structures such as gabions, check dams, percolation trenches, sub-surface dykes etc.

(c) Impounding surplus runoff in the village catchment and water sheds in village ponds and percolation tanks.

(d) Recharging treated urban and industrial effluents underground by using for direct irrigation or through recharge ponds or wells etc.

Themainobjectivesofrainwaterharvestingare:

(a) Torestoresuppliesfromtheaquifersdepletedduetooverexploitation.

(b) Toimprovesuppliesfromaquiferslackingadequaterecharge.

(c) Tostoreexcesswaterforuseatsubsequenttimes.

(d) Toimprovephysicalandchemicalqualityofgroundwater.

(e) Toreducestormwaterrun-offandsoilerosion.

f)Topreventsalinityingressincoastalareas.

(g) Toincreasehydrostaticpressuretopreventorstoplandsubsidence.

(h) Torecycleurbanandindustrialwastewatersetc.ponds,

(i) To rehabilitate the existing traditional water harvesting structures like village percolation tanks, baolis, tanks etc.

(j) To convert the traditional water harvesting structures into ground water recharge facilities with minor scientific modifications and redesigning.

(k) To use the existing defunct wells and bore wells after cleaning and also the operational wells as recharge structures.

Theexpectedadvantagesofrainwaterharvestingare:

(a) Riseingroundwaterlevelsinwells.

(b) Increasedavailabilityofwaterfromwells.

(c) Topreventdeclineinwaterlevels.

(d) Reductionintheuseofenergyforpumping.

(e) Reductioninfloodhazardsandsoilerosion.

(f) Improvementinwaterquality.

(g) Arrestingseawateringress.

(h) Assuringsustainabilityofthegroundwaterabstractionsourcesandconsequently the village and town water supply systems.

(i) Mitigatingtheeffectsofdroughtsandachievingdroughtproofing.

WATERSHEDMANAGEMENT

- Watershed is a drainage area on earth's surface from which runoff, resulting from precipitation flows past a single point in to a large stream, a river, a lake or the ocean. It is a geo-hydrological unit and drains at a common point, has been accepted world over as ascientific unit for area development.
- The watershedcanrange from a fewsquare kilometreto fewthousand square kilometre in size. Damodar Valley Corporation in 1949 adopted first Integrated Watershed Management. Watershed development is the rational utilization of naturalresourcesof soilwaterandvegetation forincreasingandstabilizingthe productivity of land on a sustainable basis.
- The development of watershed will result in increase in sub soil water regime, recharge of wells.
- The watershed based development approach is undoubtedly an agreeable concept to set the goal. But this demands a massive people's movement to make the village community self reliant.
- The watersheds are very often found to be degraded due to uncontrolled, unplanned and unscientific land use activities like over grazing, deforestation, mining, soil erosion, industrialization etc.

Objectivesofwatershedmanagement.

Watershedmanagementistherationaluseoflandandwaterresourcesforoptimum production causing minimum damage to the resources.

Themainobjectivesofwatershedmanagementareas:

1. Toincrease agricultural production i.e. increasing the availability of fodder, fuelwood, timber and raw materials for industries.

2. Therationalutilizationof naturalresourceslikewatersoiland vegetation. 3.To minimize the risks of floods, droughts and landslide.

4. To Manage the watershed for developmental activities like domestic water supply, irrigation, hydropower generation.

5. Todeveloptheruralareasandtheirlifestyle.

Under the development of national policy, the watershed management was included in fifth Five Year Plan. Now a days, a number of national watershed development programmes are in progress. Various measures are necessary for watershed management.

Someofthemare:

1. Scientificminingandquarryingmustbedone inthewatershedareasbecausehills loose stability and get disturbed by improper mining.

2. Waterharvestinginthewatershedstobeusedindryseason.

3. Afforestation and agro forestry (crop plantation) should be promoted to prevent runoffsloss and soilerosion and increasesoil moisture. Woody trees like Eucalyptus and Lencaena should be grown in between crops to reduce the runoffs and loss of fertile soil in high rainfall areas.

4. some mechanical measures like terracing, bunding, bench terracing, contour cropping etc. are used to minimize runoff and soil erosion in the slopy regions of watersheds. 5. Topromote soil binding plants like Vitex.

6. People's participation should be ensured including farmers and tribals in the water shed management programmes. This can be done by properly educating people about the campaignorpayingsome incentives.

The Himalayas are one of the most critical watersheds in the world. Most of the watersheds of our country lie in this region. Successful watershed management has doneat Sukhomajri and Panchkula withtheactive participation of the localpeople.

Resettlementandrehabilitationofpeople:Itsproblemsandconcerns

- Some times for the development of projects like construction of dams, mining, creationofparksetc.andduringnaturalcalamitieslikeEarthquake,Landslides, Volcanos, Floods, Droughts, Cyclones, the problems of resettlement and rehabilitation arise. For example recently the Tsunami cyclone affected thousandsof familiesand during construction of Indira Sagar dam in Khandwa district of Madhya Pradesh thousands of families were displaced and rehabilitated near Chanara and other places.
- Thiscausedpermanent lossofthebenefitsandfacilities.ThisdisturbedSocio-economic and ecological base of local community which are generally forest and tribal people.

Families are disintegrated and also lost ancestral link between people and the environment.Varioustypesofprojectsresultinthedisplacementofnativepeopleare :

1. DisplacementduetoDams. Universewithoutenergyisnot imaginable. Themost easily accessible and eco-friendly form of renewable energy is hydropower. Water is scarce natural resource and India is blessed with it. Hence it has to judiciously harnessedandmanagedforwelfareofallIivingbeings.India'sexploitablehydropower potential is 84044 MW.

CaseStudy

INDIRA SAGAR PROJECT (ISP)- Indira Sagar Project (1000 MW) is in Khandwa district of MP. It is constructed, operate and maintain by Narmada Hydroelectric Development Corporation (NHDC). Narmada is bestowed with rich potential of 29 major, 135 medium and 3000 minor projects. The reservoir of ISP Dam is largest reservoir in India with storage capacity of 12.22 BM of water for irrigation of 2.70 lakh Ha. A total of villages and people affected by this project. They were given plots, transportation grant, shifting facilities, agricultural land and other compensation. A separatetownshipCHANERAwasdevelopedfordisplacedpeople. Underthisproject 26000Haareaisproposedforirrigation,564villagestobebenefitedbyirrigation.This will cause the production of 4.00 lakh tonnes of food grains and 10.55 lakh tonnes of other crops every year additionally.

REHABILITATION.

- The United Nations Universal declaration on Human Rights (Article 25(1) has declared that “Right to housing is basic human right”.
- This suggest better rehabilitation, adequate compensation, job opportunities, civic amenities and religious and cultural benefits. Therefore, National Rehabilitation Policy is needed to honour the human rights of the displaced people. Govt. under Land Acquisition Act 1894 has power to vacate the land from people by giving notice for Govt. use.

For displaced persons in case of Indira Sagar Dam, the following compensations for resettlement and rehabilitation were given :

1. DevelopedplotorRs20,000forpurchaseofplotforonefamily.
2. RehabilitationgrantofRs18700/-or9350/-asperstatusofPAFs.
3. TransportationgrantRs5000/-forshiftingofonefamily.
4. Allotted2-8hectaresofagriculturelandperfamilyorlandcompensation.
5. Attractive compensationforhouse,trees,wellsandotherstructures.
6. At the plot sites, developed roads, water supply to lights, schools, health centres, worship places, panchayats, community centres, shops etc.
7. RandRworkisbeingexecutedsmoothly.
8. Additionallymorebenefitsweregiven.
9. Professionaltrainingbeinggiventoprojectaffectedfamiliesatl +1NarmadaNagar.
10. Centralschool(KendriyaVidyalayastartedinJune01)

11. Different socio-economic upliftment programmes such as free medical check up, vaccination, training programmes are being organized.

ENVIRONMENTALETHICS

IssuesandpossibleSolutions

- The issues, principles and guidelines relating to human interaction with their environmentORhumanobligationstowardsthe environmentandlivingbeings are called Environmental Ethics or Earth Ethics.
- Ethics constitute the basic codes of civilized behaviour, without which our environment as we know would be impossible. Such rules embody the basic constraints each of us agrees to practice in relationship with others. Ethical codescanbe of helpinmostinstancesthat confront us,but dilemmasdo arise in which it seems there are nosuitable alternatives.
- We canseethatouractswillfollowwhatwethinki.e.human-centricthinkingor earth centric thinking. The first view urges us to march ahead gloriously to conquer the nature and establish our supremacy over nature through technological innovations, economic growth and development, while second urgesustoliveon thisearth asapartof it,likeanyothercreation of natureand live sustainably.
- Human beings are over exploiting the natural resources and polluting the environment. These human acts are very dangerous and may lead to environmental crisis.

Inrelationto environmental protection orinneed of environmental ethicstwo world views

1. Eco-centric worldview. This states that earth resources are limited, and they are not for human beings alone but for all species. So we have to draw our requirements from environment, but not to that extent it degrades the environment. A healthy economy depend upon the healthy environment, therefore, success of mankind dependuponhowwecooperatewithnaturewhiletryingtousetheresourcesofnature.

2. Anthropocentric World view. It states that man is the most important species of nature. Earth has an unlimited supply of resources. Most of the industrial societies believeinthisview.Sothesuccess&healthy economyofmankinddependuponhow nicely man derives benefits from nature.

To check the environmental crisis, we must follow the certain environmental ethics for better future. Some of them are -

1. Oneshouldloveandhonourtheearth.
2. Weshouldcelebratetheturningoftheseasonsoftheearth.
3. Donotwasteorexploitthenaturalresources.
4. Tobringaboutawarenessregardingconservationoflifesupportsystems.

5. Ourshouldbefairinsharingofresources.

6. Weshouldrespectfultoplantsandanimalswhichprovideusfood.

7. We shouldconservetheecosystemandpromoteappropriatesustainable development.

8. Weshouldnotdoanythingatthecostofnature.

CLIMATECHANGE

- Though climate is an average weather of an area or environmental factors of an area. These include quantity of light, temperature, humidity, wind, gases, water etc which average for about 30 yrs.
- Thus the changes in environmental conditions of an area over long period of time is called climate change. These changes effect the agriculture, migration ofanimals,hydrologicalcycle,thermalgradientbetweenthepolesandequator, wind pattern, distribution of rainfall etc.
- The scientific and technological revolution has given multiple facilities to mankind, but at the same time man-made (Anthropogenic) activities are responsible for depletion of resources and upsetting the delicate balance between the various components of the environment.
- They are, excessive use of fossils fuels, deforestation, desertification, loss of fertility of soil, rapid industrialization, increase of automobiles. Changes in the atmosphereconditionsresultingintoseriousproblemslikegreenhouseeffect, depletion of ozone layer and rise of world temperature etc.
- The global change in temperature will not be uniform everywhere and will fluctuate in different regions. The places at higher latitudes will be warmed up more during late autumn and winter than the places in tropics. Poles may experience 2 to 3 times more warming than the global average, while warming in tropics may be only 50 to 100°C on an average. The increased warming at poles will reduce the thermal gradient between the equator and high latitude regions, decreasing the energy available to the heat engine that drives the globalweathermachine.Thiswilldisturbthe globalpatternofwindsandocean currents as well as the timing and distribution of rainfall. Shifting of ocean currentsmaychange the climate of iceland and Britain, it may result in cooling at a time when rest of the world warms.

GLOBALWARMING

- The average global temperature is 15°C. The lower most layer of atmosphere i.e., troposphere, traps the heat by a natural process due to the presence of certain gases called Greenhouse gases.
- They are carbon dioxide, ozone, methane Nitrous oxide, Chlorofluorocarbons (CFCs) and water vapours. In absence of these gases the temperature (15°C) would have been - 18°C. Thus warming of the earth's climate owing to the increasedconcentration of green housegases is called Greenhouse effect.
- Therefore, thiseffectcontributesatemperatureriseto the tune of 33°C. These gases act like the glass in the botanical greenhouse trapping the reradiated heat near the earth's surface and warming the planet.

- These gases along with water vapour and clouds absorbs the infrared radiation, trapping heat near the earth's surface. The two predominant green house gases

(1) the water vapourswhoselevelinthetroposphere hasrelativelyremainedconstant is controlled by hydrological cycle while

(2) CO_2whose level has increased is controlled by the global carbon cycle. Other gases whose levels have increased due to human activities are methane, NO and CFCs. Deforestation has also elevated levels of CO_2.

GREENHOUSEGASES

Thegreenhousegasespresentinthetroposphereandresulting inan increaseinthe temperature of air and the earth are discussed here.

CARBON DIOXIDE (CO_2)- The $CO_2$is considered as the most dominant factor responsible for the green house effect. The troposphere contains only 0.0375% CO_2 (byvolume) and its amount is controlled by carbon cycle .

CHLORO FLUORO CARBONS (CFCs) - The main source of CFCs include leaking air conditioners and refrigerators, evaporation of industrial solvents, production of plastic foams, aerosols, propellants (CFC-11) etc.

The concentration of CFCsisrising nearly5%per year. CFCstrap heat 20,000times moreefficientlythan CO_2 and alsodestroyozone layer, thusposing aserioustwofold environmental problem.

METHANE (CH_4)- It is produced in a number of ways including the action of anaerobic bacteria on vegetation, decomposition of organic matter, incomplete combustion of vegetation, natural gas pipeline leaks, burning of biomass during production and uses of oil and natural gas and petroleum oil etc. It is rising approx. 2% every year. It absorbs 20-25% times more heat than CO_2.

NITROUSOXIDE(N_2O)–

- Itisreleasedfromnylonproducts,fromburningofbiomassandfuels(specially coal). From breakdown of fertilizers in soil, livestock wastes and nitrated contaminated ground water, nylon products etc.
- It is responsible for about 6% of global warming. Besides trapping heat in the troposphere it also depletes ozone in the stratosphere. It absorbs about 250 times more heat than CO_2. The N_2O concentration in atmosphere is 0.3 ppm and is increasing 0.2% annually

OZONE - It comes mostly from hydrocarbons and nitrogen oxides. It causes irritation to eyes and respiratory organs. It decreases the resistance power to infections and aggravates illness.

IMPACTOFGLOBALWARMING

(i) Climatic change (Increase in global temperature) - Increase the level of Green housegases causesthe global warminghave affected theglobal climate. This effect

willincreaseinfuture.AccordingtoIPCC(1996)theworldclimatehaswarmedfrom 0.3to0.6°Cduringthelastcentury.

(ii) EffectonSealevels-Risingtemperatureswillcauseglacierstomeltandthepolar icecapstoshrink.Asa resultsealevelmayriseby0.2-1.5moverthenext50-100 yrs It is proved that sea level have already risen by 10 - 25 cm. If it continues, many low lying areas may be submerged in near future, and it is possible to destroy 20% - 80% of the coastal wetland..

(iii) Reduction of Biodiversity- As we have discussed, increased temperatures, inundation of some coastal biological communities and changes in the pattern of distributionofmanyspecies overalongperiodoftimeare likelyto causereduction in biodiversity in aquatic and terrestrial ecosystems.

(iv) Effect on Agriculture - There are different views regarding the effect of global warming on agriculture. It may be positive or negative. However, the effects of this change will vary for C_3(i.e. wheat, rice and beans) and C_4(e.g. maize, millet and sugarcane) plants.

(v) Effect on human health - The global warming will lead to changes in the rainfall pattern in many areas, thereby effecting the distribution of vector borne diseases like malaria filariasis, elephantiasis etc. Warmer temperature and more water stagnation wouldfavour the breeding of mosquitoes, snails and some insects, which arevectors of such diseases.

(vi) Effect on Arcticecosystems - Globalclimatechange will haveprofoundeffects on arctic ecosystems. Tundra is more sensitive to global climate change than most other ecosystems on earth. According to Shaver et al 1992 warmer temperature may increase primary production, thereby increasing Carbon input and soil respiration hence increasing carbon output.

(vii) Ecological disturbance- Global warming increases the desert. It increases temperature in North America, South Africa, Mexico, India and other countries. Changes of hurricanes, cyclones and floods will be more which will damage the lagoons,estuariesandcoralreefs.Globalwarmingmaycauseextinctionofmorethan one million species of animals and plants by 2050 A.D.

MEASURESTOCHECKGLOBALWARMING

Tocheckthegloballwarmingfollowingstepsarenecessary-

(1) Plantmoretrees(Afforestation)

(2) Controlpopulationgrowth.

(3) CutdownthecurrentrateofCFCsandfossilfuel.

(4) Useofnon-conventionalsourceofenergy.

(5) ShiftfromcoaltoNaturalgas.

(6) Totrapandusemethaneasafuel.

(7) Reducebeefproduction.

(8) EfficientlyremoveCO,fromsmoke

(9) UsephotosyntheticalgaetoremoveatmosphereCO2

(10) Adoptsustainableagriculture.

(11) Useenergymoreefficiently.

ACIDRAIN

Normal rain water is always acidic because of the fact that CO_2present in the atmospheregetsdissolvedinitformingcarbonic(H_2CO_3)acid.Because,thepresence of SO_2(Sulphur Dioxide) and NO_2(Nitrogen Oxide) gases as pollutants in the atmosphere, the pHof the rain water is further lowered (as low as 2.4). This is known as Acid rain.

Howdoesacidcomefrom

- Acidification of environment is a man-madephenomenon.No doubt that mostacid come from human activitiesi.e. cars, houses, factories, power stationsetc.
- Therehasalwaysbeen someacid inrain, comingfromvolcanos, swampsand planktons in the oceans, but scientists know that it has increased very sharply over the past 200 years.
- The acidity is mainly associated with the transport and subsequent deposition of oxides of sulphur, nitrogen, and these oxidative products. These oxides are produced by combustion of fossil fuels, smelters, power plants, automobile exhausts, domestic fires etc.

Howacidrainisformed

In high temperature combustion processes most of the nitric oxide originates from atmosphere and some Nitric oxide also released by burning of wood and as a result of microbial nitrification in thesoil. Lightning is anothersource of Nitric oxide.

IndaytimeNitricoxideisoxidizedbyoxygen,ozone

$$NO + O_3 \rightarrow NO_2 + O_2\ H_2O$$

$$\rightarrow H^+ + OH^-$$

$$NO_2 + OH^- \rightarrow HNO3$$

Similarly, formulation of H_2SO_4acid in the atmosphere can take place with a wide range of reduced as well as partially oxidised Sulphur compounds, H_2S, CS_2etc. Thesecompoundsarereleased from oceans and soil under reducing conditions.The production of H_2SO_4 from SO_2maytakeplace homogeneously inthe gas phaseas :

$$SO_2 + OH^- + X \rightarrow HSO_3 + X$$

Where$X=O_2$orN_2inatmosphere.

The HSO_3^-so formed can undergo a number of reactions, some of which produce sulphuric acid.

$HSO_3^- + O_2 + X \rightarrow HOO^- + SO_3 + X\ SO_3 +$

$HO_2 \rightarrow \quad H_2SO4$

The hydroperoxy radical HOO^- can also react to give HNO_3 NO

$+ HOO^- \rightarrow \quad NO_2 + OH^-$

$NO_2 + OH^- \quad \rightarrow \quad HNO_3 + X^-$

Thus a number of reactions are taken place, forming different acids.

Effects of acid rain

Acid rain exerts both direct and indirect effects on the organisms and materials it comes in contact with. The dry deposition attacks building material, steel and other metals. Some of the effects may be described as :

1. A significant reduction in fish population accompanied by decrease in the variety of species in food chains have been observed.

2. Adirondack ponds having high acidity levels, were among the first to lose fish population.

3. Different species reacts differently to acidified lakes. Adult fish can survive in more concentration aluminium than dry fish.

4. Many bacteria and blue green algae are killed due to acidification, disrupting the whole ecological balance.

5. In 1958 at Europe pH of rain water was 5.0 and in Netherland (1962) was 4.5. It damaged the leaves of plants and trees.

6. Forests of West Germany, Switzerland, Czechoslovakia, Swedish were severely affected by acid rain.

7. In North America and Europe, acid rain destroyed crops and forests, reducing agricultural productivity

8. Acid rain has retarded the growth of pea, beams, radish, potato, spinach, carrots etc.

9. Modern researches show that acid rain leaches Potassium, Calcium, Magnesium etc essential elements from the top soil.

10. Acid lakes have low levels of phytoplankton.

Lime stone attacked as :

$CaCO_3 + H_2SO_4 \rightarrow \quad CaSO_4 + H_2O + CO_2$

The attack on marble is termed as Stone-leprosy.

14. The Taj Mahal in agra is suffering from SO_2, H_2SO_4 and other fumes, pollutants released from Mathura refinery.

15. Acidraincorrodeshouses,monuments,statues,bridges,fences,railwaysetc.

16. Acidificationcanplayhavocwithhuman nervous,respiratoryanddigestive systems by making the person an easy pray to neurological diseases.

OZONELAYERDEPLETION

Stratosphere - Troposphere is the part of atmosphere where humans live and other life processes also occur. The stratosphere is the region of space between approximately 15-50 kms above the earth's surface. The gas molecules in the stratosphere act as absorbing centres, moderating the transmission of the solar radiation to the earth. The qualitative as well as quantitative effect of this is an important determining factor with respect to life processes.

CREATIONOFOZONELAYER

- Ozone is naturally occurring gas found through out atmosphere, with a maximum mixing ratio at the altitude ranging from 15-30 km above the earth. This region is known as ozone layer.
- Ozone can be toxic to plants and animals but increased concentration has a profound beneficial effect. Both, atmosphere and earth surface are subjected to radiation from sun.
- These certain radiations are absorbed by atmospheric gases leading to ionization or dissociation of gases. In the lower mesosphere, atmospheric oxygen gets dissociated and subsequently combines with molecular oxygen forming ozone in stratosphere.

FORMATIONOFOZONE

- In the lower mesosphere, the atmospheric oxygenabsorbsUVradiation < 240 nm and photo dissociates in to two oxygen atoms.
- These atoms subsequently combine with molecular oxygen of upper stratosphere producing ozone. Ozone is also capable of absorbing short wave length UV radiations releasing oxygen atoms.

$$O_2 + hv\ (\lambda < 240\ nm) \rightarrow O + O\ O +$$

$$O_2 \rightarrow O_3$$

Decomposition03+hv(=230-320nm)O_2+O

$$O + O_2 \rightarrow O_2 + O_2$$

- This mechanism does not necessarily upset the ozone equilibrium because ozone(loss) is compensated bycreation of ozone.Asaresult ozoneoccurs in 10 ppm concentration in the form of layer in stratosphere.
- Thethicknessofozonelayerismeasuredin Dobsonunits(DU),where1DU= 0.01 mm of the compressed gas 0°C and 760 mm mercury pressure. The average thickness of ozone layer in stratosphere has been estimated to be about 230 DU. It varies marginally with latitude.

MECHANISMOFOZONEDEPLETION

Therearetwoprocesses

1. Naturalprocess
2. Anthropogenicprocess

1. Natural process:A dynamic equilibrium existing between the production and decomposition of ozone molecule constitutes one of the most important mechanism. The heat generated during the reaction causes a rise in temperature. Secondly, the photochemical process absorbs most of the harmful solar UV radiations.

2. Anthropogenic process - Some of the natural species moving in to stratosphere has been augmented in recent years by a number of human activities. Many of the processes, which are responsible for ozone layer depletion share a general mechanism of the type –

$$X + O_3 \rightarrow XO + O_2$$

$$XO + O \rightarrow X + O_2$$

WhereX=reactingspecies

Netreaction $O + O_3 \rightarrow O_2 + O_2$

Themost of thecommon species (above x) havebeen identified to befree radicals like HO_X, $NO_X$and ClO_X

EFFECTSOFOZONEDEPLETION

(1) With the ozone layer depletion, there is danger of the increase in the flux of ultraviolet radiation over earth's biosphere. They are harmful for man's life.

(2) UV radiations effects biological systems in two ways - one is confined to patches of skin while the other develops in the immune system as a whole.

(3) These kinds of skin cancer, Basal cell carcinoma, squamous cell carcinoma and melanoma caused by UV rays.

(4) UVradiationscausesunburns,leukaemiaandbreastcancer.

(5) UV radiations absorbed by cornea and lens in the eye leading to Photokeratitis and cataracts.

(6) Ozone at ground level of low concentration) exerts its toxic effects directly on the lungs.

(7) Ozone exposure has been shown to be associated with lung cancer, DNA breakage.

(8) Photochemical smog is the measure cause of ozone exposure causing urban air pollution posing a threat to human health.

(9) Many micro- phytoplankton's would die because of their exposure to UV solar radiation. The marked reduction in the productivity of phytoplankton's would in turn adversely effect zoo planktons.

(10) Thelossoffishpopulationwoulddirectlyeffecttheinhabitantsofcoastalareas.

NUCLEARACCIDENTSANDHOLOCAUST

- Japanese towns of Hiroshima and Nagasaki . The first atom bomb was exploded about 580 metres in the atmosphere over ill fated Hiroshima on August 6, 1945. the second atom bomb was detonated 507 metres high in air over Nagasaki.
- At least 100,000 people were reported killed, severely injured and missing in Hiroshima alone, where the bomb virtually demolished all structures and buildings inabout 15 squarekm.area. In Nagasaki49000civilians werekilled, injured and disappeared while an area of 6 to 7 km. was devastated.
- The atom bomb exploded on Hiroshima used Uranium (U – 235) with a half life periodof8.5×10^{8}years,whiletheNagasakibombhadplutonium(Pu -239)as an explosive man-made radio-nuclide with half life of 24,000 years.

Case study

CHERNOBYLACCIDENT

- Chernobyl was the first officially acknowledged nuclear accident in USSR and first reported to the world. April 26, 1986 was a sad day for nuclear power generation when a major accident occurred at 1.23 A.M. in the nuclear reactor at Chernobyl, in the Ukraine area of the Soviet Union.
- It resulted in clouds of radioactive smoke over a large area in Scandinavian countries which are 2000 km. away in the Russian region itself. There was a devastatingfireinthereactorwhichcausedfewcasualtiesandseveredamage to the nuclear plant.
- On finding the fire uncontrollable the soviet authorities sought the help of West Germany and other nuclear nations totackle thesituation. Presumably, thecore of the nuclear reactor had melted.
- TheexplosionattheChernobylpowerplantinSovietUkraine,USSRconfirmed the worst nuclear disaster. Poor design of the reactor magnified with operator negligence caused the havoc. The operators ignored warnings from various sensors and even disconnected the emergencycore cooling systems.

Neutrons went out of control and enormous steam built up in pipes. The explosionsentthegraphiteslabsofthereactor corethrough theroof,settingit a fire and spewing radioactive materials around the world.

THEAIR(PREVENTIONANDCONTROLOFPOLLUTION)ACT1981

- With increasing industrialization andthetendency ofthemajorityofindustri estocongregateinareaswhicharealreadyheavilyindustrialised,theproblemof air pollution had begun to be felt in the country.
- The various pollutants discharged from certain human activities connected with traffic, heating, use of domestic fuel, refuse, incinerations etc. also have detrimental effects on the health of the people as also on animal life, vegetation and property.

- Inviewofdecisions takenattheJune1972 UnitedNations Conferenceholdat Stockholm, the Govt. decided to implement those decisions related to the preservation of the quality of air and control of air pollution.
- Accordinglythe Air(Prevention and ControlofPollution) Bill was introduced in the parliament and passed by both the houses of parliament.
- It came into force on the 16th day of May 1981 as THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT 1981 (14of 1981). Its amendmentact 1987(47of1987)cameintoforce.

THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981 (14 OF 1981) [29TH MARCH 1981]

An Act to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carrying out the aforesaid purposes, of Boards, for conferringonandassigningtosuchBoards,powersandfunctionsrelatingtheretoand for matters connected therewith.

(v)the form and the manner in which appeals may be preferred, the fees payable in respect

CENTRAL AND STATE BOARDS FOR THE PREVENTION AND CONTROL OF AIR POLLUTION

Central pollution control board -The Central Pollution Control Board constituted under section 3 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974), shall, without prejudice to the exercise and performance of its power and functionsunderthe Act, exercise thepowers and performthefunctions ofthe Central PollutionControl Boardfortheprevention and controlof airpollution under this Act.

State Pollution Control Boards - In any State in which the water (Prevention and Control of Pollution) Act, 1974 (6 of 1974), is in force and the State Government has constituted for that state a State Pollution Control Board under section 4 of that Act, suchStateBoardshallbedeemedtobetheStateBoardforthePreventionandControl of Air Pollution constituted under section 5 of this Act, and accordingly that State Pollution ControlBoard shall, without prejudiceto theexercise andperformance of its powers and functions under that Act, exercise the powers and perform the functions of the StateBoard for the prevention and control of air pollution under this Act].

POWERSANDFUNCTIONSOFBOARDS

FunctionsofCentralBoard–

(1) Subject to the provisions of this Act, and without prejudice to the performance of its functions under the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974), the main functions of the Central Board shall be to improve the quality of air and to prevent, control or abate air pollution in the country.

(2) In particular and without prejudice to the generality of the foregoing functions, the Central Board may

(a) advise the Central Government on any matter concerning the improvement of the quality of air andtheprevention, control or abatement of air pollution;

(b) planandcauseto beexecutedanation-wide programmefor theprevention,control or abatement of air pollution;

(c) co-ordinatetheactivitiesoftheStateBoardsandresolvedisputesamongthem;

(d) provide technical assistance and guidance to the State Boards, carry out and sponsor investigations and research relating to problems of air pollution and prevention, control or abatement of air pollution;

(e) plan and organize the training of persons engaged or to be engaged in programmes for the prevention, control or abatement of air pollution on such terms and conditions as the Central Board may specify;

(f) organize through mass media a comprehensive programme regarding the prevention, control or abatement of air pollution;

(g) laydownstandardsforthequalityof air;

(h) collectanddisseminateinformationinrespectofmattersrelatingtoairpollution;

(i) performsuchotherfunctionsasmaybeprescribed.

(3) The Central Board may establish or recognize a laboratory or laboratories to enable the Central Board to perform its functions under the section efficiently.

(4) TheCentralBoardmay

(a) delegate any of its functions under this Act generally or specially to any of the committees appointed by it;

(b) dosuchotherthingsand performsuchother actsasitmaythinknecessaryforthe proper discharge of its functions and generally for the purpose of carrying into effect the purposes of this Act.

Functions of State Boards - (1) Subject to the provisions of this Act, and without prejudiceto the performanceof its functions, if any, under the Water (Prevention and Control of Pollution) Act, 1974), the functions of a State Boardshall be

(a) to plan a comprehensive programme for the prevention, control or abatement of air pollution and to secure the execution thereof;

(b) to advise the State Government on any matter concerning the prevention, control or abatement of air pollution;

(c) tocollectanddisseminateinformationrelatingtoairpollution;

(d) tocollaboratewiththeCentralBoardinorganisingthetrainingofpersonsengaged or to be engaged in programmes relating to prevention, control, or abatement of air pollution and to organise mass-education programme relating thereto;

(e) to inspect, at all reasonable times, any control equipment, industrial plant or manufacturingprocessandtogive,byorder,suchdirectionstosuchpersonsasitmay consider necessary to take steps for the prevention, control, or abatement of air pollution;

(f) to inspect air pollution control areas at such intervals as it may think necessary, assessthequalityofairthereinandtakestepsfortheprevention,controlorabatement of air pollution in such areas;

(g) to lay down, in consultation with the Central Board and having regard to the standardsforthe qualityof air laiddownbytheCentral Board, standardsfor emission of air pollutants into the atmosphere from industrial plants and automobiles or for the discharge of any air pollution into the atmosphere from any other source whatsoever not being a ship or an aircraft;

PREVENTIONANDCONTROLOFAIRPOLLUTION

(i) Powertodeclareairpollutioncontrolareas.

(ii) Powertogiveinstructionsforensuringstandardsforemissionfromautomobiles.

(iii) Restrictionsonuseofcertainindustrialplants.

(iv) Persons carrying an industry etc, not to allow emission of air pollutants in excess of the standard laid down by State Board.

(v) Powertotakesamplesofairoremissionandproceduretobefollowed.

(vi) Reportsofanalysis.

(vii) Appeals,

PENALTIESANDPROCEDURE

Failuretocomplywiththeprovisionsofsection21or section22orwiththe directions issued under section 31A –

(1) Whoeverfailstocomplywiththeprovisionsofsection21orsection22ordirections issued under section 31A, shall, in respect of each such failure, be punishable with imprisonment for a term which shall not be less than one year and six months but whichmayextendto sixyearsand with fine,andincase thefailurecontinues,withan additional fine which may extend to five thousand rupees for every day during which such failure continues after theconviction for the first such failure.

(2) If the failure referred to in sub-section (1) continues beyond a period of one year after lhe date of conviction, the offender shall be punishable with imprisonment for a termwhichshallnotbelessthantwoyears(butwhichmayextendtosevenyearsand with fine.]

Penaltiesforcertainacts-Whoever-

(a) destroys, pulls down, removes, injures or defaces any pillar, post or stake fixed in the ground or any notice or other matter put up, inscribed or placed, by or under the authority of the Board, or

(b) obstructs any person acing under the orders or directions of the Board from exercising his powers and performing his functions under this Act, or

(c) damagesanyworksorpropertybelongingtotheBoard, or

(d) fails to furnish to the Board or any officer or other employee of the Board any informationrequiredbythe Boardorsuchofficerorotheremployeeforthepurposeof this Act, or

(e) failstointimatetheoccuranceoftheemissionofairpollutantsintotheatmosphere in excess of the standards laid down by the State Board or the apprehension of such occurrence, to the State Board and other prescribed authorities or agencies as required under sub-section (1) of section 23, or

(f) in giving any information which he is required to give under this Act, makes a statement which is false in any material particular, or

(g) for the purpose of obtaining any consent under section 21, makes a statement which is false in any material particular, Shall be punishable with imprisonment for a term which may extend to two to three months or with fine which may extend to (t en thousand rupees) or with both.

THEWATER(PREVENTIONANDCONTROLOFPOLLUTION)ACT,1974

- Asa resultof growth of industries and the increasingtendency to urbanization the problem of pollution of rivers and streams had assumed considerable importance.
- Ithadbecomeessentialtoensurethatthedomesticand industrialeffluents are not allowed to be discharged in to the water courses without adequate treatment. To draw a draft enactment for the prevention of water pollution a committee was set up in 1962. Later on a draft bell was prepared and put up for consideration at the joint session of Central Council of local sell Govt., ministers of Town and Country planning hold in 1965.
- Afterlongdiscussion,someresolutionswerepassedbythelegislativesofsome states. To give effect to these resolutions, the Water (Prevention and Controlof Pollution) bill was introduced in the parliament, and having been passed by boththe houses, received the assent of the President on 23 March 1974.
- It came on the Statute book as THE WATER (PREVENTION AND CONTROL OFPOLLUTIONACT1974(6OF1974).Lateron,itwasamendedtwice(44of 1978) and (53 of 1988).

POWERSANDFUNCTIONSOFBOARDS

FunctionsofCentralBoard-(1)Subjecttotheprovisions of thisAct,themainfunction of the Central Board shall be to promote cleanliness of streams and wells in different areas of the States.

In particular and without prejudice to the generality of the foregoing function, the Central Board may perform all or any of the following functions, namely:

(a) advise the Central Government on any matter concerning the prevention and control of water pollution;

(b) co-ordinatetheactivitiesoftheStateBoardsandresolvedisputesamongthem;

(c) provide technical assistance and guidance to the State Boards, carry out and sponsor investigations and research relating to problems of water pollution and prevention, control or abatement of water pollution;

(d) plan and organize the training personsengaged or to be engaged in programmes for the prevention, control or abatement of water pollution on such terms and conditions as the Central Board may specify;

(e) organize through mass media a comprehensive programme regarding the prevention and control of water pollution:

(f) collect,compileand publishtechnical and statisticaldata relating to water pollution and the measures devised for its effective prevention and control and prepare manuals, codes or guides relating to treatment and disposal of sewage and trade effluents and disseminate information connected therewith;

(g) laydown,modifyorannual, inconsultationwiththeStateGovernmentconcerned, thestandards may belaid downfor thesame stream orwellorfordifferentstreams or wells, having regard to the quality of water, flow characteristics of the stream or well andthe natureof theuseof the water in such stream or well or streams or wells;

Functions of State Board - (1)Subjectto theprovisions ofthis Act,thefunctionsof a State Board shall be

(a) to plan a comprehensive programme for the preventions, control or abatement of pollution of streams and wells in the State and tosecurethe execution thereof;

(b) to advise the State Government on any matter concerning the prevention, control or abatement of water pollution;

(c) to collect and disseminate information relating to water pollution and the prevention, control or abatement thereof;

(d) to encourage, conduct and participate investigations and research relating to problems of waterpollution and prevention, controlor abatement of water pollution;

(e) tocollaboratewiththeCentralBoardinorganizingthetrainingofpersonsengaged or to be engaged in programmesrelating toprevention,controlor abatement ofwater pollution and to organize mass education programmes relating thereto;

(f) to inspect sewage or trade effluents, worksand plants for the treatment of sewage and trade effluents and to review plans, specifications or other data relating to plants set up for the treatment of water, works for the purification thereof and the system for thedisposalofsewageortradeeffluentsorinconnectionwiththegrantofanyconsent as required by this Act;

(g) to lay down, modify or annul effluent standards for the sewage and trade effluents and for the quality of receiving waters (not being water in an inter-State stream) resultingfrom thedischarge of effluents and toclassify waters of the State;

(h) to evolve economical and reliable methods of treatment of sewage and trade effluents.havingregardtothepeculiarconditionsofsoils,climateandwaterresources of different regions and more especially the prevailing flow characteristics of water in streams and wells which render it impossible to attain even the minimum degree of dilution:

(i) toevolvemethodsof utilizationofsewageandsuitabletradeeffluentsinagriculture:

(j) to evolve efficient methods of disposal of sewage and trade effluents on land, as arenecessaryonaccount ofthepredominant conditionsof seantstreamflowsthatde noprovide for major part of the year the minimum degree of dilution;

(k) to lay down standards of treatment of sewage and trade effluents to be discharged into any particular stream takinginto account theminimumfairweatherdilution available in that stream and the tolerance limits of pollution permissiblein the waterof the stream, after the discharge of such effluents;

(l) tomake,varyorrevokeanyorder-

(i) fortheprevention,controlor abatement ofdischargesof wasteintostreams or wells;

(ii) requiring any person concerned to construct new systems for the disposal ofsewageandtradeeffluentsortomodify,alterorextendanysuchexisting system or to adopt such remedial measures as are necessary to prevent, control or abate water pollution;

(m) to lay down effluent standards to be complied with by persons while causing discharge of sewage or sullage or both and to lay down, modify or annul effluent standards for the sewage and trade effluents;

(n) to advise the State Government with respect to the location of any industry the carrying on of which is likely to pollute a stream or well;

(o) toperformsuchotherfunctionsasmaybeprescribedoras may, fromtimetotime, be entrusted to it by the Central Board or the State Government.

TheBoardmay establishorrecognizealaboratoryorlaboratoriestoenabletheBoard toperformitsfunctionsunderthissectionefficiently,includingtheanalysisofsamples ofwaterfromany stream orwell orof samplesofany sewage ortrade effluents.

PENALTIESANDPROCEDURE

1. Failure to comply with directions under sub-section (2) or sub-section (3) of section20,ororderssissuedunderclause(C)ofsub-section(1)ofsection32or directions issued under sub-section (2) of section 33 or section 33A -

(1) Whoever fails to comply with the direction given under sub-section (2) or sub-section(3) of section20withinsuchtimeas maybespecified inthedirectionshall,on conviction, be punishable with imprisonment for a term which may extend to three monthsor withfinewhichmayextendtotenthousandrupees or withbothand incase thefailurecontinues,withanadditionalfinewhichmayextendtofivethousandrupees

foreverydayduringwhichsuchfailurecontinuesaftertheconvictionforthefirstsuch failure.

(2) Whoever fails to comply with any order issued under clause (C) of sub-section (1) of section 32 or any direction issued by a court under sub-section (2) of section 33 or any direction issued under section 33A shall, in respect of each such failure and on conviction, be punishable with imprisonment for a term which shall not be less than one year and sixmonthsbut whichmay extendto sixyearsand with fine, and incase thefailurecontinues,withanadditionalfinewhichmayextendtofivethousandrupees for everydayduring whichsuchfailurecontinuesafter the conviction for the firstsuch failure.

(3) Ifthefailurerefferedtosub-section(2)continues beyond aperiod of one year after the date of conviction, the offender shall, on conviction, be punishable with imprisonment for a term which shallnot be less than two years but which may extend to seven years and with fine.

2. Penaltyforcertainacts-

(1) Whoever-

(a) destroys, pulls down, removes, injures or defaces any pillar, post or stake fixed in the ground or any notice or other matter put up, inscribed or placed, by or under the authority of the Board, or

(b) obstructs any person acting under the orders or directions or the Board from exercisinghispowersandperforminghisfunctionsunderthisAct,or(c)damagesany works or property belonging to the Board, or

(d) fails to furnish to any officer or other employee of the Board any information required by him for the purpose of this Act, or

(e) fails to intimate the occurrence of any accident or other unforeseen act or event under section 31 to the Board and other authorities or agencies as required by that section, or

(f) in giving any information which he is required to give under this act, knowingly or wilfully makes a statement which is false in any material particular, or

(g) forthepurposeofobtaininganyconsentundersection25orsection26,knowingly or wilfully makes a statement which is false in any material particular, shall be punishable with imprisonment for a term which may extend to three months or with fine which may extend to [ten thousand rupees) or with both.

(2) Where for the grant of a consent in pursuance of the provisions of section 25 or section26theuseofmeterorgaugeorothermeasureormonitoringdeviceisrequired and such device is used for the purposes of those provisions, any person who knowingly alters or interferes with that device so as to prevent it from monitoring or measuring correctly shall be punishable with imprisonment for a term which may extendtothreemonthsor withfinewhichmayextendto[tenthousandrupees] or with both. or wilfully

3. Penalty for contravention of provisions of section 24- Whoever contravenes the rovisions of section 24 shall be punishable with imprisonment for a term which shall not be less an one year and six months) but which may extend to six years and with fine.

4. Penalty for contravention of section 25 or section 26- Whoever contravenes the provisions of section 25 or section 26 shallbe punishable with imprisonment for a termwhich allnot be lessthan [oneyear and six months]but which may extendto six years and with fine.

5. Enhanced penalty after previous conviction- If any person who has been convictedof offenceunder section 24 or section 25 or section 26 isagainfound guilty of an offence involving contravention of the same provision, he shall, on the second and on every subsequent conviction, *punishable with imprisonment for a term which shallnot beless than (two years] but which may seven years and with fine;

Provided that for the purpose of this section no cognizance shall be taken of any conviction made more than two years before the commission of the offence which is being punished.

6. Penalty for contravention of certain provisions of the Act- Whoever contravenes any of the provisions of this Act or fails to comply with any order or direction given under this Act, for which no penalty has been elsewhere provided in this Act, shall be punishable with imprisonment which may extend to three months or with fine which may extend to ten thousand rupees or with both and in the case of a continuing contravention or failure, with an additional fine which may extend to five thousand rupees for every day during which such contravention or failure continues after conviction for thefirst such contravention or failure.]

7. Publicationofnamesofoffenders.

8. Offencesbycompanies.

9. OffencesbyGovt.Departments.Cognizanceofoffences.servants.

10. Cognizanceofoffences.servants.

11. Members,officersandservantsofboardstobethepublicservants.

PUBLICAWARENESS

Environmental pollution, environmental degradation, environmental deterioration, environmental crisis etc. are few words which becoming day by day a subject of concernineverywalkoflife.ThisisallduetoindustrialIzation,rapidpopulationgrowth, urbanization, changing life style etc. The formulation of various acts and legislations to control pollution and conserve or protect environment, underlines the will and concern of the Government.

Methods-

To protect and conserve the environment is the basic duty of all sections of people becauseenvironmentbelongstoallandeveryindividualmatters.Insteadofsearching the solution, it is necessary to find the permanent solution of environmental and ecological problems. It can be done by following means.

(1) Through mass-media- There are various means of mass communication to educate,entertain&giveinformation's,instructionsetc.topeople.Radiowasthefirst. Next is T.V. in terms of its reach to the masses.

(2) Through Education - Students are the back bone of a country. If environmental education is started from grass root level i.e. from childhood stage, it will give good results. It will be done through formal and informal environmental education. A welcome step to introduce environmental studies paper at collage level by Government bythedirective of SupremeCourtis good in the direction of awareness.

(3) Through rallies, orientation and training programmes: - To promote environmental awareness, environmental rallies with posters, handbills, programmes maybe organizedon certainoccasions like 5th Juneasworldenvironmentaldayand is week of October as wild life week. Some training programmes, orientation, workshops, seminars, meetings based on environment awareness may be organized fordecisionmakers,planners,leadersalso,sothattheycanalsospreadthemessage to protect & conserve the environment.

(4) Through voluntary organizations and NGOs- Due to having link between people and Government some voluntary organizations and non-Government organizations can play an important role in the direction of environmental awareness in people by organizing educational, religious, plantation, musical, competitions (essay, drawing, oral) etc. programmes. These organizations can also advise the government to implement effective programmes for environmental awareness.

(1) BombayNaturalHistorySociety(BNHS).

(2) WildLifePreservationSocietyofIndia.(WPSI)

(3) WorldwideFundforNature-India(WWF-India).

(4) CentreforScienceandEnvironment(CSE)

Unit7:Humanpopulationandtheenvironment

POPULATIONGROWTH

Themostimportantfeaturesofpopulationisthegrowthi.e.thecapacityofincreasein individualmembers.Bymeasuring the sizeor densityof agivenpopulation from time to time, we can get rate of increase and can also predict future changes in its size. It can be defined in following

(a) Logistic growth : When a population is allowed to grow in a limited space (environment) it shows logistic growth. If we plot a graph between number of bacteria or cells against time, we typical S shaped sigmoid curve called population growth curve.

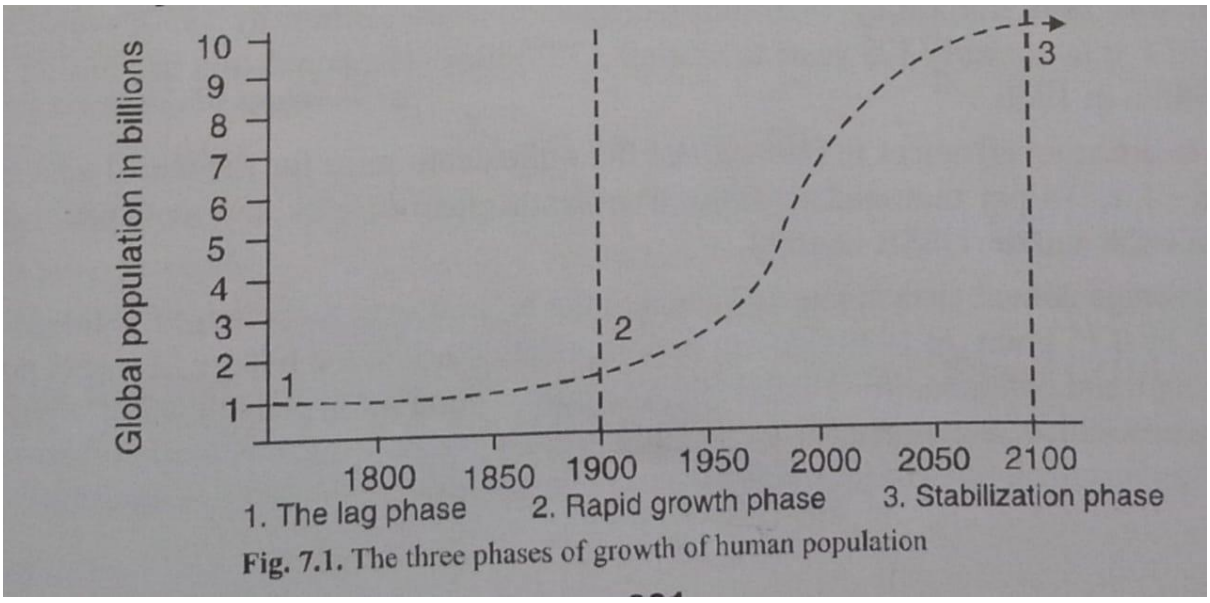


Fig. 7.1. The three phases of growth of human population

It has four phases i.e. Ist phase shows slow rate called lag period, second is accelerating stagefollowed by a phaseof extremelyrapid population. The last phase isacceleratingmultiplication followedbyequilibriumphasewhereisessentiallynonet change in population called saturation level or carrying capacity. It is represented by letter K.

The logistic equation shows density dependent growth i.e. growth of a simple population in a limited space with limitedresources. It may be written as

$$dN/dt=\gamma N(1-N/K)$$

wheredN/dtrateofgrowthofpopulation

γ=intrinsicrateofincrease(perindividualofpopulation)

N=Populationsize(No.oforganismsinpopulationattimet) K =

Carrying capacity of population

(1-N/K)=density-dependentfactor.

(b) Exponential Growth : When a population growth curve quickly begins to rise very steeply,thepopulationshowsexponentialgrowth.ItisIshaped(Fig.7.1).Apopulation growing exponentially increases accordingly to the equation

$N_t=N_0e^{rt}$

WhereN_t=Thenumberofindividualsinthepopulationaftertunitsoftime N_0 =

initial population size (t = 0)

r=exponentialgrowthrate

e=thebaseofthenaturallogarithm

(c) Geometric Growth : Geometric growth may be defined as the population growth in which the rate of increase is proportional to the number of individuals in the population at the beginning of the breeding session. When young ones are added to the population only at specific times of the year during well defined reproductive periods,thepopulation is saidto havegeometric growth. Theequation forthis is

$N_t=N_0\lambda$

Whereλ=thegeometricgrowthrate.

POPULATIONEXPLOSIONFAMILYWELFAREPROGRAMME

- Previously this programme was known as National Family Planning Programme. In the year 1977 the name was changed to National Family Welfare Programme. Family planning programme was launched in India in 1952. India was the first country to doso.
- Beginning of the programme wasmodest,i.e., establishment of fewFPclinics, distribution of FP educational material, training of health functionaries and research. During the third 5-year-plan (1961-66) family planning was declared as centre of planned development.
- Then the emphasis was shifted from clinic approach to extensive education approach (i.e., motivating people about small family norm). A separate DepartmentofFamilyPlanning was created in 1966 in the Ministryof Health.
- In 1972, the MTP Act was passed. In April 1976, National Population Policy was framed. During the emergency period (1976), forcible sterilisation campaign led to the defeat of Congress in 1977 elections.
- InJune1977,newJanataGovernmentformulatedanewpopulationpolicyand made family planning as voluntary and renamed it as Family Welfare Programme.

ImportanceofFamilyWelfareProgramme

1. The family welfare programme occupies an important position in the nation's socioeconomic development.

2. Indianpopulationwhichwas34croresin1947hascrossed100croremarkby2000 AD. India has only 2.4% of world's land area but it supports about 15.5% of world's population.

3. India's population is increasing by 1.8 crores every year. To check this galloping growth, the country has laid down long-term demographic goal of achieving an NRR of one by the year 2000 AD.

4. Acceptanceofthefamilywelfareservicesismadevoluntary.

5. The programme was 100% centrally sponsored scheme. FP programme was integrated the MCH services.

ORGANISATIONALSETUP

1. Centrallevel

At central level Central Cabinet Subcommittee is present. It is headed by Prime Minister. Next level is Population Advisory Council. This is headed by Union Minister of Health and Family Welfare. Members are representatives of various professional bodies and some technical persons. Next level is Central Family Welfare Council, which is headed by union minister and ministers of and family welfare of all states. It coordinates the work of the programme.

2. Statelevel

Ministryof Health and Family Welfareisthe apexorganization at the state level. This is headed by the minister of health and family welfare of the respective state. At the state level the family welfare work is organised by State Family Welfare Bureau. The State Family Welfare Bureau has three wings:

(a) Administrative wing (headed bystate family welfare officer and associated bysome officers)

(b) Educationandinformationwing(headedbymassmediainformationofficer)

(c) Fieldoperationandevaluationwing(headedbystatisticalofficer).

3. Districtlevel

- At district level the work of family welfare is organized by District Family Welfare Bureau. has three wings like the state level.
- AtsomedistrictsRegionalFamilyWelfareTrainingCentres arepresent.These will undertake training of medical officers and para-medical staff. 4. Peripheral level
- In rural areas the family welfare work is looked after by rural family welfare centresattachedtoPHC while inurbanareas urbanfamily welfarecentres will took after this work.

At village level the MPHA(F) and MPHA(M) are mainly responsible for the programme. They will take the assistance of CHG, TBA and anganwadi workers.

5.Villagelevel

AtvillageleveltheMPHA(F)and MPHA(M)aremainlyresponsiblefor theprogramme. They will take the assistance of CHG, TBA and anganwadi workers

GoalsofNationalPopulationPolicy

1. NRR1(whichimpliestwo-childnorm)
2. Birthrate21/100population
3. Deathrate9per1000population
4. Raisingcoupleprotectionrateto60%
5. Reductionoffamilysizeto2.3livebirths.
6. DecreasetheIMRto60per1000

ProgrammeStrategies

1. Integratedapproach
2. Cafetariaapproach
3. Welfareapproach
4. Atriskapproach

VALUEEDUCATION

- Man acts to satisfy his needs or wants. Anything which satisfies human need becomes thereby a thing of Value. It is the element of desirability and satisfaction that is common to all values, material or non-material.
- In psychology the term value is generally employed to designate a dominant interest, motive or broad evaluative attitude. Value has been defined variously bydifferenteducationists,butonthe whole, it isinterpretedtobeeitherasetof feeling or an action. Human behaviour is governed by his values. These are socially approved desires or goals, conceptions or standards by which things are approved or disapproved.
- Value is a dynamicterm used in different aspects. Indian philosophy has used it in sense of state free from pleasure and pain, psychologists in the sense of “psychic energy", sociologists in the sense of “use of time, energy and money for certain ends. The last theory is named as “Integral theory”.
- The progress and development of a nation depends upon the quality of the values cherished by its citizens. One of the serious criticism against our educational system is that it lacks value orientation. Our 1986 National Policy onEducation and its modifications havestrongly advocated value education.

IMPORTANTVALUES

Importantvaluesmaybedescribedasfollows

(i) Religious Value : It is defined in terms of faith in God. The outward acts of behaviour expressive of thisvalue aregoingon pilgrimage, is linking in simple life,

having faith in religious leaders, worshipping God andspeaking the truth. Students (Higher studies) prefer least the religious value.

(i)SocialValue: Itisdefined intermsofcherity,kindness, loveand sympathyforthe people, efforts to serve God through the service of mankind, sacrificing personnel comforts and gain to relieve the needy and affected of their misery.

(iii) Democratic Value : This value is characterized by respect for individuality, absence of discrimination among persons on the basis of sex, language, religion, caste, colour, race and family status, ensuring equal social, political and religious rights to all and respect for all democratic institutions.

(iv) Aesthetic Value : It is characterized by appreciation of beauty, from proportion andharmony,loveforfinearts,drawingpainting,music,dance,sculpture,poetryand architecture, love for literature, decoration and the surroundings. It is also the least preferred values in schools.

(v) Economic Value : This value stand for desire for money and material gains. A manwith high economicvalue is guided by consideration of moneyand materialgain in the choice of his job.

(vi) Knowledge Value : This value stand for love of knowledge or theoretical principlesof an activityand loveof discovery of truth. Amanwith thisvalue considers a knowledge of theoreticalprinciples underlying a work essential for success in it. He values hard work in studies.

(vii) Hedonistic Value : It is the conception of desirability of loving pleasure and avoiding pain. For a hedonist the present is more important than the future. He indulges in pleasure of senses and avoids pain.

(viii) PowerValue : Itisdefinedastheconceptionofdesirabilityofrulingoverothers and also of leading others. A man with this value prefers a job where he gets opportunity to exercise authority over the others.

(ix) FamilyPrestigeValue: Itisdefinedastheconceptionofdesirabilityofsuchitems of behaviour roles, functions and relationship as would become one's family status. It implies respect for roles which traditionally charateristic of different castes of Indian society.

(x) HealthValue: Itistheconsiderationfor keepingthebody in afitstatefor carrying out one's normal duties and functions. It also implies the consideration for self preservation.

RoleofInformationTechnologyinEnvironmentandHumanHealth

- Just as chemical or metallurgical or electrical technologies enable the processing of raw materials in to usable goods, to satisfy man's and societies needs, so does information technology (IT) help the storage, processing, transmission and exploitation of information to satisfy a person's, company's, society's or Govt's needs for information. Information covers voice as in telephony,text as infax, images as in video anddataas between computers.

- Informationisknowledgeandknowledgeispower.Knowledgeplusexperience is wisdom and it is the wise use of information that gives advantage to those who have information. in extending man's mind or
- Information technology as commonly picturised by computers brain or intellectual power. Information technology devices like microprocessors and becoming mass appliances from pace makers for the heart, hearing aids and efficiencyenhancesinautomobileenginesanddevicestosteerspacevehicles on the moon. Like banking, trading, learning and teaching, sectors of human activity, Information technology has tremendous use in the