## UNIT-I

#### Multi disciplinary nature of environmental studies

Environment is derived from the word "French"- environner, which means to encircle (or) surround. Environment includes biological and non biological things. As per environment protection (act) 1986, environment includes physical and biological things & their interaction between them.

Anyhow environment is thus defined as "the total sum of water, air, land and their relationships, also with human, other living organisms & materials.

aterials. 71 ving organisms Water Huma Ehvirament

From the figure it is clear that each and every factor inter depends with one another. At the same time human have direct influence on the various factors .i.e., the over exploitation of these influence heavily on the human beings. Hence human have direct (or) indirect relationship with surroundings (flora & fauna). The multi stored buildings, commercial complexes, factories, transportation networks, pollutants, animals, plants & population of urban environment is differed with the rural environment.

Environment is a complex subject in which it includes & interrelates with many subjects

(disciplines).

- Life sciences includes botany, zoology, microbiology, genetics, biochemistry helps in understanding the biotic components and their interactions.
- Physical sciences includes physics, chemistry, geology, atmospheric science etc helps in understanding the abiotic components and their inter actions.

(Life sciences)	: (Physical sciences)
Biology, Biochemistry	Physics, chemistry, Earth science
Nicostriplogy, Biotechnology	Atmountary science, according
Modeiling)	iental Geography
Mathematics,	(Technical)
Statistics, computer	(VIL, CHEMICAL Engineering
Science	Hydraulics, Namo technology)
Conomics, sou	conta)
Economics, sou	iology, Law.
Education, Me	mazement,
Mass commun	section

- Mathematics, statistics, computer science, helps in model of the environment.
- Economics, management, sociology deals with the socio-economic aspects and their development activities.
- > Technical like civil, chemical, nanotechnology gives control and treatment of the environmental pollution.
- Law & education provides guidelines & deals with legal issues regarding environmental activities.
- Mass communication creates awareness about environmental measures.

From the above it is clear that environmental studies is a multidisciplinary subject which deal & inter relates with the other subjects also.

#### Scope:

As it is a multidisciplinary subject, it has wide scope. The environmental studies comprises of the following:

- Natural resources-conservation and management.
- Ecology and biodiversity.
- Environmental pollution & control.
- Social issues related to development and environment.
- Human population and environment.
- Environmental studies have direct effect on the every section of the society. It is also concentrated in the technical subjects like environmental science, environmental engineering, environmental management-which are going to be boom subjects in the future. The scope of environmental science are listed as follows:

#### 1. Research and Development(R & D):

Various R&D activities can be carried out in finding issues and also solutions to the environmental problems. Man power is needed at every level of the environmental issues. As the pollution controls laws are stringent (more strict), industries are facing problems in the disposal of the wastes produced. Companies are adopting green technologies rather than the expensive ligitation (fine).

So, companies are in a position to invest for the pollution control technologies with cost cutting effluent treatment. So they are investing in R&D activities, because cleaning and disposal is a big task. It is estimated that American business spends more than \$100 billion dollars per year for this purpose. Germany and Japan also have stringent (measure) laws. There is \$200 billion market for cleaning East Germany alone. In India also there strict laws for the disposal of effluents i.e., before they reaches the water bodies they have to be purified.

#### 2. Green advocacy:

With increasing of various issues related to the environment, the demand for the environmental lawyer also being increased. They deals with the cases related to water, air pollution and also regarding wild life, forest preservation etc.

#### 3. Green marketing:

As the people are being educated and got awareness about the environmental issues, interesting in buying and marketing about the eco-friendly products. So, in related to that issues and also stringent laws, companies are producing the eco friendly products with ISO certification (ecomark (or) ISO 14000). In future there are demands for environmental auditors and managers.

#### 4. Green media:

For the environment awareness, among the people, mass media like TV, radio, news paper, advertisement, etc are needed which ultimately provides scope for the people.

#### 5. Environmental consultancy:

Many government and non government organizations are involved in the consultancies for studying and tackling the issues related to the environment.

**Importance of the environment:** Environment belongs to all. As the relation between environment and us is bidirectional, if we disturb environment, it disturbs us. Here is the some important days listed in the environment calendar

Environmental calendar

World wet land day	-February 2
World forest day	- March 21
World day for water	-March 22
World metrological day	-March 23
Earth day	-April 22
International biodiversity day	-May 22
Anti tobacco day	-May31
World environment day	-June 5
World ocean day	-June 8
World population day	-June 11
Ozone week	-September 16-23
World care free day	- September 22
Green consumer day	- September 28
World farm animal day	- October 2
World habitat day	-October 3
World animal welfare day	-October 4
Wild life week	- October 1-7
World conservation day	- October 24
International day for natural Disaster reduction	- October 13
International day for biological Diversity	-December 29

# Multidisciplines' and Natural Resources

#### Global verses local nature of environment:

Activities of environment can be socialized or globalised. Global issues are global warning, depletion of ozone layer, dwindling forests and energy resources, loss of global biodiversity etc. local issues are mining of hydro electric project, disposal of waste, lake (or) river pollution, Soil erosion, water logging, salinization of soil, flourosis, etc. So in order to know and rectify problems, people should be environmentally educated.

#### Individualistic nature of environment:

As the issues of the environment becoming more serious, are has to understand and have the solution of problems raised due to those issues. If we want to live in a clean, healthy and hygienic conditions means we should be aware of the environment. If we want to live in authentically beautiful, safe & secure environment (or) if we want to hand over clean & safe earth to our future generations, it is most essential to understand the basics of environment.

#### Need for public awareness:

#### **Conferences:**

Environmental issues led to many problems. So, to draw attention from the globe conference held on 5<sup>th</sup> June, 1972 called Stockholm conference. From that day we celebrate every 5<sup>th</sup> June as world environment day.

- Another conference on environment & development held at Riode Janerio from the United Nations. This is popularly known as earth summit (1992).
- Another summit on sustainable development held at Johannesburg (2002). In this, issues of the environment were discussed.

The above awareness held was to draw attention of the public towards deteriorating environment.

#### Awards:

For the first time an environmentalist got the Nobel Prize, this made the land mark and also shows that interest in global environment concern. Wangari Maathai awarded Nobel prize in 2004 for her contribution to sustainable development, democracy and peace. This is the greatest recognition for environment at international level. The Nobel committee expressed the views while awarding the Nobel Prize & peace on earth depends on our ability to secure our living environment.



Wangari Maathai is Kenya's deputy environment minister and also founder of Kenya based green belt movement. In this movement woman has planted about 30 million trees across Africa. This helped in conservation of wild life. Maathai gave a beautiful slogan "when we plant new trees we plant the seeds of peace".

#### Awareness of environment in public:

Stringent rules by the government (or) measures alone cannot be helpful in achieving development of the environment until public has the participatory role. But it is only achieved by awareness about ecology and environment issues. The awareness can be done by educating the public about the environment. We should educate the public such that we shouldn't reach the threshold level. **E.g:** Ban of polythene littering.

A Chinese proverb say "if you plan for one year, plant rice, if you plan for 10 years, plant tress and if you plan for 100 years, educate people". i.e., if we want to protect and manage our earth, the only way is people to be educated environmentally.

**Contemporary Indian environmentalists:** In our country, effects are made to create awareness about the environment. In that relation many legends are there.

- Kuldeep singh, green judge & sh. M. C. Mehta, the green advocate
- Sh. Sunderlal bahuguna- Chipko movement
- Tehri Bachao Andolan, Smt. Medha patker and Ms. Arundhati Roy- Narmada Bachao Andolan.
- Sh. Rajendra singh, Magsaysay awardee water conservation.

- Salim Ali, ornithologist studied on birds.
- Mrs. Indira Gandhi Introduced environmental protection in constitution of India.
- Mrs. Menaka Gandhi –worked on wild life protection.
- Sh. Anil Aggarwal- Founder, Chairman of Centre for Sciences & Environment.

# **Concept of Ecomark:**

To get awareness, the concept of eco mark was introduced, i.e., product to be marketed in such a way that it is eco-friendly product & has no harm in the disposal, etc. In this relation Eco-clubs & Eco task force was launched by the government. Now a days it is fashion that everybody talk about the environment, but only a few have clear cut idea and still fewer people have actual experience and interest about it. But this awareness is becoming a political issue.

"Environment is very wrongly taken as a fashion by all walks of life, hardly realizing that is our real life- situation and our sustenance and security are at state".

The awareness about the environment is compulsory because

- 1. Environment belongs to all, such that everyone should participate in implementation of environment protection plans.
- 2. To change the mindset of the modern society, environmental awareness is needed.
- 3. There is need to create awareness regarding health issues i.e., to live in a clean & healthy environment.
- 4. Keeping in the mind of future generations, there is no other option that we have to educate about environment awareness.

Henry D. Thoreau said that "what's use of a beautiful house if you don't have a descent planet to put it on". Even if we begin today, the restoration is expected in next 40-50 years.

# NATURAL RESOURCES

Living things on this earth depends on variety of goods and services gifted by nature known as natural resources e.g: water, soil, air, minerals, forest, wildlife etc. This can be categorized into two:

1) Renewable resources: These resources are in-exhaustive and can be regenerated within a span of time.

Eg: Forest, Wild Life, Wind energy, Hydropower Solar energy.

2) Non-renewable resources: This resources are exhaustive and cannot regenerated

Eg: fossil fuels like coal, petroleum, etc.

Even our renewable resources become non-renewable if the rate of regeneration is less than the rate of consumption. If any species is exploited too much than it fall below the threshold level, followed by endangered and extinct. So, we have to be careful in consuming the natural resources such that it should be available for future generations (we should not exhaust them). We shall discuss about some major natural resources:

- 1) Forest resources
- 2) Water resources
- 3) Mineral resources
- 4) Food resources
- 5) Energy resources



Forests are one of the most important natural resources on this earth and covers like a blanket. It not only produces goods but also provides services.

- One-fourth of the earth is land area, of which one-third of the worlds land area is forest area. Rank of different countries based on forest resources are USSR -5<sup>th</sup>, Brazil 7<sup>th</sup>.
- Canada and USA covers 6-7% of Worlds forest area but these forests are subjected to deforestation. The greatest occurred in tropical Asia. Now Brazil is subjected to deforestation at the maximum level.



Fig. 2.1 Forests give us a variety of valuable gits as materials and services.

#### **Uses of Forest:**

Forests are potential value to us. They are useful for industries; nevertheless they are very useful to the environment. It also decides economic status of the country.

Let's compare the values of forest in terms of economics and commercial where the economic ultimately dominates commercial.

## **Commercial Uses:**

*The commercial uses of forest are*: It can be used as goods like timber, pulp wood, rubber and gums, oils etc. Half of the timber cut every year used for the heating and cooking.  $1-3^{rd}$  of wood is used as building materials,  $1/6^{th}$  of pulp wood is used for making paper. These forest lands are used for mining, agriculture, dams' construction, grazing, etc.

## **Ecological Values**:

A Typical tree produces a value of 30000 rupees in terms of goods but it provides a value of 1000000 rupees as ecologically. They are:

- Production of O<sub>2</sub>: The trees generate O<sub>2</sub> by photosynthesis, which is very important to the life and so called earth lungs.
- 2) **Reduces global warming:** The main green house gas is  $CO_2$ , which is responsible for global warming. This  $CO_2$  is taken by the plant for photosynthesis and thereby acts as sink.



- 3) Wild life habitat: Forests are homes for millions of animals and plants (7 million species are found in forests).
- 4) **Regulation of hydrological cycle**: Trees in forest absorbs water in the ground level and some part of the water is released into atmosphere by transpiration process. There by trees is main cause of clouds which ultimately reaches into earth by rain. So thereby this maintains hydrological cycle.
- 5) Soil conservation: Trees and plants hold the soil firmly, such that it prevents from soil erosion.
- 6) **Reduces pollution**: Trees and plants in forest absorb many toxic gases including CO<sub>2</sub>. They also absorbs noise and their by reduces sound pollution.

## **Over Exploitation of Forest:**

Forests posses potential uses for human and so they have been exploited since early times. Forests are used to meet the demands of human as follows:

- 1) Timber and wood cutting
- 2) Deforestation for a) Road construction
  - b) Mining activities
  - c) Hydro projects (dams)
  - d) Agriculture.

These all leads to destruction of forest. About 1.36 million hectares forests have been destructed (2002). About 78% of forest subjected to grazing. As a result of exploitation, the forest (tropical) areas are present and left with are (in India) 1) Coastal Western Ghats 2) Northeast India. But this is also a serious issue such that we have to stop over exploitation. A recent World Bank study 2004 reported that if we use the opportunities from Indian forest it gives the economy of dollars 222 million to 2 billion in next 15 years. So in order to preserve, the joint forest management is involved. The public also involves in issue.

## **DEFORESTATION:**

The total forest area of world in 1900 was estimated as 7000 million hectares. But reduced to 2890 million ha in 1975 by 2000 it came down to 2300 M ha. Comparatively tropical countries are subjected to deforestation than temperate countries. Forest area in tropical countries is reduced to 40-50%. In the next 60 years it would be reduced to 90%.

# Multidisciplines' and Natural Resources

But in India deforestation is comparatively less; instead FAO (1983) brought 1.44 M ha of land into afforestation. Among the tropical countries India has less deforestation rate. Compared to the population of India, the forest area is less (0.075 ha per capita) our national forest policy is to achieve 33 % forest area, we are far still behind it.

INDIAN FORESTS STATISTICS

Total forest area	: 67,701,000 ha		
Land area	: 22.8%		
(Deforestation) total loss (sin	ice 1990) : 3,762,000 ha		
Annual loss (2000-2005)	: 29,400 ha		
(Different forest areas) natur	al : 32,943,000 ha		
Semi natural	: 31,532,000 ha		
Production plantation	: 1, 053,000 ha		
Plantation	: 3,226,000 ha		
(Classifications)	Public : 98.4%		
	Private: 1.6%		
(User) Production: 21.2%			
	Protection :14.8% Conservation: 21.7%		
(			
Multiple purpose : 42.4%			

✓ Rather than increase in awareness of forest, deforestation is continuing.

- ✓ Each day 32000 ha of forest is disappearing and another 32000 ha is suffering for degradation.
- ✓ During 2000-2005 deforestation is severe (increased by 8.5 % compared to 1990).
- ✓ Primary forest are subjected to loss, instead they are replaced by plantation with less biodiversity.

#### MAJOR CAUSES OF DEFORESTATION:

The following are the reasons of deforestation:

#### 1. Shifting cultivation:

300 million people living on shift cultivators who follow slash and burn culture. So, due to this half of the forests are cleaned annually in Bihar, Madhya Pradesh and Andhra Pradesh.

#### 2. Fuel Requirements:

Due to increasing the demands of the people many forest are subjected to deforestation. During independence 65 million tons were used but in 2001, 300-500 million tons are used.

### 3. Raw Materials-Industries:

Woods are used in preparation of furniture, railway sleepers, plywood, pulpwood are used in making papers etc. Plywood are used for packing of tea leafs in J & K, Assam etc.

#### 4. Development Projects:

For different project works like dams (river valley project), hydro-electric project etc, forests are being removed.

#### 5. Growing Food Needs:

Due to increase in population and to face the demands of people, forests are permanently cleared for agriculture.

#### 6. Over Grazing:

Due to overgrazing by cattle, forests are cleared. Many of the forests are subjected to deforestation.

#### 7. Forest Fires:

Sometimes naturally forest are subjected to fires (or) man may induce it, which causes major loss to forests.

#### Major consequences - Deforestation (problems)

a. Many wildlife species are affected because their habitat (home), forests are subjected to destruction.

- b. Due to loss in forest, biodiversity is also lost.
- c. Hydrological cycle is affected such that it influences rainfall.

# d. Soil erosion

e. Landslides in hill stations

f. Global warming- due to increase in  $CO_2$ .

# CASE STUDIES:

# Himalayas:

Due to deforestation pinus roxburghi, eucalyptus camadulensis etc. have been removed, due to which biological properties, nutrients cycling, original germ plasm is lost and in addition to exotic weeds (unwanted) is involved, finally leads to less fertile. The entire khasi hill of Meghalaya in north east Himalayas Ladakh and parts of kumaon & gashwal are facing serious problems of deforestation.

# Chhoto Nagpur: Disappearance of tea gardens

As this is the hilly region with forest area, normally frequent showering is observed. But due to deforestation rain fall is declined such that tea gardens are vanished.

# Ooty: Warning rainfall

Prior to 1965-84, annual rainfall is much higher but when these are subjected to deforestation, the rainfall is fluctuating and decreased very much.

# Major Activities in the Forest:

**Timber Extraction**: As we cut the trees such as teak etc for the wood purpose, it not only affects those trees but also surrounding trees also affected as they are strongly interlocked with each other. Wood removal in 2005 is estimated at  $1.3 \text{ m}^3$  in India.

**Mining**: To extract minerals & fossils fuels like coal etc. involves removal of forest and digging into earth crust (surface and sub-surface mining). This results in defacing the topography and destruction of land scope in the area. More than 80000 ha of land is subjected to mining activity in India. Mussorie & Dehradun valley is largely affected in the length of about 40 km. Mining activities in Goa since 1961 has destroyed 50000 ha of forests. Jharkhand, Jharia, Raniganj & Singrauli are affected by deforestation due to coal mining. Mining of radioactive minerals affected in the region of kerala, tamilnadu, Karnataka. The rich forests of Western Ghats are also affected by deforestation due to projects such as copper, chromite, bauxite etc...

**Dams**: Big dams & rivers valleys projects are termed as temples of modern India. But any how these are responsible for deforestation. Conflicts over these dams are socio-economic problems related to tribal people and also deforestation. So due to which natural ecological imbalance takes place which leads to floods, droughts, landslides, loss of biodiversity etc. These forests are store house of rich species over millions of years ago and can be lost by single stroke. In India there are more than 1550 large dams (Maharastra-600, Gujarat-250, Madhya Pradesh-130). The highest one is Tehri dam on the river Bhagiratha in uttarakand. The largest in terms of capacity is Bhakra dam on river Sutlej in Himachal Pradesh.

# **Conflicts over Dams**:

The silent valley hydro electric projects in Western Ghats of tropical rain forests created major problems and after that the projects has been suspended.

Sh. Sunderlal Bahughuna faught against damages due to Tehri project.

Medha patkar, Arundhati Roy & Baba Amte raised issues over Sardar Sarover Project.

# CASE STUDIES – Sardar Sarovar Dam:

This dam is situated in the river Narmada and spread over three states of Gujarat, Maharashtra & Madhya Pradesh such that drinking water, irrigation & electricity are shared between them. The total area is 1,44,731 ha of which 56,547 ha is forest land and also 573 villages are submerged by this dam.





Fig. 2.4 Big dams provide clean energy-but have environmental impacts.

For building big dams, large scale devastation of forests takes place which breaks the natural ecological balance of the region. Floods,

Due to submergence of 40,000 ha of forest under Narmada sagar, 13800 ha on sardar sarovar & 2500 ha on omkareshwar created pressure on adjoin forest areas which are rich in wild life. eg: bears, tigers, panthers, bears, wolf, pangolins, jackals, squirrels etc.

As per data from institute of urban affairs, New Delhi, this project led to eventual displacement of more than one million people (which is largest one as per World Bank). Due to these displacements, the tribal people may not adjust easily to the new place not only that their culture beliefs, myths, rituals, festivals, songs dances, etc, are lost. They are very poor and belong to scheduled cast and tribals. These people struggle much as that of survival of the fittest. So the government has to take necessary action against these cases.

#### WATER RESOURCES:

Water is an indispensable natural resource as all life depends on it earth is covered by  $3/4^{\text{th}}$  of water . In animals and plants they contain upto 90%.

#### **Unique Characteristics of Water:**

1. Liquid: It exists as liquid for wild range of temperature that is from 0-100 °C

2. Specific heat: High specific heat it warms up and cools down slowly such that does not affect aquatic life.

3. *Latent heat of vaporization*: It consumes more energy for vaporization and also produces cooling nature after condensation.

4. Universal solvent: Most of the compounds and substances can be dissolved in water and so considered as universal solvent  $O_2$  is also present as dissolved  $O_2$  (DO), due to which aquatic life sustain .

5. *Surface tension*: Water has high surface tension, due to which water is pumped to the tallest trunks of sequoia by the cohesion forces.

#### Water-Use and Over Exploitation:

Life doesn't exist without water. Water performs different functions like nutrient uptake, regulation of temperature, removal of wastes etc. So, human depends on it for every activity. Water is used for drinking, irrigation, transportation, washing, coolant, etc. The climatic conditions also depends on it, as this inter-related with it. Based on usage of water it can be divided into a) water withdrawal (water from the ground or any surface source) b) water consumption (water is taken up but not circulated for reuse). 60% of water withdrawn are evaporated. Due to increase in population the withdrawn water usage is also increased.

On a whole in earth 70 % of withdrawn water is consumed for agriculture. In India- 98 %, in Kuwait- 4 %. For industrial purpose as a whole 25 % of water is used, but in European countries- 70 %, 5 % in undeveloped countries. In USA an average family (4) consumes 1000  $\text{m}^3$  water per year (which is many time compared to most of the developing countries).

#### Water - Precious:

Earth is covered by water 1/3<sup>rd</sup>. But 97% of water is salty and not fit for drinking, only 3% of water is available and that too large amount is locked as polar ice caps and just 0.003% is readily available for use (ground and surface water). Ground water is extensively used for drinking, irrigation & domestic purposes, which led to decrease (rapidly). Due to pollution many of the water bodies becomes unfit for usage. Industries releases effluents into the water bodies without cleaning it.

As per United Nations estimation 2002, 101 billion people do not have safe water to drink, 2.2 billion do not have good sanitation. With increasing in demands water would become shortage by 2024,  $2/3^{rd}$  of population would suffer from this. **Ground Water**:

About 9.86% of fresh water is in the form of ground water. Earlier days ground water is considered as pure water, but due to pollution it is be contaminated. Sediment of rock which holds water is called aquifer. Aquifers are of two types:

1) *Unconfined aquifers*: These are permeable and present in deeper areas and can be recharged by rain water.



Fig. 2.6 The groundwater system. An unconfined aquifer (water table) is formed when water collects over a rock or compact clay. A confined aquifer is formed sandwiched between two layers having very low permeability.

2) *Confined aquifers* : These are not permeable as the sediment of rocks cover them and can only be recharged where the aquifers meet the surface but the problem is source for recharge is some kms away.

## **Effects of Ground Water Usage**:

- 1) Subsidence: If the recharge rate is more when compared to usage rate, then more water is sedimented (ground subsidence) due to which large economic loss happens by submergence of land surface and finally leads to problems like structural damage in buildings etc.
- 2) *Lowering of water table:* Due to continuous usage of water for different purposes, sharp decrease in the water table takes place. If this continues there will be no sufficient water for future uses (agriculture, etc.)
- 3) *Water logging:* If excess irrigation is done with brackish water, it leads to water logging and salinity problems.

#### Surface Water:

The water present in lakes, pond, rivers, and artificial reservoirs are known as surface water. The sources for this surface water are rainfall and snow. This surface water is largely used for irrigation, industrial use, navigation etc.

- $\checkmark$  The economical status of the country depends upon the rivers and water sources.
- ✓ The top 10 water which countries are ice land , Surinam, Guyana, Papua New Guina , Gabon, Solomon islands, Canada ,Norway, panama, brazil.
- ✓ The water poor countries are Kuwait ,Egypt, UAE, Maita, Jordan, Soudi Arabia, Singapore, Maldovia, Israel and oman.

## Floods:

In some countries like India and Bangladesh rain fall does not occur throughout the year rather than 90% of the rainfall fall will be in the few months (June, September). This leads to floods by over flowing of lakes and rivers.

Floods are regular in some parts of India and Bangladesh, which causes economic loss. If the floods are moderate then it can be utilized for cropping of paddy. Floods are severe in the years of 1970, 88, 91 resulted in massive damage and also deaths. In 1970 one million drowned, where as in 1991-140000 died. The reasons for the floods are deforestation, over grazing, mining and rapid industrialization etc. In earlier day's floods are natural disasters but now days this is manmade.

## **Droughts**:

There are about 80 countries which experiences droughts frequently. Drought is due to decrease in rainfall and increase in evaporation. The densely populated areas are more affected to droughts.

## **Reasons :( Man-made Effects)**

This is a metrological phenomenon and occurred due to over grazing, deforestation, mining etc. Now days, India is experiencing the drought condition in higher rates.

The cropping pattern is also another reason. Some crops consume more water in that case the same crop should not be cultivated every time instead we have to rotate it with another crop.

## **Precautions: Remedial measures**

To avoid drought condition mixing of cropping pattern should be followed social forestry and waste land should be utilized based on natural processes.

## CASE STUDY:

In kolar district of Karnataka 11 talukas suffered from the drought condition. It is now known that the reason is due to the tree eucalyptus which is planted before. This tree releases much water in the process of transpiration into the atmosphere.

## **Traditional Water Management**:

In India several villages maintains the power of water supply by some bodies called as local managers. They are named by different in the different areas as follows:

- 1) In south India Neerkath
- 2) In Maharashtra- Havaldars or Jaghyas
- 3) In Ladakh Charpur

All of the above managers will have the knowledge about the requirement of water for the different purposes like drinking, irrigation etc. They operate according to the requirements. These plans are approved by gram sabhas and this is called traditional water management. Even disputes of water between states can be resolved, but these local managers work affective in this case.

#### **Big Dams:-** (Advantages and Disadvantages)

Dams are the symbol of national development. Due to this there are advantages and disadvantages.

### Advantages:

- 1) DAMS place key role in development of social activities.
- 2) People get employment due to projects.
- 3) Economically country can be uplifted.
- 4) Floods can be checked.
- 5) Electricity can be produced by hydroelectric project.
- 6) Water can be supplied for irrigation, fisheries etc.

#### **Disadvantages:**

As there are benefits over the dams, in the same way it also cause severe damage which are categorized into upstream and downstream as follows:

- a) Upstream problems:
- 1) Displacement of tribal people
- 2) Deforestation-loss of biodiversity
- 3) Changes in fisheries
- 4) Siltation and sedimentation of reservoirs
- 5) Loss of land (non forest area)
- 6) Water logging and growth of aquatic weeds
- 7) Diseases are easily spread
- 8) Earth quakes
- 9) Micro climatic changes
- b) Downstream problems:
- 1) Water logging and salinity
- 2) Micro climatic changes
- 3) Flash food
- 4) Reduce water flow and silt deposition in rivers
- 5) Loss of fertile land along the sediments of river
- 6) Diseases are spread

So due to big dams there are many conflicts so now a days we have to turn into the construction of mini projects.

**Conflicts over water:** Indispensability of water and its unequal distribution led to problems among states and countries. Some of the major conflicts are:

#### The Indus water treaty

After the partition of India and Pakistan in 1947, an understanding on the sharing of water of Indus river between two countries became necessary to facilitate the development of water resources of this basin. After prolonged talks between two countries, it was signed for an agreement. According to this, three western rivers (The Jhelum, Chenab and Indus) were allocated to Pakistan and three eastern rivers (The Ravi, Beas and Sutlej) were allocated to India. In addition to these certain restrictions were made:

- India has not been allotted to build storages (reservoirs) on the rivers allocated to Pakistan.
- More restrictions are imposed to India and less for Pakistan, as it is in lower riparian (part).



#### The Cauvery water dispute

Out of 18 major rivers in India, 17 are shared between different states. On all these sharing different conflicts are raised. One of the severe conflicts is between states of Karnataka and Tamilnadu for Cauvery. Karnataka claims that the agreements were made heavily in favour of Tamilnadu. Both states have increasing demands for agriculture and industries. Tamilnadu occupy downstream region and Karnataka is in upstream region and refuses to give water. An agreement was made on 2<sup>nd</sup> june 1990, such that 205 TMCF of water should be maintained in the Mettur dam of Tamilnadu. Based on this agreement made, farmers of delta region of Cauvery belonging to Tamilnadu started cropping complex pattern which includes *SAMBA* and *KURVAI* which needs more water. But after that due to crisis of rain water, they did not release water to Tamilnadu as agreement made but releasing only the excess water that they have.

#### The Sutlej Yamuna dispute

The issue of sharing Ravi-Beas water and Sutlej Yamuna Link (SYL) issue between Punjab and Haryana is being discussed again & again and the case is in Supreme Court. The Supreme Court ordered to Punjab government to complete construction of SYL canal, as case filed by Haryana state. If Punjab constructs the canal of remaining 10 % (90 % of canal was already constructed by Haryana), this would enable to two states to share water from the river as per the award.

#### Water Conflict in the Middle East

Three major rivers are shared in the Middle East. They are Tigiris-Euphrates, The Jordan and The Nile. Ethiopia controls 80 % of the water flow and Sudan too is diverting water of Niles flow. It affects low lying country Egypt, which is irrigating crops along the river Nile and its delta. The river Jordan is shared among Jordan, Syria and Israel. Turkey is planning to build 22 dams on Tigiris-Euphrates for power generation. It affects Syria and Iraq, which is lying in downstream.

The next war in the middle would be fought over water and not for the oil.

#### MINERAL RESOURCES:

Minerals are naturally occurring inorganic crystalline solid having definite physical properties and chemical composition. There are many minerals around the world, some of them are quartz, feldspar, biolite, dolomite, calcite, etc. composing of elements such as O, Fe, Mg, Ca, Al, etc.

#### Uses of Minerals and its Exploitation:

Minerals are used in different sectors like domestic, agricultural and, industrial etc. The main causes are

- 1) Development of industries with machinery
- 2) Production of energy
- 3) Constructions (houses, buildings etc)
- 4) Defense equipments (weapons)
- 5) Transportation (coal tar vehicles)
- 6) Communication (telephone wires, cables, devices)
- 7) Used in medicines (some metals in Ayurveda)
- 8) For preparation of alloys (Steel)
- 9) Agriculture (fertilizers), fungicides (zineb with Zn)
- 10) Jewelry (Au, Ag, Pt and Diamond)

Based on their properties, minerals are basically two types:

1) Non-metallic: eg: graphite, diamomd, quartz, feldspar etc

2) Metallic: eg: bauxite, laterite, haematite, etc.

Human beings has been using metals extensively and so named bronze and iron age. Some elements determine the economy and political power. Iron and steel are used in maximum quantity, followed by Mn, Cu, Cr, Al & Ni

# Multidisciplines' and Natural Resources

# MAJOR RESOURCES OF METALS AND THEIR USES

<i>S. No.</i>	Metal	Major World reserves	Major uses
1.	Al	Australia, Gvinea, Jamaica	packing food items ,transportation, utensil, electronics
2.	Cr	CIS, South Africa	for making high strength steel alloys, textile/tanning
3.	Cu	USA, Canada, CIS, Chile, Zambia	electric and electronic goods, buildings, constructions
4.	Fe	South Africa ,Canada, US, CIS	heavy machinery, steel products for transportation
5.	Pb	North America, USA, CIS	leaded gasoline, paints, communication
6.	Mn	South Africa, CIS, Brazil, Gabon	making high strength & heat resistant steel alloys
7.	Pt	South Africa, CIS	auto mobiles, catalysts, electronics, medicines
8.	Au	South Africa, CIS, Canada	ornaments, medicines, electronics, aero space
9.	Ag	South Africa, Canada, Mexico	photography, jewelry, electronics
10.	Ni	CIS, Canada, New Caledonia	catalyst
NON-	METALS	S AND THEIR USES:	
Non-A	Aetalic M	inorals	Maior Uses

Major Uses
sand & gravel for construction, bricks, painting etc
used for concrete, building stones, used in agriculture for neutralizing acid soils
used in plaster wall board, in agriculture
fertilizers
used in medicine, car battery, industry.

From the above data it is clear that CIS (common wealth of independent states i.e., 12 republics of former USSR), USA, Canada, South Africa & Australia are major sources of most of metallic minerals. Due to this USA become richest & most powerful nation (<200 years). Japan without any reserves, developed technologically, & sustained with its economy.

Classification of minerals: Based on the requirement minerals are classified into two.

a) Critical minerals: Required for the economy of a nation. eg: Fe, Al, Au, Cu, etc.

b) Strategic minerals: Required for defence of a country. eg: Mn, Co, Pt, Cr, etc.

# Some major minerals of India:

## A. Energy generating minerals:

i. Coal & lignite: West Bengal, Jharkhand, Orissa, Madhya Pradesh, Andhra Pradesh.

ii. Uranium (pitch blend (or) ore): Jharkhand, Andhra Pradesh, (Nellore, Nagaland), Rajasthan (Ajmer).

## **B.** Commercial minerals:

- i) Al (bauxite ore): Jharkhand, West Bengal, Maharastra, Madhya Pradesh, Tamil Nadu.
- ii) Fe (haematite & magnetite): Jharkhand, Orissa, Madhya Pradesh, A.P, T.N, Karnataka, Maharastra.

iii) Cu (copper pyrites): Rajasthan (khetri), Bihar, Jharkhand, Karnataka, M.P, W.B, A.P, Uttarakhand.

## **Environment impacts of mineral extraction (or) impacts of mining:**



Fig. 2.9 Large scale devegetation and ecological changes occur due to mining.

Fig. 2.8 Mining activities in hills disturb the ecology of the region (Picture : Garhwal hills, Uttarakhand)

The environmental damage caused by mining activities are as Environmental concern arises from the impacts of extraction & processing of these minerals during mining, smelting, etc. Mining is done to extract minerals from their deposits by *1*.sub-surface mining (or) *2*. Surface mining. Sub surface mining is destructive, dangerous, expensive & includes risks of health hazards, accidents etc. But surface mining can be achieved by

- a. Open pit mining: digging hole & removal of ores. Eg.: Cu, Fe, gravel limestone, sand stone, marble, granite.
- b. *Dredging*: Buckets & draglines are used to scrap the minerals.



c. *Strip mining*: can be achieved bulldozers, powers towels, stripping wheels. Eg.: phosphate rocks.

# Impacts:

The impacts due to mining activities are

## i) Devegetation & defacing of landscape:

Vegetation, bio diversity is lost for the mining activity. Sometimes large scale of deforestation is done which leads to several ecological losses. In addition to this top soil is also removed, which affects the landscape also. Due to this aesthetic value is affected & also it is prone to soil erosion.

## ii) Subsidence of land:

This is mainly due to underground mining. It results in fitting of building, cracks in houses, building of roads, bending of rail tracks & leaking of gas from cracked pipe line leading to serious disasters.

# iii) Ground water contamination:

Ground water is polluted due to mining. 'S' is present in many minerals. During mining 'S' mixes with water & will be converted into  $H_2SO_4$  by microbes. Due to this water becomes acidic & unfit. Some heavy metals also be mixed with ground water which affects health.

# iv) Surface water pollution:

The acid mine drainage contaminates nearby surface stream like lakes, etc. Due to this aquatic life is affected. Sometimes uranium is also contaminated in the water bodies and kills aquatic life. Heavy metals also pollutes the surface water streams, leading to health hazards.

# v) Air pollution:

Due smelting of minerals/ores, the pollutants enters into atmosphere and causes serious environmental health impacts & several health problems. The suspended matter may be SO<sub>2</sub>, soot, As, Cd, Pb, etc.

# vi) Occupational health hazards:

People who works in mines suffers from various respiratory diseases, skin diseases, asbestosis, silicosis, etc, due to continuous exposure to particular matter.

# Indian scenario –problems:

India produces 84 minerals through which, the income is 50,000 crores. Problem in six major mines are listed below.

- i) Jaduguda uranium mine: Jharkhand, Radioactive hazards
- ii) Jharia coal mines: Jharkhand, Fires in underground Relocation of people
- iii) Sukinda Chromite mines: Orissa, Cr (VI)- toxic & carcinogenic and causes serious health problems.
- iv) Kudre mukh iron ore:- Karnataka, River pollution & threat to biodiversity
- v) East coast bauxite mine: Orissa, Land encroachment settlement issue
- vi) North-eastern coal fields: Assam, High 'S' contaminates water

# **Remedial measures:**

Statistical data shows that an average of 30 non-fatal disability accidents / ton of mineral produced. One death / 2.5 tons.

- 1) To minimize adverse impacts, we have to adopt eco friendly mining technology.
- 2) Microbial leaching technique is used. Thiobacillus ferroxidants used for extracting gold in iron sulphide ore. The biological method is helpful in term of economy and as well environment.
- 3) Mined areas are restored by re-vegetation with appropriate plant species.
- 4) Toxic drainage should not be discharged into water bodies.
- 5) Only permitted standard air emissions are allowed to emit from the mining process.

#### CASE STUDIES:

#### Mining & quarrying in Udaipur:

These are about 200 cast mining & quarrying centers in Udaipur of which half of them are illegal. They spread over 1000 hectares. 150 tones of explosives are used / month. Wash-off and mine water are discharged into the nearby water bodies, due to which Ahar river was polluted. People of surrounding areas are forced to use the water (polluted) for irrigation due to scarcity. Due to blasting activity, animals like tiger, lion, deer, hare, fox, wild, cats, birds have disappeared from that area.

#### Mining in sariska tiger reserve in Aravallis:-

Aravalli cover Gujarat, Rajasthan, Haryana & Delhi with an area of 692 km. They are rich in biodiversity in wild life, mineral reserves (quartizite, marble, granite). Due to mining the area is converted into infertile & barren land. They affected the wild life also. So, due to this, Supreme Court on Dec 31st 1991, judged to stop the mining activities nearby the park. In response to that, 400 mining were seized but still illegal process is going on.

## Uranium mining in Nalgonda, A.P:

The uranium preserver of jaduguda mines, Jharkhand supplied till 2004. So to meet the demands of nuclear programme, uranium corporation of India Ltd. (UCIL) found the deposit of uranium in Lombapur & Peddagattu villages of Nalgonda district. A processing unit of about 18 kms is run at Mallapur. But this is 1 km away from human habitation and 10 km away from Nagarjun Sagar dam and 4 km from Akkampalli reservoir, which is Hyderabad's new source of drinking water. Though they provide employment, but it pollute the environment and affect the people generations together. In Jharkhand due to uranium mines massive deaths had occurred and considered as a black historical due to accidents. Which would not be likely to happen in Nalgonda. Due to the proposed mines Yellapuram reserve forest & Rajiv Gandhi tiger sanctuary is also affected.

It is estimated that 20 years of mining would generate about 7.5 million metric tons of radioactive wastes of which 99.9% left behind without cleaning. The villagers are likely o be affected by the radioactive wastes.

#### **FOOD RESOURCES:**

There are large varieties of plants & animals all over the world. Many of them are edible and very few constitute major food for human. They are rice, maize, potato, barley, oats, cassava, sweet potato, sugar cane, pulses, sorghum, millets, fruits, etc. Milk, meat, fish, sea food etc are also consumed by humans. About 1500 million metric tons of rice, wheat, maize are produced each year which is half of the total agricultural crops. 4 billion people of developing countries consume rice & wheat as their staple food.

80% of meat & milk are consumed by more developed nations like North America, Europe, Japan etc. proteinecious diet like fish & sea food are consumed nearly about 70 million metric tons.

Food & agriculture organisation (FAO) of United Nations had stated that an individual should intake 2500 cal/day (normal). They classified categories based on the availability & intake of energy.

2500 cal / day	 Normal individual
<90%	 Under nourished
<80%	 Seriously undernourished

Deficiency of minerals, protein etc (or) lose of nutrition is called malnutrition. Impacts of malnutrition are listed below:

Deficiency	Health effect	No. of cases	Death per year
Proteins	Stunted growth/kwashiorkor, marasmus	750 million/1million	15-20 million
Fe	Anaemia	350 million	0.75-1million
$I_2$	Goitre/cretinism	150/6 million	
Vit A	Blindness	6 million	

#### Problems due to Food- World level:-

During last 50 years world grain production has increased by three times but at the same time population is also enormously increased. Every year 40 million people (50% of children from 1-5 years) die due to under nourishment & malnutrition.

"Every year food problem is killing as many people as were killed by the atomic bomb dropped on Hiroshima during world war-II".

So in order to avoid the above problems, we have to increase food production, control population and food should be equally distributed. World food summit (1996) planned to reduce the no. of under nourished to half by 2015. It states still 410 millions remain under nourished.

#### Problems- Indian scenario:-

Although India is third largest producer of staple crops, still an estimate of 300 million people are under nourished in India. Indian population is 3 times of USA but land available is just half it.

**Impacts of over grazing & agriculture:** Increase in population ultimately led to increase in food production which have the following side effects:

*Impacts due to overgrazing*: Most of the animals are fed on the grazing land for their food. So grazing is a threat to biodiversity also. The impacts are:

#### i) Land degradation:

Vegetation is removed due to over grazing. Soil gets directly exposed due to which the roots cannot be penetrated into deeper layers, which is ultimately linked with moisture content. Organic recycling and humus content is affected. Thus over grazing leads to loss in soil structure, hydraulic conductivity, soil fertility etc.

#### ii) Soil erosion:

Soil is directly exposed after removing the surface vegetation. Then the soil is not binded well, because roots help in binding the soil. Finally this leads to soil erosion with effect of strong wind, rainfall etc.



#### iii) Loss of useful species:

Overgrazing affects composition and regeneration capacity of grass lands. It also affects the nutritional value of grass lands. Due to overgrazing some species are removed in turn other species which has no nutritional value may appear in that area. Eg.:- Cenchurs, Dichanthium, Panium, Heteropogan etc are replaced by Parthnieum, Lanthana, Xanthium etc. In Arunachal Pradesh & Meghalaya thorny brushes, weeds are invaded due to overgrazing. So, total ecosystem will be affected.

#### Impacts due to agriculture:

10 to 20,000 years ago human used to cultivate plants of his own choice. He followed slash and burn culture (shifting cultivation) i.e., he will select the land or forest area for the cultivation and vacate that area and more to another area. In this method all the vegetation has been disturbed. But it is, still present in north east hills of India. The impacts are

#### 1. Traditional agriculture system:

It involves of small plota, naturally available water, organic fertilizer and a mix of crops. It is natural but the yield is low. But still practised by half of the global population. The impacts are.

#### i) Deforestation:-

Due to slash & burn agriculture system forests are cleared for the purpose of agriculture due to which it is subjected for deforestation.

#### ii) Soil erosion:-

If the vegetation is removed, then the soil is not firmly binded together, because absence of trees. It finally leads to soil erosion with effect of rainfall etc.

**iii) Depletion of nutrients:-** Due to slash & burn type the crops absorb nutrients very rapidly from the soil which leads to the infertility of the soil.

## 2. Modern agricultural system:-

Hybrid, single crops, hitech equipments, fertilizers, pesticides, irrigation water are the contents of modern agricultural system. The impacts are:

#### i) High Yielding Varieties (HYV):

To compensate over population, high yielding varieties are grown. The problem with the high yielding varieties are easily attacked by pathogens, the total crops are affected i.e., the resistance power is les due to uniformity.

#### ii) Fertilizers:

The following are the fertilizer related impacts:

#### a) Micronutrient imbalance:

The macro nutrients are C, H, O, P, K, N, S, Ca, Mg (CHOPKNS COFFEE MAY GO). So farmers use these macro nutrients for the best growth leaving behind micro nutrients. This lead to micro nutrient deficient, which affected soil fertility in Punjab & Haryana.

#### **b) Nitrate pollution:**

If the nitrogenous fertilizers are used in excess, they percolate into the soil and mix with the ground water and converts into nitrates (the permissible level in 25 mg/l). If it crosses the permissible level, cause blue baby syndrome (methaemoglobinemia). This disease affects infants mainly. In India, this problem is present in many areas. In countries like Denmark, England, France, Germany & Netherlands also this problem is prevalent.

#### c) Eutrophication (Eu-More / Trophic-Nutrition)

Excessive use of N & P fertilizers creates another problem in the nearby water bodies (lakes & ponds). The excess fertilizers run off to nearby lakes, ponds etc, thereby it causes over nutrients. Due to this over nutrition, the algae species present in water grows very fast and completes their life cycle also fast. After the death of these species they are oxidized i.e., decomposed, which consumes O<sub>2</sub> present in the water as dissolved oxygen (DO). Due to decrease in the DO, the aquatic life is severely affected. The flora and fauna present in that eco system will be perished. This effect is due to eutrophication (rich in nutrients).

#### iii) Pesticides:

Many pesticides are used for the cultivation of crops. There are different levels of pesticides.

The first generation pesticides are S, As, Pb, Hg, etc.

The second generation pesticide is DDT (Dichloro Diphenyl Trichloroethane-discovered –Paul Mueller). In connection with the addition of pesticides for protection of crops, many damages also occurs, which are discussed below:

#### a) Resistance in pests:

Due to continuous usage of pesticides, the pests also develop immunity power against the pesticides. So they are able to survive even after the use of it. About 20 species are known to survive against the pesticides and named as super pests.

#### b) Death of non target organisms:

These insecticides are broad, such that they kill all the organisms including the non target organisms. The non target organisms may be useful for the growth of the crops.

#### c) Biological magnification:

The pesticides which are used in the crop fields will be accumulated, through the series of the food chain (zooplanktons- $\rightarrow$ small fish--- $\rightarrow$ large fish). The accumulated pesticides will be magnified (increased) known as biomagnifications.

#### iv) Water logging:- The excess water with-standard in the ground is called water logging.

#### Causes:

Due to over irrigation of croplands, excess water is accumulated which reaches into the underground and forms continuous column with the underground water table. If the soil is completely drenched with water, there will be no space (or) pores, due to which roots cannot get adequate air for respiration, loss of mechanical strength etc. Punjab and Haryana are more affected due to water logging.

## **Remedy:**

1) Prevention of excess irrigation.

2) Sub surface drainage technology.

3) Growth of trees like eucalyptus which consumes more water.

## v) Salinity:

One –third of total cultivated land is affected due to salinity. In India 7 million hectares re estimated to be salt affected. Salinity is characterized by accumulation of soluble salt like NaCl, Na<sub>2</sub>SO<sub>4</sub>, CaCl<sub>2</sub>, MgCl<sub>2</sub> etc. in soil layers. Due to accumulation of salts, the electrical conductivity will be more than 4 ds/m and P<sup>H</sup> is ~ 8.0. Some of the Na<sub>2</sub>CO<sub>3</sub> & NaHCO<sub>3</sub> are also present.

#### **Causes:**

Excessive irrigation (canal (or) ground water is used, which is not depended on rainfall). In canal & ground water excess salts are present. Salinity causes stunted growth & fewer yield.



1000's of hectares of land are affected by salinity in Punjab & Haryana. Most of the crops cannot tolerate salinity.

## **Remedies:**

- 1) Usage of more quality water for irrigation.
- 2) Underground drainage for flushing of salts slowly.
- 3) Sub surface drainage is in experimental section in CSSRI, Sampla, Haryana (Central Soil Salinity Research Institute). Through this research institute barrier level is to be converted into productive level.

## CASE STUDY:

The first salinity problem is recorded in Haryana in 1858, followed by the effect in Punjab. Several villages in Panipat, Rohtak and Delhi suffered from salinity problems. REH commity explained about the concept of irrigation, drainage and their inter relationships.

The floods of 1947, 50, 52, 54-56 in Punjab resulted in water logging. Introduction of canal system of irrigation in Haryana resulted in water logging and salinity of about 1.2Mha of land. Due to this, crop productivity was affected. Rajasthan was also affected due to INDHIRA GANDHI CANAL PROJECT. So in Western Rajasthan – status changed as water starved waste land to water soaked waste land.

## **ENERGY RESOURCES:**

"Energy is neither be created nor destroyed but can change from one form to another form"-Thermodynamics 1st law. All the activities are associated with different forms of energy. Energy consumption is considered as an index of its development for a nation. Earlier day only heat energy is considered in the form of fire. This is used for cooking & heating. Wind &hydropower is also used. The steam engines replaced wood later by oil. In 1970's due to Iranian revolution oil prices shot up and there is need for alternate sources of energy.

#### Growing energy needs:

For the development of different sectors like agriculture, industry, mining, transportation, lightening, cooling, heating needs energy. With increase in population, the energy needs also increases. Fossil fuels like coal, natural gas, oil are supplying 95% of the energy, but it can lasts for few decades only. The need of energy is increased due to change of our luxurious life style, this includes use of cars, home appliances etc.

Developed countries like USA, Canada, constitute 5% of global population but consumes 1/4<sup>th</sup> of global energy resources. There an average person consumes 300 GJ of energy/year (300 Giga joules=60 Barrels of oil). In contrast to that an average person in poor countries like Bhutan, Nepal consumes 1GJ/year. This shows the relationship between life style & energy. USA, Norway, Switzerland has high GNP (Gross National Product)

with high energy use. While China, India have low GNP with low use of energy. But UAE high GNP & high energy use but development is not up to extent.

**Classification** –**energy resources:** Energy resources are classified into renewable & non-renewable based on regeneration.

1) Renewable resources: (non- conventional ) These energy resources are regenerated & inexhaustible in nature.

E.g.:- wood, solar energy, wind energy, tidal energy, hydro power, biomass energy, geo thermal energy, bio fuels,  $H_2$  etc.

2) Non- renewable resources: These energy resources are not regenerated in a given life span of time and exhaustible in nature. E.g.:-coal, petroleum, natural gas, nuclear fuels (U, Th).

Wood is renewable i.e. can be regenerated within 15-20 years but coal in non renewable because it takes thousands of years to form.

#### 1) Renewable energy resources:

#### a) Solar energy:

Solar energy is ultimate energy where all forms of energy depends on it. The reaction that takes place in sun is nuclear fusion which releases enormous amount of heat & light energy. The solar energy received by earth is  $1.4 \text{ KJ/S/M}^2$ . We use this solar energy for different house hold purposes like drying , clothes, food grains, separation of salt from sea water etc., There are different devices used for harvesting solar energy.

#### i) Solar heat collections:

Passive solar heat collectors-receives energy in nature as such. Eg: Stoves, bricks, glass, etc. Active solar heat collectors are pumped through medium like water (or) air, normally placed on building top.

#### ii) Solar cells:

These are also known as photovoltaic cells (PV Cells). These are made up of semiconducting materials like Si, Ge etc. when solar radiations fall on them, the electrons gets excited and conducts electrons. Si is obtained from silica (or) sand is abundantly available and inexpensive. The potential produced from a PV cell is 0.4 to 0.5 V (4 cm<sup>2</sup> size) & 60 mA current.

A group of solar cells joined in series which produces energy that is sufficient for running irrigation water pump, street lights, traffic signals, water pumps etc. They are also used in satellites for electricity generation. They can be used much in remote areas.

#### iii) Solar cooker:

It consists of black insulated box fixed with reflective mirror perpendicularly. Concave (Or) parabolic reflects much instead of plane mirror. The solar energy falls on mirror and reflects to the food material placed in insulated box. The food cooked in these cookers is nutritious & healthy. Only defect is during rainy season & at night times it is not effective.

#### iv) Solar water heater:

It consists of black insulated box covered with glass. Inside the black box copper wire is connected which gets heated and flows to storage tank fitted on roof top and then supplied.

#### v) Solar power plant:

On large scale, solar energy is utilized on many concave









Fig. 2.17 Solar power plant with thousands of concave solar reflectors.

Fig. 2.18 A wind farm with large number of wind mills in Tamilnadu.

mirrors (thousands) to produce heat and converts water into steam, this steam rotates turbines which ultimately produces electricity. In Gurgaon 50 kW capacity power plant was installed.

# b) Wind energy:

High speed winds have lot of kinetic energy with them. The driving force of wind is sun. A large wind mills are constructed very high, the wind energy rotates the blades. A cluster of wind mills are called wind farms. Due to rotation of the blades of the wind mills, electricity is produced. These are located in hilly areas, coastal regions, open grass lands etc. The speed required to rotate is 15 km/hr. The electricity produced is utilised for water pumps, flour mills, electric generators.

As it does cause any air pollution, it is effective. The only thing is initial installation is high but wind energy is cheap. 10% of world electricity is produced through this method. In our country we can generate 20000 MW, but at present we are generating 1020 MW only. The largest is situated near Kanyakumari, Tamil Nadu which generates 380 mw.

#### c) Hydropower:

In dams water is stored from rivers. The stored water in dams are made to fall from height into the turbines situated (or) fixed at the bottom. The turbines are rotated by which mechanical energy is converted into electrical energy. We can also construct mini hydal project in the hilly areas, but the minimum height required is 10 meters. India has power to generate  $4x10^{11}$  KWH (estimated) but only 11% is utilized. It does not cause any pollution and also renewable, check floods, used for irrigation, navigation etc., but the problems are deforestation, land clearance etc.,



Fig. 2.19 Hydroelectric power (Dam)

#### d) Tidal energy:

Ocean tides are produced due to gravitational forces of sun & moon. This causes high & low tides. Reservoirs are connected with barrages. When high tide comes, the water flows into the barrage of the reservoir due to which turbines are rotated. When the low tides happens, then the water flows from the reservoir of the barrage due to which turbines are rotated. Finally due to rotations, electricity is produced.

These are only few sites in the world where tidal energy is utilised. They are:

1) Bay of Fundy, Canada (17-18 m high tides) capacity to generate 5000 MW.

2) La Rance, France.

3) Gulf of Combay, Gulf of Kutch & the sunderban deltas in India.





Fig. 2.20 A tidal barrage harnesses tidal energy.

Fig. 2.21 Water flow out from the reservoir at low tide (a) and flow into the reservoir at high tide (b). Electricity is generated by the incoming and outgoing tides. Turbine is driven by the power of the sea in both directions.

# e) Ocean thermal energy:

The energy available due to difference in temperature of water in the surface and deeper levels is called ocean thermal energy. The difference required is  $20^{0}$  C for energy conversion. As the surface layers are very hot, liquids like NH<sub>3</sub> is set to boil & these are converted into vapours, these vapours rotates the turbines. The hot vapours are sent to deeper layer where cool temperature is seen which converts vapours into liquids and recycled. This process is for 24 hours.

# Geothermal energy:

The energy associated with hot rocks present inside the earth is called geothermal energy. Below the earth surface, there is high temperature & pressure. This heat sometimes comes naturally in the form of hot water through cracks known as natural geysers. But it does not find place to come out artificially holes are drilled through which steam (or) hot water flushes out which is passed through rotating turbines to produce electricity. In USA & New Zealand, there are several geothermal plants working successfully.

# **Biomass energy:**

Bio mass is the organic matter present in the plants & animals which includes wood, crop residues, cattle dung, manure, sewage, agricultural wastes etc. They are:

# a) Energy plantations:

The plants trap solar energy and convert them into biomass energy. The energy is produced from this by burning directly, fermentation etc.

Eg: sugar cane, sweet, sorghum, sugar beet, cotton wood, popular, potato, cereal etc.

## b) Petro crops:

Some plants rich in hydro carbon can yield oil like substances. These oily materials are refined to get petroleum products & so these plants are known as petro crops. Eg: Euphorbias.

# c) Agricultural & urban wastes biomass:

- i) Some crops residues produce energy by burning. Eg: sugar cane residues, coconut shell, peanut shell, cotton stalks, etc.
- ii) Animal dung wastes from fishery, poultry, human also consists of biomass energy. In Brazil 30% of electricity is obtained from burning bagasse. About 80% of heat obtained from animal dung cakes in the rural areas of our country. The wastes are buried in open furnace called 'chulchas'(efficiency is <8%), but now they are burnt in long chimneys with smokeless.
- iii) The burning of either plant (or) animal residue causes pollution and so it is useful to convert biomass energy into biogas (or) bio fuels.

## **Bio gas:**

Bio gas is a mixture of CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>, H<sub>2</sub>S with more % of CH<sub>4</sub>. Biogas is produced by anaerobic degradation of animal wastes (sometimes plants, wates).

Anaerobic degradation: Degradation in the absence of O<sub>2</sub> by bacteria.

As India has largest cattle population and so can produce bio gas in large quantities with lot of animal wastes and agricultural wastes. India can produce 22,500 mm<sup>3</sup> annually from animal dung alone.

# Characteristics (or) advantages over bio gas:

- i) Clean, non polluting & cheap.
- ii) No storage problem as it supplied directly.
- iii) Residue is rich in fertilizer.
- iv) Anaerobic degradation eliminates health hazards.

There are two types of bio gas plants used. They are





#### The important model used in rurals are

## 1. Floating gas holder type bio gas plant:

This type has well shaped digester tank made up of bricks and placed under the ground. An steel drum is inverted over the digester which has dung slurry. There are inlets & out lets for dung, water & biogas release respectively. As it is the steel drum, it may be corroded and so it has to be maintained and changed regularly.

# 2. Fixed dome type biogas plants:

As earlier ones has problem of corrosion, this type is introduced. Here instead of steel drum, gas holder is made up of cement & bricks and so it is named fixed dome. It has inlet & outlet. The ministry of non-conventional energy sources (MNES) has been promoting the biogas programme in India.

- 1) KVIC model (floating drum type)
- 2) Janta model (fixed dome)
- 3) Deen Bandhu model (fixed)
- 4) Pragathi model(floating)
- 5) Ganesh model (KVIC type but made of bamboo & polythene sheet)
- 6) Ferro cement digester model (KVIC type with Ferro cement digester)

# **Bio fuels:**

As stated earlier biomass can be utilized by fermentation process, the products are ethanol, methanol, etc. Fermentation of molasses yields ethanol. Though it burns clean as LPG but has less calorific value than petrol and used as substitute for kerosene.

**Gasohol** (mixture of ethanol & petrol) is a common fuel in automobiles in Brazil & Zimbabwe. In India it is in trail version and yet to start in Kanpur.

Methanol is also good fuel as it has very low Boling point & also clean & non-polluting. It is obtained from woody plants.

Hydrogen as a fuel:  $H_2$  combines with  $O_2$  to form  $H_2O$  with release of 150 KJ/g

 $H_2$  + ½  $O_2$  -----→  $H_2O$  + 150 KJ

# **Characteristics:**

1) High calorific value

2) Non-polluting fuel

# **Preparation of H<sub>2</sub>:**

It can be prepared by

- a) Thermal dissociation of water at 3000 K. (H<sub>2</sub>O ------  $H_2$  +<sup>1</sup>/<sub>2</sub>O<sub>2</sub>)
- b) Multi step reaction of water with chemicals which do not require high temperature.
- c) Passing electricity into water, which dissociates into  $H_2$  and  $O_2$ .
- d) Photolysis of water in plants in the presence of sunlight produces  $H_2$ .
- >  $H_2$  is highly inflammable and so safe handling is required in storage & transport. As it is light, it can be stored in large amount.
- $\blacktriangleright$  Now-a-days H<sub>2</sub> is used in the form of liquid H<sub>2</sub> in space ships, fuel cells (produces electricity) etc.

# Non- renewable energy sources:

The fossil fuels like coal, petroleum, natural gas are formed from degradation of plant & animal materials which are buried millions of years ago. Once they exhaust it takes much time to regenerate and so called non-renewable energy sources.

## Coal:

Coal was formed before 255-350 million years ago. Plants are buried deeper into the earth, due to course of time with heat & pressure will be converted into coal. There are different forms of coal based on the formation of it. They are

- 1) Peat
- 2) Lignite
- 3) Bituminous (semi, sub & bituminous)
- 4) Anthracite

Of all the forms, anthracite is last stage of decomposition which is also good quality coal with high carbon content. The present coal reserves will be only for 200 years for the present rate of usage but if it increases by 2% then it would be lasts for 65 years only.

- Coal produces CO<sub>2</sub> when burnt. CO<sub>2</sub> is responsible for global warming (green house gas). 'S' is present in coal as impurity and so combustion produces oxides of sulphur which is pollutant.
- India has 5% of world's coal reserves. Major coal fields in India are Raniganj, Jharia, Bokaro, Singarauli, Godavari valley, Jharkhand, Odissa, West Bengal, Madhya Pradesh, Andhra Pradesh & Maharastra. In J&K (Anthracite).

# Petroleum:

It is the major fuel of globe. The 13 countries hold 67% of world's petroleum reserves which are together known as OPEC (Organisation of Petroleum Exporting Countries). 1/4<sup>th</sup> of oil reserves are in Saudi Arabia. It is an estimate that petroleum will be exhausted in 40 years at this present usage rate. It can lasts for another 40 years if undiscovered reserves come into existence. Crude oil is subjected to fractional distillation which gives different fragments consisting uncondensed gas, kerosene, petrol, diesel, oil, paraffin wax, asphalt etc. It is easy for the transport of petroleum & no ash (or) residue is formed like that of coal combustion.

# Liquefied petroleum gas (LPG):

The main component of petroleum is butane with little amount of propane, ethane etc. The petroleum is liquefied under pressure and used as domestic fuel under the name of LPG. LPG is odorless but Ethyl mercapton is mixed which indicates the leakage by foul smelling.

Oil fields in India are located at Digboi (Assam), Gujarat plains, Bombay plains, off shore areas in deltaic coasts of Godavari, Krishna, Kaveri, Mahanadhi.

# Natural gas:

It is mainly composed of  $CH_4$  with trace amount of  $C_2H_6$  &  $C_3H_8$ . It is a fossil fuel formed from decomposing of remains of dead animals & plants. Natural gas is clearest fossil fuel with high calorific value (50 KJ/g) and transported through pipe lines. In world the natural gas deposits are in the level of 80,450g/m<sup>3</sup>. Russia has 40%, Iran 14% followed by USA 7%. In India they are found in Tripura, Jaisalmer, off shore area of Mumbai and Krishna-Godavari delta

# Uses:

- 1. Used as domestic fuel.
- 2. Fuel in thermal power plants- electricity.
- 3. Source of  $H_2$  gas in fertilizer industry.
- 4. Source of carbon in tyre industries.

Natural gas is used in the form of

# a) Compressed Natural Gas (CNG):

It is used as an alternative to petrol in automobiles which pollutes less (auto-rickshaws, buses, etc)

# b) Synthetic Natural Gas (SNG):

It is a mixture of  $CO_2$  &  $H_2$  and produced from vaporization of low grade coal followed by catalytic action into  $CH_4$ .

# Nuclear energy:

It is a powerful energy which can destructs. (nuclear weapons) It is produced by two types of reactions.

#### i) Nuclear fission:

In this large nucleus namely  $U^{235}$  is bombarded with fast moving neutron, which splits the large nucleus into smaller ones ( ${}_{36}K^{92}$ ,  ${}_{56}Ba^{141}$ ) with release of enormous amount of energy.



This is a chain reaction as the neutrons are formed in the above reaction again bombards three more nucleus and so on.



**Nuclear fusion:** In this two small nucleus fuses together to form large nucleus, but it require extremely high temperature (1 billion  $^{\circ}$ C) to fuse. Once they combine they release enormous amount of energy. This reaction takes place in sun.



One Deuterium  $(_1H^2)$  & tritium  $(_1H^3)$  combines to form  $_2He^4$  at 100 million  $^{\circ}C$  with release of huge amount of energy.

#### **Effects (problems) due to nuclear reaction:**

1. Leakage from reactor causes severe pollution.

2. Disposal is a big problem.

Nuclear power in India is not still developed. There are only four nuclear power stations with 2005 MW capacity. They are located in – Tarapur (Maharastra).

Ranapratap Sagar (Rajasthan). Kalpakam (Tamilnadu). Narora (U.P).

# All THE BEST Dr. Dayalan V M G MUNI HEMALATHA P BABITHA