ENVIRONMENTAL EDUCATION

(For 12th Class)

Writers : Mrs. Shruti Shukla
Sh. M.K. Gupta
Mrs. Archna Mahajan
Mrs. Anita Parmar
Dr. Bhupinder Kaur

Artist : Mrs. Kuljit Kaur

Editor & Coordinator : Mrs. Shruti Shukla

Punjab School Education Board

Sahibzada Ajit Singh Nagar

First Edition : 2008..... 60000 Copies

WARNING

1. The Agency-holders shall not add any extra binding with a view to charge extra money for the binding. (Ref. Cl. No. 7 of agreement with Agency-holders).
2. Printing, Publishing, Stocking, Holding or Selling etc., of spurious Text-books qua text-books printed and published by the Punjab School Education Board is a cognizable offence under Indian Penal Code.
   (The textbooks of the Punjab School Education Board are printed on paper carrying water mark of the Board.)

Price : Rs. 55/-

Published by : Secretary, Punjab School Education Board, Vidya Bhavan, Phase-8, Sahibzada Ajit Singh Nagar-160062 & Printed by : Saharanpur Electric Press, Saharanpur
Ph.: 0132-2644343, 2643366

FOREWORD

Ever since its constitution, the Punjab School Education Board has been continuously engaged in framing the syllabi at the school level and in preparing textbooks according to these syllabi.

Punjab School Education Board decided to adopt the syllabus in the subject of 'Environmental Education' prescribed by the N.C.E.R.T. for all the classes at school level.

This book in hand is an outcome of international training programme, organized by SIDA in Sweden and in Ahmedabad. Development of the book for grade XII was a change project of this training programme. The book lays special emphasis on education for sustainable development, agriculture, environmental management and environmental action

The book in hand has been prepared for the students of class XII. A sincere efforts have been made to make this book simple and interesting with the help of fact files and stories. This book has been developed and edited by Ms. Shruti Shukla, Sr. Scientific Officer and team of expert from the field, under the guidance of Director Academic.

The book is offered with the hope that both, the students and teachers will find its study rewarding. Suggestions for further improving the book from the field will be cordially accepted by the board.

Chairman
Punjab School Education Board

About The book

This book has been developed with a mission to simplify the concepts of education for sustainable development (ESD) for the students of class XII.

The endeovour was to simplify th4e micro and macro level concepts of Environment Education as per the syllabus recommended by NCERT. The book has been written as per the latest teaching techniques which include case studies, thought provoking exercises with lucid illustrations.

The project of writing this book was selected and supported by the swedish International Developmental agency (SIDA), Ramboll Naturo AB, Sweden and Centre for Environment Education, India.

The concepts contained in the book were minutely scrutinised by national and international educators such as Tomas Hartz man, Mike Ward, Pernilla, Shivani, Madhvi, Kiran Chhokar, Mamta Pandya, Ajanta.

The project which was a brain child of Prof. Dalbir Singh Dhillon, Chairman, Punjab School Education Board was successfully completed by Mrs. Shruti Shukla, Sr. Scientific Officer and her team with active assistance and co-operation of Sh. K.K. Garg, Dr. Bhupinder Sharma and Mrs. Harsant Mohan.

Chairman
Punjab School Education Board

CONTENTS

CHAPTER 1

BIO-DIVERSITY (PART-1)

1.1 Introduction

Dear Students if you visit any garden, playground or a piece of agriculture land or if you walk along railway line, long highways or a canal passing through your city/ village, you will find a wide variety of plants & animals with your naked eyes. If you collect samples of soil from these regions & examine them under the microscope, you will be able to see different types of microorganisms.

Concept of Biodiversity

All these plants, animals & microorganisms found within an area or ecosystem are referred to as **Biological diversity or Biodiversity**

The term Biodiversity was coined by **Walter G. Rosen** in 1986 & was reintroduced by **E.O. Wilson** in 1994. He made the concept of biodiversity so popular, that today this term is used allover the world by scientists, policy makers & even by General Public.

Man's awareness about biodiversity has grown considerable with the United Nations conference on "Environment" held at Stockholm in June 1972 & another conference that was held in 1992 under the banner of United Nations at Rio-De-Janeiro on "Environment & Development". As a result of this conference by January 2000, more than 170 nations has signed an agreement for conservation & sustainable use of biodiversity.

Values of Biodiversity

Biodiversity is a highly valuable asset for mankind. Biodiversity possesses values of ecological, genetic, economical, scientific, social, cultural, recreational & aesthetic importance.

(a) Ecological value : Biodiversity has provided many environmental services free of cost for the mankind, such as production of oxygen, reduction of carbon dioxide, maintaining the water cycle & protecting the soil.

We know that the survival of one species depends upon many other species in many other ways. Destroying one species can lead to extinction or change in the system.

Dodo and Calvaris- the connection

are usually necessary for the growth of new plants. The fruits we eat have seeds, but most of these seeds will not have the chance to grow into plants. A seed needs to move away, to get better condition for its growth. This movement is called dispersal.

Some fruit seeds are eaten by animals along with the fruit and are dispersed to where the animal moves. The seeds are "planted" where the animal goes to the bathroom. Fleshy fruits, such as strawberries and cherries are well adapted to pass through an animal's digestive system. The hard seed coat is eaten away by enzymes in the process; this helps prepare the seed to grow. We eat strawberry seeds because they are tiny. But we do no eat cherry pits.

A tree called *Calvaris major*, found on the island of Mauritius in the Indian Ocean , is becoming extinct because its seeds need to pass through the stomach of a dodo bird before they germinate. The dodo, a large pigeon-like bird, is extinct. No other bird can disperse the tree's seeds.

Fig. 1.1 Dodo

(b) Genetic Values From time immemorial, farmers are developing better varieties of crops & domestic animals through artificial selection. Today it is being done by selecting useful genes from wild varieties & introducing them to domesticated species. With this type of gene exchange we have been able to produce varieties with better yield & disease resistant varieties. For example rice grown in Asia is protected from four diseases by genes taken from a wild rice species, Oryza nivara from India. For agricultural scientists, biodiversity is a gene bank that can be used to develop better crops.

(c) Economic Values Biological diversity of the biosphere is directly or indirectly is responsible for economy of mankind. The forest dewellers collect all their daily needs like food, clothing, building material, traditional medicines, fruits from the forests. The fisherman totally depends on fish & other edible aquatic animals.

Fig. 1.2 Trees

For example a single tree provides so many products of economic importance, it is a habitat for living things, it also plays a role in conserving soil and water etc.

Value of Services Rendered by Trees- Lakhs of Rupees!

According to a paper presented in the Indian Science Congress held in Varanasi in January 1981, the valuation of a 15 year old tree at rates prevailing at that time was Rs 15.7 lakhs. The bifurcation of this value was arrived at as under:

	Rs.
Oxygen	2,50,000
Control of air pollution	5,00,000
Retention of fertility of Soil	2,50,000
Contribution towards recycling of water & controlling humidity	3,00,000
Provision for shelter to birds and animals	2,50,000
Protein	20,000
Total	**15,70,000**

(d) Scientific Values Biodiversity has different scientific values for different streams of scientists. For example the biotechnologists can exploit the genetic materials of plants & animals to develop high yielding & pest resistant varieties of plants & animals. For example the biotechnologists have produced Bt-Cotton, its yield is much higher & is free from attack of Insects. This year in Punjab the farmers of Malwa region has gained much from this variety of cotton. For the scientists associated with pharmaceutical research, biodiversity is a raw material for many plant & animal based drugs.

Fig. 1.3 Bt-Cotton

(e) Medicinal Values : Many valuable drugs are obtained from plants. Some examples are given below:

- Quinine obtained from yellow cinchona is used for malaria treatment,
- Penicillin, the oldest antibiotic is obtained from pencillium,

- Digitoxin obtained from common foxglove is used in heart diseases.
- Tulsi is used India from time immemorial for the treatment of fever, soar throat etc.

Fig. 1.4 Tulsi

At present about 25% of drugs are derived from 120 species of plants. Besides these thousands of plant species are used as traditional medicines. For Industrialists, biodiversity is a rich source of many commercial products like Honey, wool, rubber, turpentine oil, sandal wood, dyes & waxes etc.

Indigenous system of medicine

Traditional system in India has relied heavily on rich biodiversity of the region. The Ayurvedic system of medicines of the view that there is no plant on the earth which is not a medicine. The story goes that Brahma ordered the sage jivaka to find a tree or a herb which had no medicinal property. Jivaka wandered for 11 years in search of such a plant but could not find one. When he returned home and informed of his failure, much to his surprise, Brahma recognized him as a great physician.

(f) Social Values : The biological diversity is closely linked to social concern of many traditional communities. Such societies are known as 'Ecosystem People'. They value biodiversity as a part of their livelihood. They cultivate many crops at a time in traditional ways which act as an insurance against the failure of one crop.

(g) Cultural Values Through out human history many plants & animals have become a part of our culture. We believe that all forms of life have the right to exist on the earth. From Kashmir to Kanaya Kumari plants like tulsi (Ocimum sanctum), Pipal (Ficus religiosa) are considered sacred & are worshiped by the people. Many birds & snakes are also considered sacred. In Punjab, Haryana & Rajasthan there is a festival called 'Nagpanchmii' is which snakes are worshiped. In our country large number of sacred groves are preserved by tribal people in several states for conserving biodiversity.

In India and other countries also, pockets of forests have traditionally been set aside as they are considered to be abode of a particular God. Local communities have protected these areas. These areas are called sacred groves.

(h) Aesthetic & Recreactional Values :

Fig. 1.5 Dancing Peacock

The biodiversity is a source of beauty, wonder, joy & recreational pleasure for a large number of nature lovers. Observing leaves changing color in autumn, smelling aroma of wild flowers, watching the dance of peacock are some of the pleasurable experiences that cannot be bought with money.

Tourism is another attraction of biodiversity. Tourism may range from holidaying for relaxation, to explore natural or historical sites or religious monuments. Tourism has made the tourists ecologically aware & encourage them to conserve biodiversity. Tourism has also promoted research & environmental impact studies.

Levels of Biodiversity – The Ecologists all over the world are preparing conservation plans for the biodiversity, therefore it has now become a necessity to study different levels of biodiversity.

It may be divided into three categories

(i) Genetic diversity

(ii) Species diversity

(iii) Ecosystems diversity

(i) Genetic diversity The genetic diversity refers to the variation of genes within species, which are passed down the generations. The diversity with in the genes and chromosomes can produce different varieties and different sub species or races.

The genetic diversity enables a population to adapt to its environment & to respond to natural selection. It leads to different varieties of cows, buffaloes and dogs.

(ii) Species diversity : The species diversity refers to the number of species of plants & animals present in a region. Till today scientists have been able to identity 1.8 million species of living organisms on Earth. This is only a fraction of what really exists. Many new species of plants & animals are being identified by researches all over the world. The species diversity can be seen both in natural ecosystem & in agricultural ecosystem. The natural forests will have greater number of species as compare to the man made forests developed by Forest Department through monoculture plantation.

We share our planet with :

5,000	-	viruses
4,700	-	bacteria
40,000	-	Algae
47,000	-	Fungi
17,000	-	Lichens
16,000	-	Bryophytes
13,000	-	Pteridophytes
750	-	Gymnosperms
2,50,000	-	Angiosperms
11,68,600	-	Invertebrates
2,170	-	Protochordates
21,700	-	Fish
5,150	-	Amphibians
5,680	-	Reptiles
10,000	-	Birds
4,600	-	Mammals

As far as the measurement of species diversity is concerned, the number of species per unit area is called species richness. As the area increases the number of species also increases.

(iii) Ecosystem Diversity - You already know that a community & its environment forms an interacting entity called ecosystem. There are different types of eco systems on the earth, such as forests, grass lands, deserts, mountains & aquatic eco system. The aquatic ecosystem includes river, lakes & seas. Each ecosystem has its own complement of interlinked species based on their habitats. An ecosystem can be called "natural" if it is not disturbed by human activities, or "Modified", when it is changed for the use of some other purpose.

Mangroves

Tropical rain forest

Wetland

Grassland

Corals

Fig. 1.6

Another measure of ecosystem diversity is based on the number of habitats/ ecosystem present in a region. The major ecosystems are deserts, savannas, rainforests, wetlands, lakes & oceans, where species live & evolve.

India has a rich ecosystem diversity due to its different biogeographically region with different physical conditions. Almost all the biogeographically zones of the world are present in India.

Balance in nature : Balance means a situation in which different things exist in equal amounts. At the levels of ecology most of the ecosystems are also not in balance because of many reasons.

There are two major forces working in nature to prevent the balance state

(a) External Forces (b) Internal Forces.

(a) External forces - The natural external forces include storms, floods, fire & pests etc. The ecosystems which are not balanced, behave differently to such forces as compare to the systems which are balanced e.g. if a gap is formed in a balanced ecosystem by a landslide or falling of a tree, new plants will grow in the gap and the balance is restored. On the other hand if any external force creates disturbance in an ecosystem which is not in a balance state, it will not return to balanced state but will develop into a new ecosystem e.g. when the land used for agriculture in the Amazon forest is abandoned; it grows into grassland (Savanna) but not a forest.

(b) Internal Forces – The internal forces are the large scale shifting of plates inside the earth. This results in spreading of the rocks of the sea bed & compression of rock strata. Some times the plates are pulled apart due to internal forces as a result the continents drifts from one place to other. Some times these plates knock against each

other and cause the emergence of mountains. The jerking of these plates set off vibrations called earthquake. So the landscape is never static, it changes from day to day.

Both the above mentioned forces disturb the balance in nature & affect the biodiversity.

Cats Parachuted

Some years ago, DDT was sent to Gyanpur by health services to control the mosquitoes which spread malaria. DDT spray not only wiped out mosquitoes but accumulated in the lizards also which ate them. Due to this accumulation lizards become inactive and slow. So cats can easily catch them. With this it was observed that many caterpillars moved into feed on the roofing materials of homes of that village. Then it was realized that previously lizards kept control over population of mosquitoes, which were eaten by cats now. And now, the cats that ate the lizards died due to DDT poisoning. Then rats moved in with a new danger- Plague. Officials sent out emergency calls for cats and cats were sent in by airplane and dropped by parachutes.

Biodiversity for sustenance of mankind

Dear students, now you have understood the concepts of biodiversity & its values. Let us now focus our attention how biodiversity is essential for our sustenance.

What is sustenance: As per the oxford's dictionary- Sustenance means the food & drinks that people, animals plants need to live & stay healthy". In this context the biodiversity act as life supporting system for mankind as it is the source of food, fibers, timber, natural drugs & many other products. It is also responsible for renewing atmospheres oxygen without which no life is possible.

Nature has been very kind to man. Ever Since his appearance on the earth's surface, the natural biodiversity has provided in abundance for the sustenance of mankind. However, the present day man is at the crossword where he has to choose between either of the two paths. One provides a positive approach that he should conserve biodiversity & lead a state of harmony with the nature or the environment. The other path is that of apathy towards its biodiversity. It will lead to pollution, depletion of natural resources, degradation & destruction of soils, forests & fisheries. Such degradation will cause the extinction of many plants & animal species.

Plant & Animal diversity for sustenance of Mankind

During the age of animal husbandry, man started domesticating animals for his protection, hunting, transportation, source of food, milk & other products. The first animal domesticated by man was dog followed by horse. The present day man is using many animal species for his welfare. For example, horse, camel, yak & bullocks are used for transportation & for tilling the soil. Elephants are also used for transportation & they were used to be the part of army. Cattle & Buffalo provide us food in the form of milk & meat. Pig is the most efficient meat breeder. Fish is another rich source of meat. The Honey bees are the source of natural sugar, the honey. In different regions of the world animals like frogs, lizards, snakes, cockroaches & earthworms are used as food.

All early civilizations whose diets are mentioned in different records are based on seed-reproducing cereals such as maize, rice & wheat. The early human beings were using the plants of multiple uses like coconut palm, date palm, mulberry, agaves & hemp etc.

These cereals are the most important constituents of our diet & they make up two third of our carbohydrate requirements. The other cereals which are included in diet include barley, millets, oats, rye & sorghum. Probably man started using oil for lighting & later on for cooking. The main crops grown for oil are cotton, seed coconut, grape seed, mustard, ground nut, sunflower, & oil palm etc.

Fruits & vegetables are also a part of our diet. They are the source of minerals & vitamins. The most useful are vegetables and pulses, which provide more proteins than cereals. Through nitrogen fixation they add nutrients into the soil. The common fruits grown are orange, mango, apple, pineapples & bananas etc. Sugarcane, sugar beet & date palm is grown for obtaining sugar.

Nearly all the present day crop plants were developed in prehistoric times by bringing into cultivation or management of some wild species.

Resource Limitations

Natural resources include land, water, minerals & biological resources. Let us now consider Human resources, which refer to human wisdom, experience, skill & enterprise. If we use human wisdom of experience for the proper & judicious use of natural resources, we will not have to face the resource limitations for a limited space of time. For example due to advanced technology we can get seven times more electric power from one tone of coal than we did in 1900. Similarly we have been able to produce high yielding hen varieties which yield up to 240 eggs per year from 60 eggs per year. Another method of decreasing the limitations of resources is the recycling of the used

resources. For example a discarded ship into Iran sheets or iron rods is much cheaper than obtaining Iron ore from the mines.

Malthus theory states that population when not checked, increase in a geometric ratio, while the foods & other resources increases in arithmetic ratio. Therefore beyond a certain limit use cannot increase our natural resources. Let us now study the limitations of our natural resources.

Limitations of Land Resources : As per the report of geological survey of India 43 percent of India's land surface is covered by plains, 28 percent of its is plateaus & less than 30 percent comprises mountains & hills In all only 62 percent of our total land area is topographically usable. Land is a basic resource for us. It is the foundation on which the entire ecological system rests. It is the living ground for all terrestrial plants & animals. It seems to be a limitless resource, but land is under great pressure due to increase in population. Our landmass, which was occupied by 238 million people in 1901, is now shared by more than 780 million people. Thus you can well realize the magnitude of the pressure on our land resources.

Soil : Soil form the uppermost layer of the land. It is more precious of all resources, because it supports the whole life system, provides food & fodder in the form of vegetation & stores water essential for life. It possesses rich organic & mineral nutrients.

Let us know how we can use the land & soil judiciously so that it may not be exhausted soon.

To meet the demand of food for increasing population, the encroachment of fertile agricultural land for non agricultural purpose should be reduced to the minimum.

The proper use of the soil has two aspects-

(i) To restore productivity of the soil

(ii) To minimize soil erosion.

The overuse of soil, without rest, makes it deficient in essential nutrients & the soil looses its fertility. Rotation of crops & vegetables such as peas & bean can remove the deficiency of nutrients. They add nitrogen to the soil which increases its binding properly as well as productivity. The use of organic fertilizers, bio pesticides

Fig. 1.7 : Soil Erosion

& integrated pest management can also maintain the productivity of the soil. Excessive Irrigation causes water logging of the soil, which consequently looses productivity. In some areas it increases the salinity & alkalinity of the soil. It can be controlled by sealing off all points of leakage, Trickle drip irrigation can also prevent water logging of soil. Planting of salt resistant plants like barley, soya, cotton, spinach & date palm can overcome the problems of salination of the soil.

In hilly areas soil erosion along the slopes can be prevented by constructing networks of drainage ditches filled with stones or bricks so that water flows out through them. This is called Drip Irrigation.

Limitations of Water Resources

Water as you know is the most essential not only for human life, but also for life of animals & plants. Goethe has rightly said **"Everything has originated in the water & is sustained by water".** Approximately 70.8% of the earth's surface is covered with water. Of this, approximate 97.0% is in the oceans. The ocean water has high salt contents & is this not suitable for human consumption. About 2.0 % of water is locked in the glaciers & Ice caps. The remaining 1.0% is available as fresh water for human consumption, Irrigation, generation of hydro electricity & industrial uses.

Fig. 1.8: Save Every Drop of Water

Even today, most of the villages do not have adequate supply of good quality of drinking water. Towns also do not have adequate municipal water supply system. A lot of water is misused or wasted with the continuation rise in population. The demand for usable water is increasing day by day. Thus water must be treated as an economic commodity & used judiciously in the following ways

- The sound & sustained management of water can help us to save water. For example the domestic & municipal water should be recycled.
- It should be made free from germs & poisonous elements.
- The water can be used for irrigation & generation of electricity.
- Growing of algae & water hyacinth in polluted water can serve double purpose. It can clean the water pollutants like phosphates & nitrates that act as nutrients for these plants, these plants can be utilized for the production of biogas.
- Recharging of ground water is another aspect of water management. In rural & urban areas, flood water, storm water & used water can be injected into aquifers through deep pits.
- The excess flood water can be diverted to areas where there is a scarcity of water.

Limitations of Mineral Resources

The main minerals used in all kinds of Industries in our country are coal, Iron, Copper & steel. A major portion of the minerals produced in our country are exported to other countries to earn foreign exchange. However some minerals like uranium. Diamond, non-ferrous alloys & crude oil etc.are imported by our country. The mineral resources with us are in a limited quantity. With the present rate of consumption, minerals will be exhausted within 100-200 years. We should therefore conserve these resources. For example, Scraps of used metals can be recycled or used again; the alloys of magnesium can be used as substituted for copper, lead & tin. We should find substitutes for metals like gold, silver, mercury & platinum etc.

Limitations of Biological Resources

Our biological resources include forests & wild animals. Forests are our treasures, they provides us many commodities like fodder, fiber, fruits, fuel wood, timber, herbal drugs, cosmetics & many other raw materials.

The forests are responsible for recycling of thousands of tons of carbon dioxide & oxygen everyday. The rainforests helps in recycling of water. For example more than 75% of rain that falls on the forests is returned to the atmosphere through plant transpiration & evaporation.

Let us now have a look on the fate of our forest. The satellite photographs taken in 1982 shows, that about 14% of our geographic area was covered by forests. As a result of over utilization of wood & other forest products the forests are fast disappearing. It has greatly disturbed environmental balance. Rain water flows over the naked mountain slopes leading to floods. These floods cause washing away of top soil that reduces the fertility of the soil leading to decreased production of crops.

A great many types of Insects, reptiles, birds & mammals which live in forests, serves as useful biological resources. Man is destroying the habitats of these animals through pollution, commercial logging & reclamation of wetlands. If the wetlands disappear, the migratory birds from the sub polar regions will not be visiting our country for breeding. Building of dams along rivers, destroy forests & its biodiversity. As per the latest information we are losing our forests at the rate of 0.16 million hectare every year. If it continues, a good deal of our country would become a more grassland within a hundred years. The droughts & floods will become a regular feature in India.

It is the time that we should use all of our resources judiciously & should prevent their over consumption & exploitation.

Ecological Role of Biodiversity

It is clear that the sustenance of the ecosystem depends on the diversity of species in an ecosystem. Each species has a particular role to play in the ecosystem, which is known as its **ecological niche**.

As for as the ecological role of biodiversity in different communities is concerned the following points are of utmost importance.

Some communities like tropical rainforest & coral reaf community, show high species diversity with many different types of species living at each tropic level. In other communities like a desert, there may be relatively few species in the entire community.

In communities of variable environment, the individuals of a species with different characteristics make it stable. For example, if in a community all plants of a species have similar water requirements, all of them will suffer from water shortage in any year having scanty rain fall. In such years, there will be fewer yields. On the other hand, if due to genetic variations the different plants of a species require different water requirements. All of them will not have to face environmental stress each year & there will be satisfactory yield every year. Thus it can be concluded that variability within a species is essential for its long term survival.

Exercise

Short Answer Type Questions

1. What do you understand by the word 'Biodiversity'? Give examples?
2. Name some medicinal plants of your locality and their uses?
3. Name the external forces causing imbalance in 'Nature'?
4. What is Resource Limitation?
5. What is ecological role of biodiversity?
6. What kind of plant and animal diversity/species is your village/town/city famous for?

Long answer type questions:

1. What are the values of Biodiversity?
2. Write down the three levels of Ecosystem diversity.
3. What do you understand by the balance in nature and how does it maintained?
4. Name some resources which are limited in nature. How water can be conserved?

5. Find out five medicinal plants of your locality. What are these used to treat? What part of plant is used? There is an increased market for Ayurvedic medicine. Find out five such products in the market.

Question for Critical Thinking :

1. What is the relationship of grass with a lion?
2. How do humans effect the populations of insects on the earth?
3. How extinction of one species affect other species ? Give example?
4. You have already read the story –cat parachuted. Now do this exercise.

Given below is the random sequence of a real life story. Re-write and complete the story.

1. Rats increased
2. Lizards become inactive
3. Caterpillar number went up
4. Health services sent DDT to Gyanpur
5. Mosquitoes wiped out
6. Caterpillars ate grass roofs
7. Cats were parachuted in
8. Cats died
9. Cats caught lizards
10. Plague spread by rats
11. Lizards disappeared
12. Lizards ate mosquitoes and stored DDT

Discussion

Do you think reviving local health traditions(e.g. Tribal and Ayurvedic medicine) will help conserve the biodiversity of India? Why or why not?

CHAPTER 2

BIO-DIVERSITY (PART-II)

2.1 Introduction

In the previous chapter, you have learnt that no living organism can live in isolation. They depend on other living & non living components of their ecosystem. You have also learnt that the essential needs for the existence of life like water, nutrients & energy etc are continuously made available by certain processes going on in nature. In this chapter you will learn interdependence between plants & animals interaction between different species. You will also learn about the economic potential of biodiversity & India as mega diversity nation.

Interdependence between plants & animals

Dear students , you all know that earth is the only planet where life exists & sun is the ultimate source of energy for nearly whole life on the earth. Solar energy is captured by green plants & also some kinds of algae & bacteria which are called **producers**. Through photosynthesis they convert low energy substances like carbon dioxide & water into high energy complex carbohydrates,. Lipids, proteins & other food components.

Herbivores are the animals that feed on different parts of plants or different plants. Deer, duck, sheep, goat are some examples of herbivores. Some human beings who are vegetarian by choice, can also be considered as herbivores

Fig. 2.1 Deer

Fig. 2.2 Carnivorous Wolf

Carnivores feed on herbivore animals. Wolf, tiger, cat, dragonfly & eagles are some examples of carnivores

Rats & most human beings are **omnivores** as they eat both plants & animals.

Plants also provide shelter to many insects, reptiles birds & mammals. They modify the physical environment to make it more suitable for our living. For example they act as wind breakers to storms and they prevent soil erosion, they also help in moderating the temperature. As they absorb large quantity of water, thus they prevent flooding & water logging.

Many insects like honeybees, butterflies & birds like humming bird helps in pollination of flowers. Many birds & mammals help in the dispersal of seeds & fruits. Some animals develop some protecting mechanism to camouflage them from their enemies. For example in many butterflies, the colour of their body & wings resemble the flowers around which they live. The praying mantis looks like a twig and a leaf insect mimics the shape of leaves.

Fig. 2.3 Butter Fly

Certain members of biotic community modify their form, appearance, structure or behavior to resemble with other members or some non-living objects so as to escape predators notice. It is called **mimicry**.

Thus it can be concluded that plants and animals are interdependent on each other for food, space, protection & reproduction. Such interdependence is important for the survival of different species.

Species Interaction

In a community the populations of species interact with each other for protection, obtaining food or to complete some part of their life cycle. The interaction is divided into two categories

(i) Beneficial or positive interaction

(ii) Harmful or Negative interaction

(I) Beneficial or Positve Interaction

In this type of interaction one or both the partners of the interacting species are benefited. Positive interaction can be of three categories

(i) Mutualism (2) Commensalism (3) Proto cooperation

1. Mutualism :

In this case, both the interacting species are strongly benefited. In mutualism , there is a close physical association between the two species, it is called **symbiosis.** There are many examples of mutualism, the most common are :

Lichens are the best example of mutualism. The body of the lichens is made up of algae and fungus. The algae prepares food by phosynthesis whereas the fungus provides minerals & moisture to the algae.

The bacterium **Rhizobium** forms nodules in the roots of legumes. Bacteria get protection & food from the host plant & in return fix atmosphere nitrogen & make it available to the host plant.

Fig. 2.4 Proto-cooperation

2. Commensalism :

It is a relationship between two species in which one is benefited but the other is neither benefited nor harmed. The benefited organisms are called **commensals.** eg. In dense forest ,where sunlight does not reach the ground in sufficient quantity, orchids grow on other tree species. The orchid is benefited by getting sufficient light, but the tree is neither benefited nor harmed.

3. Proto-cooperation

It is a facultative type of mutualism . In this relationship both partners are benefited, but they do not have permanent association It is an occasional relationship e.g. Red-billed ox-pecker sits on the back of black rhinoceros & feeds on the parasites sticking to the skin of the rhinoceros. In this way both the partners are benefited.

Harmful or Negative Interaction :

In this type of interaction either one or both the interacting species are harmed. It is of four types.

(i) Predation (2) Parasitism (3) Competition (4) Amensalism & Antibiosis.

1. Predation

In this type of relationship one species called predator kills another species, the prey of which it feeds. This type of relationship is common among carnivores & herbivores eg, Tiger, the predator kills deer, the prey for his food. There are some carnivorous plants like utricularia, Dionea which feeds on insects. Some Predators act as prey for others eg. Frog is a predator for insect, but is a prey for snakes which is in turn, a prey for eagle or peacock. The predator & prey relationship stabilize the prey & predator population in a community.

2. Parasitism

Fig. 2.5 Cuscuta

In this type of relationship a species smaller in size called **parasite,** lives in or on the larger species called **host.** The parasite obtains food and shelter at the expense of the host.

Parasites are of two types

(i) Ectoparasite (ii) Endoparasite

Fig. 2.6 Ascaris

(i) Ectoparasite : The parasites which live on the body of their host are known as ectoparasites. Plants like cuscuta (Amarbel or Dodder plant), Loranthus, viscum {mistletoe} & Rafflesia are parasites on the flowering plants. Animals like tick, mite, & lice are ectoparasites on skin & hairs of mammals. They are either feed on the tissues or body fluids of their host.

(ii) Endoparasites : These Parasites live in side the body of their host. For example malarial Parasite,. Trypanosoma, Leismania are endoparasites of blood of man. Giardia, Ascaris, Tape Worm, Liver fluke are the endoparasites of our alimentary canal.

(3) Competition : In this type of interaction both the species suffer from adverse effects. Competition usually occurs when there is shortage of food, space or light etc.

Two Types of competition is found in nature (a) Intraspecific Competition (b) Interspecific Competition

(a) Intraspecific Competition : Occurs between the individuals of the same species. This type of competition is very severe because all the members of a speices have similar requirements of food, Shelter & mating & they also have similar adaptations to get their needs.

(b) Interspecific Competition : It is the competition between the individuals of the different species. The competition can be severe if their needs are similar & are not fulfilled. For example grassland is the common feeding ground of herbivores like grassnopper, rabbit, deer etc. There is a little competition among them when plenty of grass is available. But when there ia a short supply of grass, a life & death competition starts among all the competitors. Plants like trees, herbs & shrubs in a forest competes for nutrients, water & sunlight.

(4) Amensalism & Antibiosis : Amansalism is a site specific relationship in which growth of one populations is inhibited & that of the other remain unaffected . For example tall trees inhibit the growth of small plants growing under them as the small plants could not get sufficient light

Antibiosis is a type of amensalism in which all species causes harm to the other species with its toxic secretion. The chemicals or toxin's secreted by them are called allochemicals or allomones. For example Penicillium Notatum, a mould produces, penicillin, which checks the growth of many bacteria. The algae blooms of some blue, green & red algae produce chemicals that are toxic to fishes.

Economic Potential of Biodiversity

A large chunk of human population in India lives in rural & semi rural areas, thus their economy depends on agriculture, forestry, fisheries & large variety of domestic animals. Due to population explosion, it has become more important to realize the economic potential of biodiversity. Let us learn about the economic potential of plants & animals.

Economic potential of Plants

At the tropic level, the plants are the producers, and forms the basis of biotic system. Forests are the rich source of plant bio-diversity which provides us timber, fruits, fodder, fire wood & drugs. The other products which we get from plants are gums, tannin, resins, organic acids, charcoal etc.

Timber : Wood is one of the most economically important commodities at the national & international level. In African & Asian countries where most of the people live near forests depend on fire wood as their chief source of fuel.

The wood based industries like paper industry, plywood production industries & wood carving industries are a source of employment for the local peoples. Now a days, Agro forestry & community forestry are offering opportunities for additional income. Forests are also the source of fodder for the animals.

Food : Plants are the fundamental source of food for man & animals . A noted ecologist N. Meyers estimates that about 85,000 edible wild plants are utilized by humans. Presently, around 200 species have been domesticated as food plants.

Drugs & Medicines : Wild plants have been providing us many useful drugs & medicines. You have already read about it in chapter 1 under sub-heading medicinal value.

Tourism :

Forests are host of animals, birds & insects. These are also a beautiful spots of tourism. Tourism is the major source of foreign exchange. Now a days, eco-tourism is getting more attention due to an increasing interest in biodiversity.

Economic Potential of Animals In addition to plants, many animal species are also of economic importance in the world

- Fish & fish products are of great economic importance in international trade as they provide good quality of proteins.
- Poultry has long been a source of meat & eggs.
- Sheep & Goat are the rich source of milk, meat & wool.
- Donkeys, camels, mules, bulls, horses are used by agriculture & transportation that plays a significant role in the economic activities of man.

INDIA AS MEGA DIVERSITY NATION

India has a rich heritage of biodiversity due to its wide spectrum of ecological conditions varying from tropical rain forests to alpine vegetation & from temperate forests to coastal wetlands. India accounts for a mere 2.4 per cent of the total land area of the world, but it contributes about 8 percent of the known global biodiversity. India is one of the twelve mega-diversity nations of the world. Among the ten biogeographical regions, a large number of species found in these regions are endemic or exclusive to India. About 33 percent of the recorded flowering plants are endemic to India. Similarly 53 percent fresh water fishes, 60 percent amphibians, 36 percent reptiles & 10 percent mammals are our endemic heritage.

Wild Plant Diversity in India

Taxon	Approx. No. of species		% of species in India with reference to World
	World	India	
Bacteria	2700	850	31.48
Algae	1,00,000	23,000	23.00
Fungi	1,50,000	12,500	8.00
Bryophyles	1,60,000	2,564	1.60
Pteriodophytes	>13,030	1,012	8.00
Gymnosperms	720	64	9.00
Total Non-flowering plants	4,06,500	30,000	7.00
Anglosperms	2,50,000	15,000	6.00
Total	**6,56,500**	**45,000**	**7.00**

Source : MoEF, 1998

Domesticated Plant Diversity in India

Crops	66 species +320 sp of wild originated relatives in India
Fruits	104 spp.
Species	21 spp.
Pulses & vegetables	55 spp.
Fibre	24 spp.
Oil seeds	12 spp.
Crops with rich diversity	Rice (50.000 –60.000 varieties), wheat sugarcane, legumes, sesame, egg plant citrus, cardamom
	Source : MoEF, 1998

Wild Animal Diversity in India

Taxon	**Approx. No. of species**		**% of species in India with reference to World**
	World	**India**	
Mammals	4,232	372	8.79
Birds	9,026	1,228	13.61
Reptiles & Amphbians	10520	428204	6.00
Fish	21,723	2,546	11.72
Insects	9,52,116	57,525	6.04
Misc. Invertebrates	2,11,994	15,033	7.10
Total	**12,11,584**	**77,000**	**8.4**
			Source : MoEF, 1998

Domesticated Animal Diversity in India

Crops	27 breeds (includes 8 breeds of buffaloes- entire range)
Sheep	24 breeds
Goats	22 breeds
Camels	8 breeds
Horses	6 breeds
Donkeys	2 breeds
Poultry	18 types

Source : MoEF, 1998

Norman major developed the **hot spot** concept in 1988. The hot spots are the richest reservoirs of biodiversity on earth. Among the 25 hot spots of the world, two i.e. western Ghaats & Eastern Himalayas are found in India. The western ghats are extended into Sri Lanka & Eastern Himalayas is extended into Burma & Bhutan. These areas are rich in flowering plants, sallow tailed butterflies, amphibians, reptiles & some mammals.

Flora d Fauna of defferent Indian Biogeographical regions

You have read above that India is divided into ten biogeographical regions. This classification was developed in 1988 by Rodgers & Panwar at the wild life Institute of India.

1. The trans-Himalayas
2. The Himalayas
3. The Indian Desert Region (Thar Desert)
4. The Semi- Arid Region :
5. The Western Ghats (Tropical Evergreen Forest)
6. The Deccan Peninsula
7. The Gangetic Plain (The most fertile area in the world)
8. North-East India Region.
9. The Islands (Andaman & Nicobar Islands in the Bay of Bengal & the Lakshadweeps in the Arabian Sea)
10. The coasts

Fig. 2.7 Ten bio-geographical regions of India

Punjab

The state of Punjab can be divided into three agroclimatic zones.

- Zone-I, which is sub-mountainous, comprises districts Gurdaspur, Hoshiarpur & Ropar
- Zone-II, which forms the central alluvial plains, comprises districts Amritsar, Tarantaran, Kapurthala, Jalandhar, Nawanshahr, Ludhiana, Fatehgarh Sahib, Patiala, Sangrur & Mohali
- Zone-III, which is south-western dry zone, comprises districts Bathinda, Faridkot, Ferozpur, Mansa, Mogo, Muktsar & Barnala.

The state has 85% area under agriculture and about 6% area under forests. Thus, the cropland ecosystem ecosystem is the dominant ecosystem in the state. The state was known to harbour great genetic variability amongst crop plants. However, over the years, the change in cropping pattern has resulted in emphasis on mono-culture farming resulting in a loss of domesticated biodiversity.

Amongst the forest ecosystem, the major forest areas in the state lie in the Shivaliks. These are rich in flora & fauna. Some forests also exist in Birs (in districts Patiala and Sangrur), Rakhs (in districts Amritsar, Kapurthala and Ferozepur) and in Mand areas.

Other bio-diversity rich areas in the state are the wellands. The state has three internationally important wetland Harike, Ropar & Kanjil. They are a haven for migratory bires. Many rare species of birds visit these areas during winter. The wetlands also supporta large diversity of fish and other flora & fauna.

Though large-scale bio-diversity studies have not been carried out in the state, however, a large number of for a & fauna has been recorded from the forest areas and wetlands.

Wild Plant Diversity in Punjab

Taxon	Approx. No. of species	% of species in Punjab with reference to India
Algae	**397**	5.2
Fungi	**498**	7.5
Lichens	21	-
Bryophytes	34	1.3
Pteriodophytes	48	4.7
Gymnosperms	21	32.8 (including cultivated)
Angiosperms	1939	12.9

Source : Tiwana et.al. 2005

Wild Animal Diversity in Punjab

Taxon	Approx. No. of species	% of species in Punjab with reference to India
Protozoa	84	3.3%
Portfera	Not Available	
Coelentera	Not Available	-
Platyheiminthes	41	2.9%
Nematoda	157	1.8%
Annelida	34	3.6%
Mullusca	1147	1.8%
Arthropoda	85	1.7%
Mollusca	Not found in Punjab	-
Verterbrate Diversity		
Pisces	112	5.2%
Amphibia	15	6.7%
Reptilia	35	6.6%
Aves	442	37%
Mammalia	43	7.7%

Source : Tiwana et.al. 2005

DomesticatedAnimal Diversity in Punjab

Demostic Animal	Existing breeds	Indigenous breeds	Threatened breeds
Cattle breeds	Jersy, Holstein cross-breed	Harfana, Sahiwal	Sahiwal
Sheep	Lohi, Nali, Desi, Cross bred	Lohi, Nali, Desi	Lohi
Horse	Bhutia, Thorough Bred (for stud farm), Grey Sindhi, Marwari, Kalhawari	Bhutia	Bhutia, Grey Sindhi
Buffalo	Nili ravi, Murrah, Murrah graded	Murrah, Nili- Ravi	Nili- Ravi
Goat	Desi, Beetal	Beetal	Beetal
Poultry	White leg horn, Desi	Punjab Brown	Beetal

Source : : MoEF, 1998 & Deptt of Animal Husbandry, GoP 2007

The Punjab Biodiversity Board

The Punjab Biodiversity Board was established in December 2004 as a statutory body under the Biological Diversity Act to conserve the state's biodiversity and regulate commercial utilization of biological resources by industrial and commercial entitles so that local communuties get an adequate share of economic benefit arising from the use of these resource. Commercial bodies harvesting natural resources from an area for economic benefit would be required to take clearance from the Punjab Biodiversity Board and deposit a collection fee. The board is required to set up Biodiversity Management Committees at village & town level to help it in this activity.

The Biodiversity Management Committees would keep a record of the natural resources and its utilization in their areas. They would comprise members of the local body, school teachers, cultivators, medical practitioners and all other stakeholders whose livelihood depends upon local biological resources, and would play an important role in implementation of the Biological Diversity Act at the field level. The Biodiversity Management Committees would also be entrusted to prepare peoples' Biodiversity Registers. Information about the local flora & fauna (both, wild & domesticated), its use and associated traditional knowledge will be recorded in these registers.

This will ensure that the natural resources of our country are protected with the active participation of people.

EXERCISE

Short Answer Type Questions

1. Identify two herbivores,two carnivores and two omnivores of your locality
2. Name two ecto and endoparasites .
3. How many bio-geographical regions have been identified in India?
4. What is proto-cooperation?
5. Name two hot spots which are present in India.

Long answer type questions

1. Write about Punjab biodiversity board.
2. What do you know about animal diversity in Punjab?
3. Describe the economic potential of animals.
4. Which is biologically the most diverse place you have visited? Why do you rate it so?

Questions for critical thinking

Do you think the different types of plants and animals that you noticed in your locality have a role in nature?

Discussion

You observe more biodiversity at places where there is less human intervention or where there is more human intervention. Discuss.

CHAPTER 3
BIO-DIVERSITY (PART-III)

3.1 Introduction

Extinction or loss of biodiversity is a natural process. It takes place due to change in environmental conditions. In the long geological history of the earth many species have disappeared & new ones, which are more adapted to the environment, have taken their place. Mass extinction has been another source of loss of biodiversity. The rate of loss of species by these two methods is very slow.

In recent times, however, an increasing number of species are disappearing from the face of the earth due to human activities. This man made loss of biodiversity is called **Anthropogenic extinction.** At present the rate of extinction is 1000-10000 times faster than natural rate. It is estimated that 25% of the world's species will be lost within the next twenty to thirty years & by the end of 21st century this loss will go upto 50%.

Causes of loss of biodiversity

The main anthropogenic causes of loss of biodiversity are

Habitat loss & Fragmentation: Loss of habitats & its fragmentations is the major cause of loss of biodiversity.

The main causes of habitat loss are agricultural activities, development of human colonies, industries & other infrastructures. Habitat loss is the result of population explosion. For example Amazon rain forests are being cut for cultivating Soya beans or for conversion to grassland for raising beef cattle.

Fig. 3.1 Cutting of forests

Fragmentation or degradation of the habitat is a process where a large continuous area of habitat is divided into many fragments. It is the result of development of canals, roads, railway lines, dams etc. Due to fragmentation many species of mammals & birds which require large territories are badly affected & their population has decreased drastically.

Over Exploitation

Fig. 3.2 Tasmanian Wolf

Man has always depended on nature for food & shelter, but due to over-population, human 'needs' are turned to 'greeds', which leads to over-exploitation of natural resources. Many species like Dodo, (Mauritius), Zebra (Africa), Tasmanian wolf (Australia) have become extinct due to over killing by humans. At present the over harvesting of marine fishes poses a serious threat to many species of marine fish.

Fig. 3.3 Falcon

Pollution : Environmental pollution may reduce & eliminate populations of many species. The common causes of pollution are pesticides, industrial effluents, and massive release of radiations or spillover of oil in sea. For e.g. fish eating birds like Falcon have already declined due to overuse of pesticides. The wide spread deaths of thousands of seals on both sides of Atlantic Ocean are linked to accumulation of toxic chemicals in the sea. Lead poisoning is another cause of death of ducks, swans & cranes as they take the spent shotgun pellets that fall into lakes & ponds where they live.

Introduction of Exotic Species

The new species introduced into habitats where they are not native are called **exotic or alien** species. These species cut off the food chains of native species that leads to the extinction of native species. Introduction of exotic species have large impact on loss of biodiversity in Island ecosystem. For example, **Nile perch,** an exotic fish introduced into Lake Victoria in East Africa has led to the extinction of many native species .

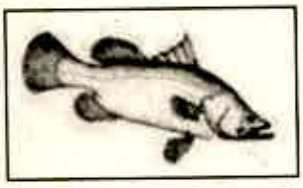


Fig. 3.4 Nile perch

Fig. 3.5 Parthenium

Congress grass (Parthenium) an exotic plant species have posed a threat to our native species.

Similarly Eucalyptus (Safeda) is replacing native tree species because they are fast growing and commercially valuable.

National and International Trade

Trading of many wild life products such as perfumes, cosmetics, museum specimens, fur, bones, tusks & horns etc. has led to decline population of many species like musk dear, one horned rhinoceros, tiger, elephant, deer etc.

Fig. 3.6 Fur and Bones of Tiger

Fig. 3.7 Elephants are killed for their Tusks

Concept of Threatend species :

The JUCN (International Union of Conservation of Nature & Natural Resources) has maintained a "Red Data Book". It is a catalogue of plants & animals facing the risk of extinction. These categories are :

(i) **Endangered species (E)** It includes those species whose number have been reduced to critical level or whose habitats have been so drastically reduced that they are in the immediate danger of extinction. For example Tiger, tortoise, vulture, lion, golden monkey, red fox, red panda etc.

Fig. 3.8 Endangered Species: Tiger, Lion, Golden Monkey, Red Fox, Red Panda

(ii) **Vulnerable species V** - These are the species whose populations have been depleted & their ultimate security is not assured. For example, Great Indian Bustard, Wild Ass etc.

Fig. 3.9 Wild Ass, Vulnerable Species

(iii) **Rare species (R):** Those species whose populations are still abundant. They are usually localized in restricted geographical areas. The example is whooping crane.

Fig. 3.10 Whooping Crane, Rare species

The term 'threatened' is used for any of the above three categories.

Status of Threatened Species

As per the Red list published in the year 2000, there are 5,485 animal species & 5,611 plant species which are considered to be threatened species throughout the world. As per this list, in India, there are 224 threatened plant species & 215 threatened animal species.

Fig. 3.11 Bramha Kamal – an endangered species

As far as plant species are concerned, they are becoming increasingly threatened due to changes in their habitats induced by human beings in the name of development. Apart from major trees, shrubs & climbers, there are thousands of small herbs, which are greatly threatened by habitat loss. Several orchids are also under threat. Many plants are threatened due to over-use in medicinal products or cosmetics. Bramha Kamal is one endangered species of plant.

As far as animal species are concerned, there are many species of threatened primates. Some of these are a rare **Lion tailed macaque** (monkey) found only in few forests of Southern Western Ghats. The **pig tailed macaque** inhabits the dense evergreen forests of North-East India. The rare **Golden langur** lives among the banks of Manas river in Assam. The **Capped langur** is a rare species of North-East India. The rare black **Nilgiri langur** lives in Southern Western Ghats. The only ape found in India is the **Hoolock Gibbon** is found in Assam forests. It is hunted by local tribe for flesh & for sale.

Lion Tailed Macaque

Pig Tailed Macaque

Golden Langur

Capped Langur

Hoolock Gibbon

Fig. 3.12 Some Endangered Primates

Number of Lions and Tigers is also declining day by day in India due to poaching.

Project tiger was launched in 1973.It has helped not only to protect the tiger, but many other wild inhabitants of India's tiger sanctuaries as well.

Fig. 3.13 Rosy Pelican, A threatened bird species

Some theatened species of birds are Great Indian Bustard, Rosy Pelican, Pink Headed Duck and Black – necked crane

Fig. 3.14 The Golden Toad, an endangered amphibian

It is now believed that global warming & high-energy radiations are seriously affecting many amphibian species in some areas. The Golden Toad is critically endangered these days

Many fresh water fish are becoming rare due to pollution of water bodies in which they live. Many marine fishes are threatened due to over-harvesting

Biodiversity loss & consequences

The state's natural ecosystem are, however, facing problems of overexploitation, habitat degradation and pollution due to increased urbanization & industrialization, population growth, deforestation & desertification, etc. Some of the examples of loss in biodiversity in Punjab include :

Decrease in number of mammalian species : Data indicates that 87 species of mammals existed in Punjab during the beginning of this century but only 43 species. Have been recorded in present day Punjab by Lamba (1984) whereas only 38 species Have been recorded by Prasad (1984). Further, ZSI has reported only 19 species from the Shivalik area.

Decrease in vulture population : Another example is the recent decline of Vulture population in the state which is attributed to loss of reproductive capacity and thinning of egg. Shells due to higher pesticide intake by these birds as well as organ failure due to presence of drug Diclofenac in carcasses (newspaper reports). Bombay Natural Society has initiated a study at Pinjore, Haryana in this respect. The results of the same would be applicable to Punjab also.

Loss of plant varieties : A stark example is the loss of a large number of desi of mango (especially varieties of 'tapka') from Districts Hoshiarpur, Nawanshahar, Gurdaspur, etc.

Loss of native species : In an effort to introduce blue revolution in the state, exotic fish species have been introduced at the cost of native species. Many exotic species, like, *Cyprinus carpio, Catla catla, Ctenophanyngodon idella,* etc. have been introduced as a result of which several native species (especially *Tor putitora, Labeo rohita, Labeo calbasu, Cirrhinus mrigala, Wallago attu & Aorichthys seenghala* which were common native fishes of Punjab) have been lost/threatened.

Similarly, in an effort to bring the white revolution in the state, high yielding breeds of cattle have been promoted over native, locally adapted breeds. Thus, the population of desi breeds has dwindled. This has played a negative role in conservation of farm animals. Murrah & Nili Ravi breeds of buffaloes, Hariana & Sahiwal breeds of Cattle and Beetal breed of goat are threatened now.

Conservation of Biodiversity

It is clear now that our biodiversity is depleting day by day due to various reasons. It becomes our moral duty to hand over our planet in a good condition to our future generations as it was handed over to us by our ancestors. Thus it is necessary for every human being to play his role in conserving the biodiversity.

Conservation of biodiversity includes protection of genes, species, population & habitats in reduced space & under increased pressure of human activities. Various organizations associated with this noble cause are

IUCN (International Union for the conservation of Nature & Natural resources);

UNEP (United Nations Environment Programme);

WRI (World Resources Institute) &

WWF (World Wide Fund for Nature)

The two strategies are being followed for the conservation of biodiversity, **in- situ** (on site) & **ex-situ** (offsite) strategies

In-situ Strategies :

It refers to the preservation of the genetic resources within their natural environment. It is being done by setting aside adequate wild areas as **protected areas.** These areas consist of **Biosphere Reserves, National Parks & Wild Life Sanctuaries.** Such a network will be able to preserve the total biodiversity of that region.

Biosphere Reserves: These are special categories of protected areas in which local people of the area are an integral part of the system. Till May 2002, there are 13 biosphere reserve in India. A biosphere reserve is divided into three zones:

- The central zone is called **Core Zone or Natural Zone**. In this zone no human activity is allowed. It is kept undisturbed & is a legally protected area.
- The core zone is surrounded by **Buffer Zone.** In this zone the research & educational activities are allowed.
- The **Transitional Zone** is the outer most zone. It is an area of active cooperation between the local people & reserve management. In this zone the activities like settlement, cropping, forestry & recreation are allowed.

National Parks : These are the protected areas exclusively kept aside for the **protection of highly and endangered species of wild plants & animals in their natural habitats.** These species are found nowhere else in the world. At present there are **89** National Parks in India.

Some of them are :

- **The Great Himalayan National Park** is one of the last homes of Snow Leopard;
- **Kaziranga National Park of Assam** is famous for One Horned Rhino;
- **Sundarban National Park** of West Bengal is famous for Bengal Tiger;
- **Kanha National Park** of Mal`dhya Pradesh offer a wonderful opportunity to conserve Wild Tiger;
- **Desert National Park** in Thar Desert is for the protection of the Great Indian Bustard (a bird), Blackbucks, Nilgai & Chinkara (Mammals);
- **The Marine National Park** in Gujarat protects Coral Reefs & Mollusks etc.

Sanctuaries : They are the protected areas where wild animals takes refuge without being hunted. Here, unlike National Parks limited activities like harvesting of timber, collection of forest products & tilling of land is allowed. There are 500 sanctuaries in India.

Some famous sanctuaries are;

The Dachigam sanctuary is famous for rare Hangul or Kashmir Stag.

The Manas Sanctuary has rare golden langur & very rare Pigmy hog.

Bharatpur is one of the famous water bird sanctuary in the world.

Ranthambore is well known for observing tigers.

Gir sanctuary protects the lost population of the Asiatic lion.

The sanctuaries of Western Ghats have many highly threatened species of Malabar giant squirrels, flying squirrels, many varieties of hill birds, several species of amphibiions, reptiles & Insects.

Bandipur, Mudumalai, Wynad & Bhadra sanctuaries of Nilgiri hills are famous for elephants.

Ex-situ Strategies : There are certain situations in which one or more endangered species are at the verge of extinction and cannot be conserved in their natural habitats. In such cases the species are conserved **outside** their natural habitats in carefully controlled situations such as botanical gardens for plants & zoology parks for animals.

There is another method of conserving plants by preserving their germplasm in a gene bank so that it can be used if needed in future.

Conservation of plants in botanical gardens is already in practice.

Many big laboratories conduct ex-situ collection of microbes like bacteria, virus, algae & fungi. They are maintained in culture conditions.

Like botanical gardens there are more than 800 professionally managed zoos throughout the world with more than 3000 species of amphibians, reptiles, birds & mammals Many modern zoos provide visitors with a visual experience of seeking wild animals at close quarter & they have their own captive breeding programmes. For example all three species are conserved ex-situ in Madras Crocodile Zoo.

Mitigating Wildlife-People Conflict

Mitigation means lessening the negative impact of natural hazards. Here mitigation can be defined as sustained action taken to reduce the conflict between wild animals & human life, his crops & domestic animals. The first question that comes in our mind is why there is conflict between human beings & wild animals or what are the causes of this conflict.

Causes of conflict between human beings & wild animals

From the time when human started domesticating animals, especially live stock & became farmer, his conflict with large carnivores & herbivores started. With the passage of time due to increase in human population, the natural habitats for wild animals has reduced drastically & the conflict between the two has reached to such a stage that many of the threatened species are at verge of extinction.

Let us consider some specific examples :

Tiger is placed under critically endangered category of wild animals. The government of India has started "Project Tiger" to increase its population, but it was reported that more than 450 people have been killed by tigers since 1978 in Dudhwa (U.P). Dr R.L Singh, The Director of Project Tiger has admitted that nearly 4,050 human beings become victims of tigers annually. Cattle lifting & killing is another phenomena. That is why the people of

Sunderbans, Ranthambhor & other reserves are always afraid of these animal terrorists. At some places the people capture & kill tigers in order to prevent similar mis happenings in future.

Elephant being largest land animal needs a very large habitat as compared to other land animals. A single elephant eats up to 450 kg of food per day. As it is a messy eater, it uproots & scatters as much as is eaten. A single elephant can destroy a hectare of crops in a short span of time. Thus, the small farmer living around the habitats of elephants lose his entire livelihood overnight from an elephant raid. People are often injured & killed by elephants each year. It is recorded that more than 100 people are killed by elephants each year. Depletion in quantity of fodder have changed the food habits of elephants. The elephants when raid crops are attacked by farmers. Many other examples can be quoted through out the world.

Mitigation efforts: As most intelligent & responsive inhabitant of the earth, we must evolve strategies to decrease this conflict so that a balance may be maintained. The mitigation efforts can be:

1. The corridors should be created between the forests. In such corridors there should be no human habitation or agricultural activities so that wild animals can move from one forest to another freely.
2. The crop protection initiatives should be taken to reduce the crop loss. For examples only such crops should be grown which animals do not like or the chilly & Tabacco based deterrents should be used to keep the animals out of fields.
3. When the population of the animals of a particular species has reached a maximum number in a particular region, they must be shifted to other regions.
4. The dogs should be trained so that they protect sheep & goats from the attack of wild animals.
5. The villagers who lose their livestock by the attack of wild animals must be suitably compensated.
6. The communities living in & around the forest should be provided alternative methods of earning to reduce their dependence on forest products.
7. The local people must be educated regarding the importance of wild life.

The effective mitigation programme must ensure effective partnership between the Government, Scientists, private sector, NGOs & the local community or population.

EXERCISE

Short Answer Type Questions:

1. What do you understand by 'Anthropogenic Extinction'?
2. What is meant by 'Fragmentation' of habitat?
3. Name two species which are extinct now due to 'over killing'?
4. What is 'Project Tiger'?
5. Define *ex-situ* conservation.

Long Answer Type Questions:

1. What are the causes of loss of biodiversity?
2. Mention different categories of threatened species with examples ?
3. How 'In-situ' strategies help in conserving the biodiversity?
4. What are the reasons of wildlife-people conflict? How it can be mitigated?
5. What are the limitations of in-situ and ex-situ conservation strategies?

Questions for critical thinking:

Ranthambhore in Rajasthan is a green Island in degraded surroundings. Tiger sighting there is rare these days. According to available data there had been 44 tigers in 1981 which are reduced to 17 now. Villagers were allowed to use natural resources earlier in 'buffer zone' (the area where people can use various resources). Due to this, buffer zone experienced tremendous pressure and is severely degraded. Also, poaching has been a cause for serious concern. Recently a kingpin of the tiger-poaching racket was arrested.

Ranthambhore is a National Park now. So, it has become attraction for Indian and foreign tourists. Inaccessible area of Ranthambhore is very much accessible now. Before turning it to National Park, native people were not consulted at all. They cannot utilize natural resources from their native area now and no alternatives were provided to them. Because of this, mistrust between the park authorities and the native people has increased which further enhanced the tiger-people conflict.

What do you think about the following:

1. Whether native people who were using the local resources for generations, should be allowed to use them continuously?
2. "Consent of native peoples was necessary before converting Ranthambore into 'National Park'."

Discussion

'Vultures are at the verge of extinction'. Discuss the issue.

CHAPTER 4

ENVIRONMENTAL MANAGEMENT

(PART-I)

Introduction

We all know that environmental degradation is increasingly undermining our lives. Now, when we have entered into 21st century, we are confronted with two conflicting scenarios for the future of mankind. On the one hand, there are possibilities of a bright future with space shuttles, information technology, genetic engineering and many other developments in science and technology. On the other hand, day by day increasing population is going to face many problems like decreased resources and pollution.

The problem of pollution and degradation of environmental resources can be solved only by understanding of their causes and effects properly. In order to protect our environment we must learn its management.

Environmental Management

(**man·age·ment** The act, manner, or practice of managing; handling, supervision, or control)

As the meaning suggest, environmental management includes almost all the aspects of environment. It starts with the identification of an environmental problem and finds its solution. Thus, it includes

- Prevention and control measures,
- Policy making and
- Environmental monitoring.

Environmental management is the most important yet most neglected discipline. It is closely linked with national development and economic growth. Infact, today we are standing at the crossroads in choosing between environment and development.

The industrial countries have achieved a decent standards of living and this achievement has resulted in enormous environmental damage. On the other hand, the developing countries are still struggling to attain a minimum standard of living, though they are also contributing toward environmental damage.

Thus both the industrialized countries and under developed and developing countries, pollute and damage the environment; former out of **greed and luxury**, and the later out of **need**.

The basic question that haunts us is what is the pattern of growth and development we must follow in order to develop sustainably?

INDIA

In India, environmental concern is not a new issue and its conservation has been an integral part of the Indian way of life and it is amply borne out by history and tradition. Over the century's, people in India have had a fascinating and respect for their natural heritage.

According to the ancient Indian text Athervaveda, **composed 3200 years ago in 1200 B.C., "O Mother Earth! You are the world for us and we are your children; let us speak in one accord; let us come together so that we live in peace and harmony."**

This has also been expressed in the **Upanishad: "All in this manifested world, consisting of moving and non-moving, are covered by the Lord. Use its resources with restraint. Do not grab the property of others – distant and yet to come."**

Twenty two centuries ago, emperor **Ashoka** made it a Kings duty to protect wildlife and forestries. Many other movements helped saving our environment after that

In order to understand this let us first try to understand the link between development and the environment.

Development

The Oxford dictionary describes the word 'Development' as '**growth**' or '**advancement**'. The word is used in different context and one such context being 'the development of nations or societies'. Traditionally, a developed country is a country that is technologically advanced and that enjoys a high '**Standard of living**'. In most cases, countries with higher **GDP** (Gross Domestic Product) or **GNP** (Gross Nation Product) are developed countries, while a developing country is one which progresses towards achieving this growth so as to give the same standard of living to its citizens.

GDP is the total output of goods and services for final use produced by an economy by both residents and non-residents, regardless of the allocation to the domestic& foreign claims. GDP divided by total population gives per capita GDP.

Ideally we take development to be a vector of desirable social objectives. Elements include:

1. increases in real income per capita;
2. opportunity to have a satisfying livelihood;
3. improvements in health and nutritional status;
4. education achievement;

5. access to resources;
6. a "fairer" distribution of income;
7. assurance of basic human rights;
8. conservation of nature & its resources;

Link between Environment and Development

All of us want to develop and for that we have to use natural resources. It results in one or more waste-products going back to the nature. So, the environment is both a **source as well as a sink** for all developmental activities.

For example ponds in villages are a source of fish, water for various purposes playing a great role for village economy. They also act as a sink for excess fertilizers and pesticides that may run-off from agricultural fields. The human centric developmental approach has already converted our biosphere into a totally different organization- the '*Technosphere*', which negatively impacted other living-beings and life support system of the earth.

Need for Environmental Management vis-a-vis Development

Now-a-days, man thinks of himself a separate, superior entity with endless hunger for power, prosperity and prestige. Forgetting his harmonious relationship with nature, he used his intellect to overpower and conquer it. **Industrialization** and **urbanization** are two important indicators of economical development.

The industrial revolution and development of modern science, basically amoral in itself, put all the traditional rituals and religious beliefs behind. The sole purpose of development was reduced to the development of things and not that of man. Technology and ecology almost parted ways.

This has practically threatened the very existence of humanity on earth. The crisis caused by man's criminal neglect of nature has several obvious manifestations today. Almost 50 per cent of the land is eroded, degraded and robbed off its fertility. The extent of damage done to the world's biological diversity and eco-system can not be assessed.

Our renewable and non-renewable resources have been alarmingly depleted. Because of man's reckless industrial activity and increasing population pressures, our atmosphere, water, land and food are being polluted and contaminated.

Building dams is considered as one of the mega-developmental project. Let us see its implications.

Dams

Dams are built & their potentials can be used for irrigation, hydroelectricity, water transport, water parks, drinking water supply etc. Building dam results in damage of vast area of forestland, loss of biodiversity of that area, dislocation of a large population from their houses and the area becomes prone to earthquakes. And according to an estimate 160-230 new large dams are built each year.

We all know that the major problems are the results of modern agricultural practices, industrialization, urbanization, population growth and our life styles. Also most of these are necessary for the development point of view so as to raise our standards of living and improving the quality of life (details you will read in the chapter 'Sustainable Development'). So, in order to avoid these problems, we cannot stop various developmental projects. We will have to **manage** these problems while growing i.e. **we should develop environmentally**.

Environmental Management is not, as the phrase suggests, the management of the *environment* as such but rather the management of the humankind's interaction with and impact upon the environment.

The **need** for environmental management can be viewed from a variety of perspectives. A more **common** philosophy behind environmental management is the concept of **carrying capacity.** Simply put, carrying capacity refers to the maximum number of organisms a particular resource can sustain.

Carrying Capacity: the population that can be supported indefinitely by its supporting systems.

In ecological terms, the carrying capacity of an ecosystem is the size of the population that can be supported indefinitely upon the available resources and services of that ecosystem.

Living within the limits of an ecosystem depends on three factors:

- the amount of resources available in the ecosystem,
- the size of the population, and
- the amount of resources each individual is consuming.

A simple example of carrying capacity is the number of people who could survive in a lifeboat after a shipwreck. Their survival depends on how much food and water they have, how much each person eats and drinks each day, and how many days they are afloat. If the lifeboat made it to an island, how long the people survived would depend upon the food and water supply on the island and how wisely they used it.

Aspects of Environmental Management

Environmental management is therefore not the conservation of the environment solely for the environment's sake, but rather the conservation of the environment for humankind's sake.

Environmental management involves the management of all components of the bio-physical environment, both living (**biotic**) and non-living (**abiotic**). This is due to the interconnected and network of relationships amongst all living species and their habitats. The environment also involves the relationships of the human environment, such as the social, cultural and economic environment with the bio-physical environment

Aspects of Environmental Management

However, when we talk about the environmental problems, we are usually referring to problems within the natural environment, meaning those parts of our surroundings that are not human constructions. The boundaries here are difficult to draw. A conifer plantation is in some sense "natural", since trees are not human construction, but it is also "human", since human planted the trees and perhaps engineered the seeds. So, it is clear that management of environment is not as easy as it seems. There are many aspects related to environmental management.

Ethical Aspects

Environmental ethics is the part of environmental philosophy which considers the ethical relationship between human beings and the natural environment. Environmental ethics examines how human beings should interact with the non human world around them. Meaning of this definition becomes clearer if these two word environment and ethics are considered separately.

The word **ethics** directs us about how we should live and what we ought to do;

what kind of behavior is right or wrong;

what our moral obligations might be.

There are many ethical decisions that one makes with respect to the environment while its management. For example:

- Should we continue to clear cut forests for the sake of human consumption?
- Should we continue to make gasoline powered vehicles, depleting fossil fuel resources while the technology exists to create zero-emission vehicles?
- What environmental obligations do we need to keep for future generations?

Fig. 4.1 Should we continue to make gasoline powered vehicles?

Ethical Considerations

Some ethics we should follow are :

(i) Respect your Mother Earth

(ii) Preserve Biodiversity

(iii) Celebrate all days related with the environment

(iv) Limit the human population

(v) Judicious use of Natural resources

(vi) Understand Rights and Duties related to Environment

Economical Aspect

In order to grow economically, we are neglecting our environment. We have destroyed the environment up to such an extent that to-day its equilibrium has been distorted. So it is the most important need of the hour that our economic policies must include every aspect of the environment that can be effected due to any developmental project. Our policymakers should ensure their implementation so that we can develop sustainably.

Economical Aspects of environmental management must consider:

Quantity to Quality: Traditionally, we measure economic progress in terms of the quantity of economic activity i.e. GDP. In today's world, the key issue should be the quality of economic activity. It means, the extent to which it meets real needs, and whether it respects ecological limits. At a product level, quality refers to durability, reparability and upgradeability

Human Capital: In a knowledge-based economy, human capital is the key to success. So we should educate and train the humans to meet environmental priorities while developing creatively.

Reduction of Economic Waste: Since environmental progress is affected by economic growth, it is desirable to reduce the economic wastage contributing to inefficiency. So they must be avoided.

Integrate Environment: In most governments, economic factors are given much higher priority than environmental factors. Environmental management requires the integration of social and environmental factors into economic decision making.

Global Standards: Multinational companies can help transfer environmentally sound technologies, processes and management practices by operating with single global standards for environment, health and safety.

Technological Aspect : It is the need of the hour to innovate and adopt eco-friendly technologies to develop sustainably.

Technological Aspect includes all the advances in technology those can help managing the environment. Goals of using technologies for environmental management include:

- reduction and clean up of man-made pollution, with future goals of zero pollution;
- reducing societal consumption of non-renewable fuels,
- development of alternative, green, low carbon or renewable energy sources so that issues like

Fig.4.2 With the technological intervention we can reduce pollution

green house effect and global warming can be tackled;

- conservation and sustainable use of scarce resources such as water, land and air;
- protection of unique ecosystems;
- preservation and expansion of threatened or endangered species or ecosystems from extinction;
- the establishment of nature and biosphere reserves under various types of protection, and, most generally, the protection of biodiversity and ecosystems upon which all human and other life on earth depends.
- shift to non-CFC technologies to combat ozone depletion problems

More recently, there has been a strong concern about climatic changes caused by anthropogenic releases of greenhouse gases, most notably carbon dioxide. Efforts here have focused on the mitigation of greenhouse gases that are causing climatic changes (i.e., through the Climate Change Convention and the Kyoto Protocol), and on developing adaptive strategies to assist species, ecosystems, humans, regions and nations in adjusting to these climatic changes.

Many natural environments are the product of the interaction between nature and humans. For this reason, the term ecosystem has been used to describe an environment that contains nature, and includes people. It follows then that environmental problems are human or social problems. Some also consider it dangerously misleading to regard "environment" as separate from "people."

Socially Environment Managemnt has following goals

Preserve Diversity: Sustainability is not only about preserving environmental assets, but also social and cultural ones. The global diversity of cultures, languages, religions and lifestyles is currently under threat. It risks reducing the resilience of socio-cultural systems which can be a great challenge for environmental sustainability.

Meet Basic Needs: In many parts of the developing world, and small pockets in the developed world, basic needs for food, shelter, health care and education are not being met. Poverty is still a fundamental source of unsustainability. Sustainability means meeting basic needs and tackling poverty. We must co-operate and help people in distress to achieve this goal.

Equity: It is hard to imagine that a society with massive inequality could be sustainable. Similarly, sustainability means not only improving equity and equality in addressing the rich-poor gaps within nations and between them, especially North-South, but also in intergenerational terms.

Access to Opportunity: Equity is not simply a matter of outcomes, but of access to opportunity. Inequalities of opportunity can arise through differences in education, training,

availability of capital or financial assistance, access to infrastructure and technological know-how.

Employment : The importance of full and fair access to employment is required. It needs not means keeping the same job for life, but would mean breaking the existing cycle of chronic, long-term unemployment.

Sustainable Consumption : Consumption patterns will need to focus much more directly on quality of life rather than standard of living. Even in the last two decades of economic growth, quality of life for many in the developed world has been static or declining. Sustainable consumption will need to respect environmental, social and ethical norms, while meeting real needs for food, housing, transport, education, entertainment and fulfillment.

Women empowerment : It is essential that women play a greater role in the management of natural resources. While they have to bear the burden of natural resource degradation, they have little control over the management of these resources. Relevant provisions of the National Policy for the Empowerment of Women provide a framework for incorporating elements of proposed actions.

Natural resources conservation : It should be achieved through consumption of finite resources (fossil fuels, mineral resources, land); reducing rate of depletion and search for their substitutes; consumption of renewable resources (forests, other biomass) and finding ways to manage production systems on a sustainable basis minimizes danger of extinction of plants and animals due to human activities and ways to prevent this.

Now you all must have understood that the eco-friendly development is the best way to enhance economic and social development. Worldwide experiences demonstrate that environmentally unsustainable practices turn out to be more expensive in the long run because of human and health costs and loss of capability. By managing environment properly, the promotion of wholesome development is not difficult. For maintaining eco-balance is a **matter of choice, not chance.**

EXERCISE

Short Answer Type Questions

1. What do you understand by development?
2. Does development affect environment? How?
3. What is environmental management?

4. What do you understand by the word 'carrying capacity'?

5. Why environmental management is necessary?

Long Answer Type Questions:

1. What is the link between environment and development?

2. 'Current model of development will lead to destruction of environment'. Discuss.

3. Which ethics you should follow to show the respect to Mother Earth?

4. How technologies can help managing the environment?

5. What are the Social aspects of environmental management? Discuss.

Questions for critical thinking

Often developed countries try to dump their old used and dirty technologies on developing countries because the law in the developed countries compels them to shift to cleaner and efficient technologies. But the industries would still want to make money from old technologies by selling them to developing countries. Countries like ours may not afford anything else and so buy those old technologies. This also happens because of the absence of strict laws.

Similarly some countries are not making some products as the process involved in their manufacture is very polluting e.g. the production of Azo dye. So they set its manufacturing units in developing countries where the law does not prohibit them to do so, and then import the dye for use.

What do you think how ethical it is?

Discussion

In order to achieve the goals of Environmental Management, we must respect our socio-cultural diversity. Discuss.

CHAPTER 5

ENVIRONMENTAL MANAGEMENT

(PART-II)

Introduction

Legal provisions for environmental management : In the last few decades many new environmental policies and laws have been formed at national and international levels in order to protect the environment. In the beginning these laws were formed to protect human beings from the environmental hazards but now the laws and policies are stressing upon the protection of environment from anthropogenic effects. Still there are many gaps in these laws.

There are many legal provisions for environmental management.

1. The Constitution and Environment

- **Article 48A**: Within the five years of Stockholm Conference, India amended its Constitution (The 42nd Constitutional amendment 1976) to include "Environmental Protection" as a Constitutional obligation. **Article 48A** lays down:

  "Protection and improvement of environment and safeguarding of forests and wildlife — The State shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country"

  Part IV Directive Principles of State Policy, Section 48A

- ***Directive Principles of State Policy****, Section 38 also states:*

  "State to secure a social order for the promotion of welfare of the people — The State shall strive to promote the welfare of the people by securing and protecting as effectively as it may a social order in which justice, social, economic and political, shall inform all the institutions of the national life."

  Part IV Directive Principles of State Policy, Section 38

- **Article 51A states :**

  "It shall be the duty of every citizen of India **to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures"**

  Part IVA(g) Fundamental Duties, Section 51A

- After it **National Committee on Environment Planning and Coordination (NCEPC) and Tewari Committee** on Environment were set up which were concerned with issues relating to appraisal of development projects, human settlements planning, survey of ecosystems like wetlands and spread of environment education.

2. THE ENVIRONMENT (PROTECTION) ACT, 1986

The EPA (Environment Protection Act), 1986 came into force soon after the Bhopal Gas Tragedy and is considered an umbrella legislation as it fills many gaps in the existing laws.

This is an act to provide for the protection and improvement of environment and for matters connected there with for eg Environmental pollution and pollutants, handling of hazardous substances etc..

3. ENVIRONMENTAL LAWS

The Department of Environment was established in India in 1980 to ensure a healthy environment for the country. This later became the Ministry of Environment and Forests in 1985. There are a number of laws – acts, rules, and notifications for the support of the ministry

Following is a list of the environmental legislations that have come into effect:

- General
- Forest and wildlife
- Water
- Air

GENERAL

1986 - The Environment (Protection) Act authorizes the central government to protect and improve environmental quality, control and reduce pollution from all sources, and prohibit or restrict the setting and /or operation of any industrial facility on environmental grounds.

1986 - The Environment (Protection) Rules lay down procedures for setting standards of emission or discharge of environmental pollutants.

1989 - The objective of Hazardous Waste (Management and Handling) Rules is to control the generation, collection, treatment, import, storage, and handling of hazardous waste.

1989 - The Manufacture, Storage, and Import of Hazardous Rules define the terms used in this context, and sets up an authority to inspect, once a year, the industrial activity connected with hazardous chemicals and isolated storage facilities.

1989 - The Manufacture, Use, Import, Export, and Storage of hazardous Micro-organisms/ Genetically Engineered Organisms or Cells Rules were introduced with a view to protect the environment, nature, and health, in connection with the application of gene technology and microorganisms.

1991 - The Public Liability Insurance Act and Rules and Amendment, 1992 was drawn up to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident while handling any hazardous substance.

1995 - The National Environmental Tribunal Act has been created to award compensation for damages to persons, property, and the environment arising from any activity involving hazardous substances.

1998 - The Biomedical waste (Management and Handling) Rules is a legal binding on the health care institutions to streamline the process of proper handling of hospital waste such as segregation, disposal, collection, and treatment.

2000 - The Municipal Solid Wastes (Management and Handling) Rules, 2000 apply to every municipal authority responsible for the collection, segregation, storage, transportation, processing, and disposal of municipal solid wastes.

2000 - The Ozone Depleting Substances (Regulation and Control) Rules have been laid down for the regulation of production and consumption of ozone depleting substances.

2001 - The Batteries (Management and Handling) Rules, 2001 rules shall apply to every manufacturer, importer, dealer, consumer, and bulk consumer involved in the manufacture, processing, sale, purchase, and use of batteries or components so as to regulate and ensure the environmentally safe disposal of used batteries.

2002 - The Noise Pollution (Regulation and Control) (Amendment) Rules lay down such terms and conditions as are necessary to reduce noise pollution, permit use of loud speakers or public address systems during night hours (between 10:00 p.m. to 12:00 midnight) on or during any cultural or religious festive occasion

2002 - The Biological Diversity Act is an act to provide for the conservation of biological diversity.

FOREST & WILD-LIFE

1927 - The Indian Forest Act and Amendment, 1984, is one of the many surviving colonial statutes. It was enacted to 'consolidate the law related to forest, the transit of forest produce, and the duty leviable on timber and other forest produce'.

1972 - The Wildlife Protection Act, Rules 1973 and Amendment 1991 provides for the protection of birds and animals and for all matters that are connected to it whether it be their habitat or the waterhole or the forests that sustain them.

1980 - The Forest (Conservation) Act and Rules, 1981, provides for the protection of and the conservation of the forests.

WATER

1882 - The Easement Act allows private rights to use a resource that is, groundwater, by viewing it as an attachment to the land. It also states that all surface water belongs to the state and is a state property.

1897 - The Indian Fisheries Act establishes two sets of penal offences whereby the government can sue any person who uses dynamite or other explosive substance in any way (whether coastal or inland) with intent to catch or destroy any fish.

1956 - The River Boards Act enables the states to enroll the central government in setting up an Advisory River Board to resolve issues in inter-state cooperation.

1970 - The Merchant Shipping Act aims to deal with waste arising from ships along the coastal areas within a specified radius.

1974 - The Water (Prevention and Control of Pollution) Act establishes an institutional structure for preventing and abating water pollution. It establishes standards for water quality and effluent. Polluting industries must seek permission to discharge waste into effluent bodies. The CPCB (Central Pollution Control Board) was constituted under this act.

1977 - The Water (Prevention and Control of Pollution) Cess Act provides for the levy and collection of cess or fees on water consuming industries and local authorities.

1978 - The Water (Prevention and Control of Pollution) Cess Rules contains the standard definitions and indicate the kind of and location of meters that every consumer of water is required to affix.

1991 - The Coastal Regulation Zone Notification puts regulations on various activities, including construction, are regulated. It gives some protection to the backwaters and estuaries.

AIR

1948 – The Factories Act and Amendment in 1987 was the first to express concern for the working environment of the workers. The amendment of 1987 has sharpened its environmental focus and expanded its application to hazardous processes.

1981 - The Air (Prevention and Control of Pollution) Act provides for the control and abatement of air pollution. It entrusts the power of enforcing this act to the CPCB (Central Pollution Control Board).

1982 - The Air (Prevention and Control of Pollution) Rules defines the procedures of the meetings of the Boards and the powers entrusted to them.

1982 - The Atomic Energy Act deals with the radioactive waste.

1987 - The Air (Prevention and Control of Pollution) Amendment Act empowers the central and state pollution control boards to meet with grave emergencies of air pollution.

1988 - The Motor Vehicles Act states that all hazardous waste is to be properly packaged, labeled, and transported.

Case Study of Delhi godowns storing hazardous waste

The Hindustan Times, New Delhi dated June 1, 1999 reported that the death toll in a day before's fire in Lal Kuan, old Delhi rose to 39. The figure was likely to rise because many victims in hospital have more than 70% burns. A case had been registered against the owner of the New Aligarh Transport Co., godown where the fire originated. He was arrested by the police. The preliminary investigations by the crime branch revealed that The New Aligarh Transport Co. used to collect goods from different companies for transporting these to outstation. The goods were hazardous inflammable material. According to report many illegal godowns storing and transporting hazardous materials are mushrooming in the lanes of Old Delhi and no survey had done to find out these godowns. A high level meeting was called to find out the solution and shifting these godowns from the city. The meeting was attended by Chief Minister and the decision was taken to shift these godowns from the residential areas. Decision was also taken to carry out a detailed census of dealers dealing with hazardous materials. This case was an ample proof of either ignorance of regulatory requirements or violation of Hazardous Wastes (Management and Handling) Rules 1989/Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 as amended upto 1994.

4. National Environment Policy 2006

The National Environment Policy (NEP) is a response to our national commitment to a clean environment. It is recognized that maintaining a healthy environment is not the state's responsibility alone, but also that of every citizen. There should also be recognition by each individual - natural or institutional, of its responsibility towards maintaining and enhancing the quality of the environment.

The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resource.

The policy also seeks to stimulate partnerships of different stakeholders, i.e. public agencies, local communities, academic and scientific institutions, the investment community, and international development partners, in harnessing their respective resources and strengths for environmental management.

Environmental Impact Assessment

Environmental Impact Assessment (EIA) is the systematic examination of the likely impacts of development proposals on the environment prior to the beginning of any activity.

EIA's three aspects — environment, impact and analysis — need to be defined in operational terms.

In case of a multi-purpose river project, we study the main project and its immediate neighborhood, the entire river basin, the entire area expected to be benefited or damaged. In the environmental aspect we study its capacity constantly springing the mankind.

The word 'impact' refers to the probable impact of the project on the resources of the system studied. Environmental resources may be classified as

- basic (air, land, water, flora),
- developmental (ocean, minerals),
- cultural (heritage such as monuments and natural wonders; and aesthetic such as views, scenery, absence of noise and smell.

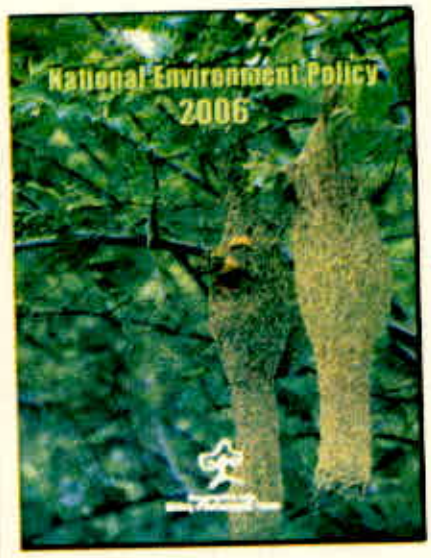


Fig. 5.1 NEP 2006

Any damage to basic resources would be life-threatening, to developmental resources would retard economic development and to cultural resources would deprive us of aesthetic and spiritual joys.

A resource could degenerate in three ways

- depletion (oil, coal)
- degradation (air, water, soil, monuments)
- displacement (soil, nutrients).

In each type, we should know whether it is significantly irreversible and needs urgent preventive/corrective action.

In India, EIA was made mandatory in 1994 under the environmental protection Act of 1986 with the following four objectives:

1. Predict environmental impact of projects;
2. Find ways and means to reduce adverse impacts;
3. Shape the projects to suit local environment;

Present the predictions and options to the decision-makers.

The result of an EIA is assembled in a document known as an Environmental Impact Statement (EIS) which looks at all the positive and negative effects of a particular project on the environment. This report is just one component of the information required to aid decision makers in making their ultimate choices about a project.

Bhopal Tragedy/ Industrial Accidents

Bhopal tragedy was the one of the most serious industrial accident took place at Union Carbide Factory at Bhopal in 1984. At least 4,000 persons died and the health impacts can still be seen in the area. This focused attention on industrial accidents that can affect the life of citizens, damage the environment and waste resources.

Accidents are unexpected and there can never be a situation in which there is zero risk of accident happening. However steps can be taken to prevent accidents and to reduce their impact when they occur. Precautions can be taken from technologies, processes and practices in industries.

Another important thing is- these types of accidents preparedness. It means how ready is an industry or community to deal with an accident when it occurs. Similarly industry should be prepared for the relief measures and clean up operations. This includes having access to correct information so that in case of accident doctors could treat patients correctly.

Important Institutions Related to Environmental Issues

The following institutions have been created to handle environmental issues:

- Department of Environment.
- Ministry of Environment and Forest
- Department of Science and Technology.
- Department of Agriculture and Co-operation.
- Department of Biotechnology.
- Department of Ocean Development.
- Department of Space.
- Ministry of New and Renewable Energy (changed name of Department of Non-Conventional Energy Sources)
- Energy Management Centre.

In addition, following **Agencies** have been created for environmental concerns:

- Central Pollution Control Board and State Pollution Control Boards.
- Indian Council of Forestry Research and Education.
- Forest Research Institute.
- Forest Survey of India and the Wildlife Institute of India.
- National Environmental Engineering Research Institute.

Fig. 5.2 Logo CPCB

- Botanical Survey of India.
- Zoological Survey of India.
- National Wastelands Development Board.
- National Museum of Natural History.
- Centre for Environment Education.
- Wadia Institute of Himalayan Geology.

It is up to us, as Citizens, to undertake development process in keeping with our heritage and the traditional conservation ethos in harmony with the environmental imperatives of this land.

EXERCISE

Short Answer Type Questions

1. What was the need for Legal provisions for environmental management?
2. What responsibility does the State / government have towards environmental protection under the Indian Constitution ?
3. What do you know about EIA?
4. What is the main purpose of Environment Act?
5. What is NEP 2006?
6. Name the major areas covered by our environmental legislation.
7. What responsibility does the citizen have towards environmental protection under our Constitution ?

Long Answer Type Questions:

1. Write a note on 'THE ENVIRONMENT (PROTECTION) ACT, 1986.'
2. 'Environmental Management is not a new term for India'. Discuss.
3. What are the objectives of 'National Environment Policy 2006'?
4. Which aspects are covered by Environmental Impact Assessment?
5. Name some Important Institutions Related to Environmental Issues?

Question For Critical Thinking

Baarang is a part of growing Markut city. Because of the increasing population of the city, demand for the houses for people has been increased. So a number of housing complexes are coming into existence in the past two years in Baarang. Baarang has a large lake. The lake is the only source of livelihood for fishermen and washer men who live along its banks. The grass growing along the lake banks are used by cattle grazers. Many migratory birds also visit lake in monsoon and winter months. A builder has made a proposal of drainage and making a housing complex on the sight of lake. He has also offered to build a bus stand for the people of Baarang in one part of the drained lake if municipal authorities accept his proposal. The fishermen, washer men, cattle grazers and members of the bird watcher club are totally against the proposal. They say that to protect the lake as it is a source of living for them and a heaven for migratory birds.

1. Being a student, what do you say? Whether the lake should be drained or not and why?

2. In order to protect the lake which legal provisions in the Indian Constitution can be helpful for the people of Baarang village?

Discuss

'If the Environmental Legislations are implemented successfully, we can get rid of a lot of environmental problems.' Discuss.

CHAPTER 6

ENVIRONMENTAL MANAGEMENT (PART-III)

Approaches for environmental management

The main aim of environmental management is to reduce or minimize the impact of human activities on the environment. In other words it stresses upon the regulation and proper use of environmental resources. It also involves socio-economic development of the society on the one hand and maintenance of environmental quality on the other. We can achieve these goals through

- effective economic policies
- monitoring environment through environmental indicators
- setting some environmental standards and
- information exchange and surveillance

1. Economic Policies –While both substantive and procedural laws relating to environment need to be tightened, what is basically needed is **social will and coherent strategy**. Environmental plans and programmes need to be reinforced by executive interest, strict enforcement of regulations and increased awareness. A cost-benefit analysis of every developmental project should also be done.

For this our Economic Policies must include

- **Appropriate pricing** - Natural resources are often sold at a very low price, leading to their exploitation. For example, the subsidies on irrigation water have led to planting of highly water intensive crops in regions inappropriate for this kind of agriculture. Excessive use of water has also resulted in water logging as well as depletion of ground water table making the soil saline. Removing inappropriate subsidies is essential to maintaining natural resources and would encourage development of more environmental friendly alternatives.
- **Tax based on pollution load** – Presently, effluent standards are based on best available technology for specific industries. Industries have no incentive to improve standards in such a system. Instead, a pollution tax should be levied so that industries pay taxes in proportion to the pollution they generate. Such a policy will reduce pollution at source and can only work if there is effective monitoring and punishment.

- **Higher credit rating for green industries** - Higher credit rating for green industries (environment friendly) will encourage upcoming industries to be more environmentally conscious. Once right to information and liability laws become effective, rating agencies would take care of this.
- **Reduce subsidies on fertilizers and pesticides** – The current subsidies on fertilizers and pesticides do not ensure that they are used sparingly. Recently, pesticides and fertilizers were found even in bottled soft drinks indicating that the runoff from agriculture is contaminating groundwater at very high levels. Reducing fertilizer subsidies will encourage more controlled use.

2. Environmental indicators

Indicator is a parameter or a value derived from parameters, which points to,/ provides information about, and describes the state of a phenomenon/environment/ area, with a significance.

As the name tells, environmental indicators, indicate about the condition of the environment. They provide information on a particular aspect of the environment. They report on the environment in the widest possible sense. Environmental indicators are simple measures that tell us what is happening in the environment. They provide insight into phenomena that extend beyond what is actually measured. For example, an increase in mean annual air temperature not only tells us that the air temperature has changed, but may also provide an indication of global warming and all kinds of processes related to global warming. Mean annual air temperature is thus an indicator of the status of the environment in a similar vein as our body temperature is an indicator of our current health status (with a fever indicating illness). They also give a clear picture of environmental driving forces, pressures, conditions, ecological impacts and (societal) responses.

Environmental indicators can include **physical, biological and chemical** measures. Examples of these include the concentration of ozone in the stratosphere or the number of breeding bird pairs in an area. Indicators can also measure human activities or anthropogenic pressures, such as greenhouse gas emissions, or the societal responses used to address environmental issues, such as the number of people serviced by sewage treatment.

Uses – Indicators can be used at international and national levels.

They are tools that can serve different purposes e.g.

- They can be used to see if environmental objectives are being met,
- They can be used to communicate the state of the environment to the general public and decision makers and
- They can be used as a diagnostic tool through detecting trends in the environment.

Pollution Issues	Available Indicators
Climate change	1. CO_2 emission intensities
Ozone layer	2. Indices of apparent consumption of ozone depleting substance (OS)
Air quality	3. SOx and NOx emission intensities
Waste generation	4. Municipal waste generation intensities
Freshwater quality	5. Waste water treatment connection rates

Biological Indicators

They are of immense importance in environmental management. These are the animals or plants that are used in some way as environmental indicator. They define a trait, or characteristic of the environment of a particular area which are as follows:

- Some of them have the ability to accumulate hazardous substances present in the environment.
- Their life processes are affected by the pollutants present in their surroundings or changing climate of the area.
- The changing number of species and the structure of their ecosystem indicate the level of environmental degradation.

Plant Indicators

The presence or absence of certain plant or other vegetative life in an ecosystem can provide important clues about the health of the environment.

- **Lichens** are indicators of **air quality**. Lichens are organisms comprising both fungi and algae. They are particularly sensitive to sulphur dioxide, sulfur-based pollutants, and nitrogen-oxides, a gas emitted from exhaust and industrial fumes and are therefore rarely found in large cities and towns or by roads.
- The accumulation of algal in aquatic systems indicates orgainc pollution due to nitrogen and phosphorus.
- Plants like Utricularia, Chara, Wolffia grow mostly in polluted water.
- Fertile soil supports plants such as **nettles**, **chickweed** etc.
- **Nitrogen**-deficient conditions are indicated by the presence of nitrogen fixing **legumes**.
- Plants like Amaranthus, Chenopodium, Polygonum grow better on overgrazed areas.
- Waterlogged or poorly drained land is indicated by the presence of species such as **mosses**, ferns etc.
- Populus, Pteris (fern) etc mostly gow on the areas destructed by fires.

- Presence of **forests** indicate the presence of **fertile land** while **poor vegetation** indicates **sterile** land's presence.
- Types of the plants growing in a particular area gives the idea of the climate type. Grasslands indicate heavy rains in summer and less in winter while evergreen forests indicates heavy rains in both seasons.

Animal Indicators

An increase or decrease in an animal population may indicate damage to the ecosystem caused by pollution. For example, if pollution causes the depletion of important food sources, animal species dependent upon these food sources will also be reduced in number-population decline.Example Dichlophenic medicine which is given to buffaloes to increase milk product may be one of the causes of extinction of vultures.

Microbial Indicators

Microorganisms can be used as indicators of aquatic or terrestrial ecosystem. For example

- *Presence of Eschericha coli (a bacterium) and diatoms in water, indicates pollution due to sewage.*
- Some microorganisms will produce new proteins, called stress proteins, when exposed to contaminants like cadmium and benzene, these stress proteins can be used as an early warning system to detect low levels of pollution.

Potential uses of Bio-Indicators

- Indicate contaminant exposure.
- Help identify mechanism of toxicity.
- Provide early warning of environmental damage.
- Provides early indications of environmental recovery.

3. Setting of standards

Our declining forest cover, sinking water table, increasing soil erosion, rising fresh water scarcity, mounting environmental pollution all call for a developmental model that is equitable, encourages participation and is environmentally sustainable. The Ministry of Environment and Forests (MoEF) progressively attempted to disseminate clean technology and environmental management through propagation of setting environmental standards.

Environmental Standards refer both to

- the acceptable levels of specified environmental quality parameters at different categories of locations ("**ambient standards**"),
- as well as permissible levels of discharges of specified waste streams by different classes of activities ("**emission standards**").

It is now well understood that environmental standards **cannot be universal**, and each

country should set standards in terms of its national priorities, policy objectives, and resources. These standards, may, of course, vary (in general, become more stringent) as a country develops.

It is also important that the standard is specified in terms of quantities of pollutants that may be emitted, and not only by concentration levels, since the latter can often be easily met through dilution, with no actual improvement in ambient quality.

In the last ten years, a substantial progress has been made in setting environmental standards for various sectors. The range of standards cover **effluent discharge standards for industries, fuel standard for vehicles, rules for disposal of solid waste and bio-medical waste etc**. Regulatory and implementing institutional infrastructure is rapidly being set up which includes an important role for the private sector. Following are some details of the environmental standards that have been set for the ambient air, water quality noise level and waste disposal.

NATIONAL AMBIENT AIR QUALITY STANDARDS (CPCB 1994)

Pollutant	Time	Concentration in ambient air		
		Industrial area	Residential Rural & Other Area	Sensitive Areas
Sulphur dioxide	Annual Average*	80 mg/m^3	60mg/m^3	15mg/m^3
SO_2	24 hoursU	120ug/m^3	80ug/m^3	20ug/m^3
Oxides of Nitrogen	Annual Average*	80ug/m^3	60 ug/m^3	15ug/m^3
NO_x	24 hoursU	120 ug/m^3	80ug/m^3	30ug/m^3
Suspended Particulate	Annual Average*	360 ug/m^3	140ug/m^3	70ug/m^3
Matter (SPM)	24 hours	500 ug/m^3	200 ug/m^3	100ug/m^3
Respirable Particulate Matter	Annual Average*	120ug/m^3	60ug/m^3	50ug/m^3
(size less than 10 um) (RPM)	24 hours	150 ug/m^3	100ug/m^3	75ug/m^3
Lead (Pb)	Annual Average*	10ug/m^3	0.75ug/m^3	0.50ug/m^3
	24 hours	1.5ug/m^3	1.00ug/m^3	0.75ug/m^3
Carbon Monoxide (CO)	8 hours*	5.0 ug/m^3	2ug/m^3	1.0ug/m^3
	1 hour*	10.0ug/m^3	4.0 ug/m^3	2.0ug/m^3

* *Annual Arithmatic mean of minimum 104 measurements in a year taken twice a week 24 houly at uniform interval*

** *24 hously / 8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.*

Designated - Best Use	Class of water	Criteria
Drinking water source without Conventional treatment but after disinfection	A	1. Total Coliforms Organism MPN/100ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical Oxygen Demand 5 days 20_0C 2mg/l or less
Outdoor bathing (Organised)	B	1. Total Coliforms Organism MPN/100ml shall be 500 or less 2. pH between 6 to 9 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20_0C 3mg/l or less
Drinking water source after ¤ conventional treatment and sisinfection	C	1. Total Coliforms Organism MPN/100ml shall be 500 or less 2. pH betwwn 6 to 9 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20_0C 3mg/l or less
Propagation of Wild life and Fisheries	D	1. pH between 6.5 - 8.5 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	A. pH 6 - 8.5 2. Electrical Conductivity at 25°C micro mhos/cm Max,. 2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2mg/l

Below-E Note Meeting A,B,C,D & E Criteria

Central Pollution Control Board

STANDARDS WITH RESPECT TO NOISE IN AMBIENT AIR

Area code	Category of Area/Zone	Limits in dB(A) Leq*	
		Day time	Night time
(A)	Industrial area	75	–
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zone	50	40

Note:

1. Day time is reckoned in between 6 a.m. and 9. p.m.
2. Night time is reckoned in between 9 p.m. and 6 a.m.
3. Silence zone is defined as areas upto 100 meters around such premises as hospitals, educational institutions and courts. The Silence Zones are to be declared by the Competent Authority Use of Vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.
4. Mixed categories of areas should be declared as one of the four above mentioned categories by the Competent Authority and the corresponding standards shall apply.

* dB(a) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specific period.

Environmental Management System

Fig 6.1 ISO

Some independent organizations called certifiers [ISO (International Organization for Standardization) and the IAF (International Accreditation Forum)] verify the Environmental Management Systems (EMS) of different types of industries. Environmental Management Systems, such as ISO 14000, are the International Standards. They require : the adoption of standardized environmental management practices, documenting their actual use monitoring and enforcement of prescribed emissions standards.

Fig 6.2 Logo ISO 14001

ISO 19011 is a document developed by the International Organization for Standardization. The standard offer four resources to organizations to "save time, effort and money":

A clear explanation of the principles of management systems auditing.
Guidance on the management of audit programmes.
Guidance on the conduct of internal or external audits.
Advice on the competence and evaluation of auditors.

ISO 14000 (Series): ISO 14000 was approved by European Commission through the recommendation of CEN (Commite de Normalisation) which is European Union's Standardisation Body. It is derived from ISO 9000 but it is brooder in scope than quality standards. It requires organizations to be concerned with everything from raw materials to the end product as it reaches the consumer and its final disposal- a cradle to grave approach.

BS 7750: The British Standard BS 7750 was introduced as a specification for the various stages of developing an environmental management system. It was the first environmental standard and influenced the development of ISO 14001. It was derived from ISO 9000.

Use of ISO's logo®: The ISO logo is a registered trademark. Unless authorized by ISO, use of its logo is prohibited

THE ECOMARK SCHEME : To increase consumer awareness the Government of India have decided to institute a Scheme on Labeling of Environment Friendly Products. The scheme will operate on a national basis and provide accredition and labeling for household and other consumer products which meet certain environmental criteria along with quality requirements of the Indian Standards for that product.

Fig 6.3 ECOMARK Logo

The Label shall be known as the "ECOMARK" and will be of the design to be notified. Any product which is made, used or disposed of in a way that significantly reduces the harm it would otherwise cause the environment could be considered as Environment Friendly Product. earthen pot has been chosen as the logo for the Ecomark scheme in India. The familiar earthen pot uses a renewable resource like earth, does not produce hazardous waste and consumes little energy in making. Its solid and graceful form represents both strength and fragility, which also characterizes the eco-system.

The logo for the Ecomark Scheme signifies that the product which carries it does the least damage to the environment. The criteria follow a cradle-to-grave approach, i.e. from raw material extraction, to manufacturing, and to disposal. The 'Ecomark' label is awarded to consumer goods which meet the specified environmental criteria and the quality requirements of Indian Standards. Any product with the Ecomark will be the right environmental choice.

4. Information exchange and surveillance

In Environment management, information exchange & surveillance play a very important role. Various ministries of Government of India are responsible for decision-making in the subject-areas allocated to them. In so far as environmental matters are concerned, the **Ministry of Environment and Forests (MoEF)** is the nodal agency for decision-making on environment-related matters at the national level as well as for dissemination of information to the users in its allotted field. The ministries collect information in their specific area and submit it to the Government.

The various departments publish their annual reports and periodically bring out brochures and host available information on the current policy and legislation on the Internet. Information management is carried out by each local government through its Department of Planning/Statistics. Each State is responsible for collection, collation, retrieval and dissemination of information on the subjects related to the particular State Government. Such information is and collated from the State Government by the respective Central Ministry in the Central Government according to the subject. The MoEF, through its agencies, coordinates information on forest cover, control of pollution in the State and environmental issues.

ENVIS : The Ministry of Environment and Forests (MoEF) has set up a National Environmental Information System (ENVIS) as a decentralized network for collecting,

Fig. 6.4 ENVIS

Fig 6.5 Logo PSCST

collating, storing, retrieving and disseminating information in the field of environment and its associated areas. The ENVIS has developed a home-page of the Ministry at: http://www.nic.in/envfor/envis. The ENVIS is a decentralized information system networks, having many nodes, known as ENVIS centres, located throughout India.

In Punjab, Punjab State Council for Science and Technology, Chandigarh (PSCST) collects information about its environment. Status of Punjab environment can be accessed from **http://www.punenvis.nic.in**

SDNP: The "Sustainable Development Networking Programme (SDNP)," which is another decentralized information network concept as an externally aided project to provide information on various thematic areas ranging from pollution, biodiversity, and wildlife conservation to agriculture, biotechnology, poverty and climate-change. The SDNP was launched world-wide in 1990 to make relevant information on sustainable development readily available to decision-makers responsible for planning sustainable development strategies. It also disseminates knowledge on sustainable development and acts as a distributing clearing house of information and functions in close association with ENVIS.

The SDNP has set up nodes on thematic areas of sustainable development in various parts of the country. Each node is in the process of developing a website on its earmarked area with an interface to the local language. The SDNP has developed a website to provide linkages with various national and international information systems at: **http://sdnp.delhi.nic.in** The SDNP-India is being implemented by the ENVIS a GOI (Govt of India)programme.

eNREE (E-Newsletter on Renewable Energy and Environment): eNREE is a quarterly non-priced electronic newsletter published by ENVIS Center "Renewable Energy and Environment" at The Energy and Resources Institute (TERI), New Delhi sponsored by Ministry of Environment and Forests, Government of India. The aim of the e-newsletter is to bridge the knowledge gap and disseminate latest developments in digitized form. eNREE is being published in addition to ENVIS Center's existing journal entitled "TIDEE (TERI Information Digest on Energy and Environment)". For a wider dissemination of information, eNREE has been made available in electronic form (PDF Format). This newsletter will be beneficial for policy makers, researchers, consultants, academicians, students etc working in the area of renewable energy and environment.

Also, enhancing environmental awareness and information exchange are essential to harmonize patterns of individual behavior with the requirements of environmental conservation. This would minimize the demands placed on the monitoring and enforcement regimes; in fact, large-scale non-compliance would simply overwhelm any feasible regulatory machinery. Awareness relates to the general public, as well as specific sections, e.g. the youth, adolescents, urban dwellers, industrial and construction workers, municipal

and other public employees, etc. Awareness involves not only internalization of environmentally responsible behavior, but also enhanced understanding of the impacts of irresponsible actions, including to public health, living conditions, sanitation, and livelihood prospects

Environment Education & Awareness Generation

Capacity building initiatives by the GOI in various sectors relating to the environment are an ongoing process and form an integral part of most projects and programs on sustainable development. Steps are taken to involve NGOs in organizing orientation training courses for teachers. The two centres of Excellence, namely the Centre for Environment Education, Ahmedabad and the CPR Environment Education Centre, Chennai provide the backup support to the NGOs. GOI's efforts towards Non-formal Environmental Education & Awareness include:

- National Environment Awareness Campaign (NEAC)
- Eco-clubs
- Paryavaran Vahinis
- Seminars/Symposia/Conferences/Workshops
- Publicity through State Transport Bus Panels
- Films on Environment related Areas
- Communication & Awareness Programmes

Fig 6.6 Eco Clubs

Early Childhood Education Scheme to reduce the drop out rates and to improve the rate of retention of children in primary school in educationally backward areas.

EXERCISE

Short Answer Type Questions

1. Name some approaches for environmental management?
2. What is Ecomark?
3. What are environmental standards?
4. How indicators help in knowing about the environmental status?
5. What are ambient standards?
6. What is SDNP?

Long answer questions:

1. What is the role of economic policies in environmental management?
2. Name some environmental indicators? What are bio-indicators? Give examples?
3. What is the role of information exchange in environmental management?
4. Why setting of standards is necessary for environmental health?
5. What is Environment Information System? How can you collect information from it?

Question for Critical Thinking:-

Krishna Chemical Factory (KCF) is a large chemical factory which supplies chemicals to many industries in the state. About 6,000 workers are employed there. Waste water from KCF finds its way into a nearby river. Villagers living downstream have been protesting that the waste water has ruined their agricultural lands. It has also resulted into their cattle deaths and has caused skin diseases. Being an educated citizen, can you answer following questions:-

1. Which laws are being broken by KCF?
2. Which Environmental Standards are being not followed by KCF?
3. Which Environmental Indicators can be utilized to find out the level of pollution increased in the village due to KCF?
4. How you can pass this knowledge to the state authorities?

Discuss

From where you can get the knowledge about the Environmental Status of Punjab? Which site do you find is more informative? Discuss.

CHAPTER 7

SUSTAINABLE DEVELOPMENT (PART-I)

Concept of Sustainable Development

Introduction

Children as you know that out of the eight planets, the Earth is the only planet, so far known, to have an environment that sustains life. Human beings are the important part of this environment which fulfills our basic needs. But our increasing demands and self-centered attitudes have exceeded so much that we all have neglected the **carrying capacity** of he Earth. The need of the poor, the greed of the rich, material affluence and technological advances in various sectors have resulted in the severe environmental imbalance. These all led to rapid erosion of our resource base, depletion of forests, decimation of wild species, pollution of our land, air & water, which have threatened the future development.

Mahatma Gandhi ji had rightly stated that "Nature possesses everything to satisfy the needs of everyone but not their greed."

The industrial revolution for the fast economical growth brought a new model of development with it. This made some parts of the world more prosperous than others. But soon the effects of this ill-planned and fast-paced development begin to show in the environment all around, putting into question the new model of development being followed. The massive project such as Bhakhra Nangal dam was once called 'The temples of India", by Sh. Jawahar Lal Nehru. But now a days mega development projects like this are facing opposition.

What do you think?

Are these groups that oppose these projects against the development of the country?

Cetainly the people who are against these developmental projects are not against the development.

Actually they are raising the questions on the following fundamental issues:

Development for whom and at what cost?

Concept of Sustainable Development

You all know that in the past few years we have realized that the current model of development is unsustainable. In other words, we are living beyond our means. The increased

stress we put on our resources and environmental systems such as water, land and air cannot go for ever. Especially as the world population continues to increase, we cannot ignore the future of our next generations. Also due to this ever increasing growth, our environment's resources are being stretched thinner than ever, and are unevenly distributed among the population. In these circumstances it is very difficult to provide the best life for the most people while making sure nature's life support systems remain intact for our children.

Considering the needs of present as well as our future generations, the concept of **'Sustainable Development'** came into existence.

The idea of sustainable development grew from numerous environmental movements in earlier decades and was defined in 1987 by the World Commission on Environment and Development (*Brundtland Commission 1987*) as:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustain: to continue without lessening, to nourish, to allow to flourish, to keep up, especially without interruption.

Develop: to improve or bring to a more advanced state.

In the context of sustainability, 'develop' does not mean continually getting bigger. We start out as infants and grow until we become adults. We don't continually get larger, but we do continue to develop. We go back to school, make new friends, learn new skills, start a new hobby, or travel to new places. In the same way, a sustainable community does not grow larger indefinitely. Sustainability does not mean sustained growth. At some point, a sustainable community stops getting larger but continues to change and improve. It develops in ways that enhance the quality of life for all its inhabitants

Fig. 7.1 Sustainable Development

The World Wildlife fund defines sustainable development as

"Improvement in the quality of human life within the carrying capacity of supporting ecosystems"

This sustainable development respects the relationship between the three "E's"-economy, ecology, and equity:

Economy - Economic activity should serve the common good, be self-renewing, and build local assets and self-reliance.

Ecology - Human is part of nature, nature has limits, and communities are responsible for protecting and building natural assets.

Equity - The opportunity for full participation in all activities, benefits, and decision-making of a society."

Another way of looking at this concept of sustainable development is to consider a three-legged stool, where each leg respectively represents one of the basic elements — economic vitality, ecologic integrity, and social equity. If one of the stool legs is removed, the stool falls over.

Fig 7.2 Three pillars of Sustainable Development

- Sustainable development implies economic growth together with the protection of environmental quality, each reinforcing the other.
- The essence of this form of development is a stable relationship between human activities and the natural world, which does not diminish the prospects for future generations to enjoy a quality of life at least as good as our own.
- Participatory democracy is a prerequisite for achieving sustainable development.
- People must share with each other and care for the Earth.
- Humanity must take no more from nature than nature can replenish. This in turn means adopting lifestyles and development paths that respect and work within nature's limits
- The term refers to achieving economic and social development in ways that do not exhaust a country's natural resources
- Sustainable development respects the limited capacity of an ecosystem to absorb the impact of human activities.
- Some people also believe that the concept of sustainable development should include preserving the environment for other species as well as for people.

All in this manifested world, consisting of moving and nonmoving, are covered by the Lord. Use its resources with restraint. Upanishad Circa 1500

Sustainable Consumption

Let us now see, how consumption pattern affects the environment.

Consumption: In order to survive we consume things. Our consumption of goods obviously is a function of our culture. Only by producing and selling things doesn't mean that we are progressing and attaining prosperity. The single most important measure of economic growth is the gross national product (GNP) which is the sum total of goods and services produced by a given society in a given year.

Almost all human consumption activities affect the environment. Let us see the ways in which consumption of a product affect the environment.

Effects of Consumption

- It depletes non-renewable resources (like metals and minerals). Like the production, processing and consumption of the commodities requires the extraction and use of natural resources (wood, ore, fossil fuel and water);
- It depletes and degrades renewable resources by activities such as over fishing, overexploitation of forests, ground water etc.
- It creates pollution and waste that go beyond the capacity of the environment to absorb them.

Yet of the three factors, environmentalists often point to as responsible for environment pollution- population, technology and consumption- consumption seems to get the least attention.

Consumption pattern: Consumption pattern means the way we consume the things. Our consumption patterns depend on our income levels. At the subsistence level, people usually consume primary goods such as cereals, milk, meat, fuel wood and so on. With a rise in income, secondary goods such as petroleum products, cement, fertilizers, etc. enter the consumption basket. Finally tertiary goods such as transport vehicles, consumer goods and appliances and services are used in large quantities. Thus, consumption levels depend on level of income and the kind of population whose income has increased.

Fig 7.3 Consumption depends upon Income

To understand the **consumption pattern and its effects** more clearly let us consider this:

- In 2001, India ranked second most populated country in the world with a population of 1,027 million persons. The USA population was 281 million.
- The consumption of food grains per person in India is less than 200 kg per year while an average American consumes 800 kg grains each day directly or indirectly.
- Only about 28% of people of India have access to sanitation facilities while in USA 100% people are served by municipal services.

- In 2000 electricity consumption per capita in India was equivalent to 335 kilowatt-hour and that of USA during the same period was 12,331 kilowatt-hour
- USA uses about 25% world's processed mineral resources and non-renewable energy compared to India's 3%.
- The USA produces at least 25% of world's pollution and waste, including 18% of global emission of Green House Gases and 22% of ozone destroying CFCs. Where as India produces about 3% world's pollution and waste, including 4% GHGs and 0.7% ozone destroying CFCs.

Source : CEE

What does this have to do with the environment?

Does the number of people influence the well-being of the environment?
Does the way people live and what they consume- their life style-also determine their impact upon the environment?

'Over' population is usually blamed as the major cause of environmental degradation, but from the above example it is clear that in India more people are consuming fewer resources and contributing less pollution. On the other hand, the USA has fewer people with affluent life style consuming more resources and contributing more to the environmental degradation. The importance of consumption patterns becomes starkly obvious. So the real issue is not consumption itself but its patterns and effects.

Sustainable Consumption :

Sustainable consumption is the consumption of goods and services that have minimal impact upon the environment. These are socially equitable and economically viable whilst meeting the basic needs of humans.

The Oslo Symposium in 1994 proposed a working definition of sustainable consumption as "***the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations***".

Sustainable consumption is an umbrella term that brings together a number of key issues, such as

- meeting needs,
- enhancing the quality of life,
- improving resource efficiency,
- increasing the use of renewable energy sources,
- minimizing waste,
- taking a life cycle perspective and
- taking into account the equity dimension.

Current unsustainable consumption patterns are destroying the environment; depleting stocks of natural resources; distributing resources in an inequitable manner; contributing to social problems such as poverty etc

Yesterday today.....

In the old days, we used to use cloth bags for shopping and used it hundreds of times until it was torn. We did not have plastic bags to throw away. We drank tea in china cups or steel tumbler. There were no disposable paper cups to litter the place. We did not have cold drink cans or cups. It was there in glass bottle which was returned to shopkeeper and then reused or recycled. Empty milk powder tins are used to store sugar dal etc. in the kitchens. We used cloth napkins in kitchens and as handkerchiefs. We washed them and reuse them till they were torn. Babies wore clean cloth diapers usually made of used old soft clothes which were reused after washing. In those days we did not waste. But now-a-days we may waste as much as we consume. We may pay more for packaging than for the product itself. Nearly a quarter of India's precious energy is used for producing the things which are ultimately going to be a waste.

The main barriers to sustainable consumption include:

- lack of awareness and training;
- lack of support from the community,
- government and industry;
- unsustainable thinking and behavior patterns;
- And lack of alternative sustainable products and services.

Commission on Sustainable Development (CSD, January 1994 at Oslo) has recommended that measures and steps to change the consumption and production patterns should be pursued for the purpose of:-

- Conserving energy and using renewable sources of energy.
- Making greater use of public transport.
- Minimizing, recycling and reusing waste.
- Reducing the quantity of packaging.
- Encouraging consumption of products produced by more environmentally sound processes and the development of environmentally sound products.
- Reducing the amount of water waste.
- Reducing environmentally harmful substances in products.

Need of Sustainable Development for improvement of Quality of life for Present and Future Generation

Before we talk about quality of life, let us first try to understand the meaning of needs, wants and luxuries.

Needs, Wants and Luxuries: Basic needs-food, water, shelter, clothing, social interaction are common to people across the world. Wants, unlike needs, depend on the social and economic background of a person. A city executive's wants may include a personal computer. A farmer's wants may include a better plough.

All humans need to consume in order to survive. The most basic essentials like food, water, clothing and shelter, come from natural resources.

When this consumption does become over-consumption? This is a very difficult question to answer. Consider food. A simple meal of dal and rice is food. On the other hand, a lavish spread of '*pulao*', *sweets, ice-cream* etc. is also food. The amount and kind of food we consume determines whether we are meeting our basic needs or enjoying luxuries.

Moreover, the perceptions of needs and luxuries vary from person to person, community to community and country to country. What some people might consider necessities for basic survival, others might consider luxuries.

Standard of living and Quality of life: In the context of 'development' you have already read about the term 'Standard of living' and you know its relation with GDP or GNP which further has close relation to 'development'.

Standard of living refers to the consumption of goods and services by an individual. Thus an individual spend more on him or her in other words, living a luxurious life will be said to have higher standard of living. So standard of living relates directly to economic development which may or may not make us happier or healthier.

In the context of sustainable development, a term that is more holistic in its scope is 'Quality of life'. Quality of life refers to a combination of attributes that provide sustained human experience of physical, mental, spiritual and social well-being.

These would include many of he earlier mentioned elements of holistic development like access to basic goods and services, social and mental security, sense of equity and justice, healthier human relations, equal opportunities, peace of mind, freedom of expression, a healthy environment, etc.

It may not possible to put economic value to many of these attributes. Now you must have understood why a higher standard of living may not necessarily guarantee a better 'quality of life'

Now-a-day 'Quality of life' is increasingly being recognized as the essential ingredient of development. The GDP or GNP doesn't give us an idea of the quality of life of people.

Let us understand the difference between Quality Of Life & Standard Of Living

Karuan's Story

Long long ago there was a little island Karu. Its 20km area was inhabited by 7000 Karuan natives. It had everything Karuans needed: coconut tree's for food & drink, huge tomano trees for shade, abundant of birds & oceans full of fish. Two hundred years ago an English sailor discovered Karu & called it pleasant island. After one century, an expedition was carried out to Karu & it was discovered that the island had one of the richest piles of phosphate rock on the globe. Tones of phosphate were shipped to other countries for fertilizing the fields & farms. Now Karu is prosperous & have 3000 imported workers.

Average Karuan family has at least two vehicles; they too have microwave ovens, stereo equipments & multiple televisions per family. Nine of every ten Karuans are obese & young men can weigh more then 135kgs. There native food is replaced by imported food & cheep meat. Today Karuans even import fish .Their changed eating habits has reduced their average life span only up to 55 years. Diseases like hypertension, heart disease & diabetes are common on the island. They have housing, power supply, water telephone education & medical services free or for a nominal charge .In other words their standard of living has raised.

What do you think?

Has their raised standard of living also increased their quality of life? Source CEE

You know that the planet Earth will not get larger. Earth is finite, one size, not growing. Thus, there is no such thing as "sustainable growth" because growth will inevitably hit physical limits. But development can continue endlessly as we seek to improve the quality of life for humans and for the other creatures with which we share the planet. To fulfill these aspirations, we must recognize that human development is not about having more, but about being more. Financial security does not necessarily correlate with happiness.

Recognizing this, the UNDP has established another measure, **the Human Development Index' (HDI)**. This index is combined measure of a country's score on three basic components of development:-

- Physical well-being as measured by life expectancy.
- Education as measured by a combination of adult literacy rates and mean years of schooling.
- Standard of living as measured by GDP per capita, adjusted to Purchasing Power Parity (PPP).

While holistic development strives for a better quality of life for all people, it also accords priority to the wise management of the environment.

Need of subtainable Development for improvement of Quality of life for Present and Future generation

Sustainable Development means meeting three goals at the same time:

- **Social** progress which recognizes the needs of everyone
- Effective protection of the **environment** and prudent use of **natural resources**
- Maintenance of high and stable levels of **economic** growth and employment.

So Sustainable development includes environmental, social and economic goals. Sustainable Development is also about trying to satisfy people's social needs. This includes basic social needs for homes and safe streets, as well as other social needs such as giving people the opportunity to achieve their potential through education, participation in society and good health. Sustainable Development is equally about maintaining a robust economy because this is needed to create the wealth to meet these various needs, now and in the future.

So sustainable development is the parallel consideration of healthy environment, life and human well-being. This includes issues of population, climate, economic prosperity, energy, natural resource use, waste management, biodiversity, watershed protection, technology, agriculture, safe water supplies, international security, politics, green building, sustainable cities, smart development, community/family relations, human values, etc. All these "pieces" are parts of the sustainable society because they are the basic ingredients of everyday life.

Thus, sustainable development focuses on improving the quality of life for all the Earth's citizens without increasing the use of natural resources beyond the capacity of the environment to supply them indefinitely. It accounts for the need of present and future generations, encourages local economic development and works towards a greater quality of life for all generations.

EXERCISE

Short Answer Type Questions:

1. Define sustainable development?
2. What are the three key areas of sustainable development?
3. Consumption depends upon income, how?
4. What is GDP?
5. How man is a barrier to sustainable consumption?
6. What do you understand by HDI?

Long answer type questions:

1. What are the basic features of Sustainable Development?
2. What is the need of sustainable development?
3. How mega developmental projects affect environment? Explain.
4. What is the difference between standard of living and quality of life?
5. How do you differentiate needs, wants and luxuries?
6. What is the need of Sustainable Development for improvement of Quality of life for Present and Future Generation?
7. Give some examples to consume **sustainably**?

Questions for critical thinking:

1. 'Environment is both a source as well as a sink for human activities'. Elaborate.
2. **Imagine it** : *You, alone with your family are escaping from your hometown due to flood. You have time to pick up just 20 things from your home before you leave except money. You are unaware of your future stay add facilities you will be provided.* ***Which things you will pick up?***

   Now the truck which is going to take you is overloaded and you have to drop five things. ***Cut off the five things from the list.***

   On the way the truck breaks down and every one has to walk down. You can carry only five things while walking. ***Which 5 items you will drop this time?***

   While walking a dacoits gang confronted with you who ask you to give them any 5 items. ***Which items you are left with?***

   What are these things? *Are these related with your basic needs or relative wants or luxuries? Explain.*

Discussion

Economic growth may ensure a better standard of living, but it may not lead to a better quality of life. Discuss.

CHAPTER 8

SUSTAINABLE DEVELOPMENT (PART-II)

Introduction

Children, now you must have understood that Sustainable development is a dynamic process. It enables all people to realize their potential and to improve their quality of life in ways which simultaneously protect and enhance our Earth's life-support systems. These, however, are the main poles of tension. Social inequity, the material disparity that accompanies it, as well as the question of why consideration for nature should come before the welfare of humans, is the center of the sustainable development debate.

The World Commission does *not* believe in the destruction of national global potential for development. ***If we take care of nature, nature will take care of us.*** Similarly if we want to save ***part*** of the system, we have to save the ***system itself***. This is the essence of what we call *sustainable development*.

After the Brundtland Report which was published in 1987, under the title '**Our Common Future**', United Nations convened a 'United Nations Conference on Environment and Development' (UNCED) at Rio de Janeiro in Brazil in 1992. It is called '**Earth Summit' or 'Rio Declaration'**. An 800 page document called '**Agenda 21**' (a plan for 21st century) was issued at this conference. It contains comprehensive Blueprints for Governments on everything to adopt the path of sustainable development. This Agenda has 27 principles which cover all the aspects of environment, conservation and sustainable development. While these proclaimed principles had no legal bindings, they carry a strong moral force to ensure their adoption.

Agenda 21 also stresses the initiatives required for strengthening the participation of major groups, such as women, children and youth, indigenous people, non-governmental organizations, local authorities, workers and trade unions, business and industry, science and technology and farmers, in the action of sustainable development. It also spells out the means of implementation that include financial resource, transfer of technology, science, education, legal instruments etc.

Challenges for sustainable Development in the world

'***Making change happen means facing up to challenges then overcoming the obstacles.***' But embracing the notion of sustainable development is easier said than done. Humans are changing the planet, with profound consequences for our future. Our activities have driven atmospheric carbon dioxide to levels beyond those experienced in the last 400,000 years.

Species are disappearing at 1,000-10,000 times the normal rate. We have transformed 30-50% of the planet's land surface, appropriated 50% of its available fresh water, and removed 90% of the oceans large fishes. Many systems have moved beyond ranges experienced during the past half-million years.

Some of the most important challenges facing by the world today include

- One of the critically important issues in sustainability is that of human **overpopulation** combined with human lifestyle. Current population of the Earth, already over six billion, is too much for our planet to support sustainably at current material consumption levels. This challenge for sustainability is distributed unevenly.
- Alleviating **poverty,** especially in rural communities, where the majority of the world's poor live.
- Improving the ability of all countries, particularly developing countries, to meet the challenges of globalization, including greater **capacity building, environment friendly technologies.**
- Promoting **responsible consumption and production patterns**, to reduce waste and over-reliance on natural resources.
- Ensuring that all people have access to the **energy sources** needed to improve their lives.
- Reducing environment-related **health problems** that account for many of the illnesses in the world today.
- Improving access to clean **water**, to reach those who today must rely on unsafe and unsanitary sources to raise their children and maintain their livelihoods.

Measuring the real impacts of **global warming**. What are the true causes of global warming trends and what are the long-term results of climate change?

Challenges to Sustainable Development in India

Social Considerations

To bring sustainable development in India is not an option but a requirement. On one hand, India is faced with environmental degradation from poverty and population pressures, and on the other, from pollution and changing consumption pattern.

Now we will discuss some social challenges we are facing to attain Sustainable Development.

1. Population

It is well known tht India is set to replace China with 1.5 billion people by 2040. Since 1951 the population has grown from 361 million to 1 billion making every sixth person in the world Indian. As India has only 2.4% of the world's total landmass, the population density is at 324 persons per square kilometer (Census 2001) and pressures on the environment are correspondingly high.

Fig. 8.1 Increasing Population- a big challenge

2. Literacy

It is well known that literacy is important for every aspect of development and the environment is no exception. For instance,

- women's literacy reduces fertility rates and thereby reduces population pressures.
- Literacy is essential to reducing poverty as it provides people more opportunities to earn as well as increases their productivity and ability to earn.
- It also allows people to become more receptive towards alternative technologies and environmental management. For example, there is sometimes aversion to switching from firewood to clean fuels such as LPG gas because women are afraid that they will be unable to operate the stove. Such aversion can easily be dealt with through literacy and education programs.
- People's ability to manage environmental resources like water, soil, and forests improves with literacy.

All in all, literacy helps reduce pollution as the added awareness allows people to link the health of the environment with their own health and well-being. In India, literacy rates are growing steadily but they are still far from adequate

3. Poverty

Fig. 8.2 People facing Poverty

Clearly, one of India's biggest problems is poverty. Fortunately, despite the growth of the population and the low level of economic development at the time of independence in 1947, India has made significant progress in poverty reduction.

The pollution that the poor generate is of a **different kind** than generated by the rich. The poor mostly rely intensively on the environment for their needs. So its degradation affects their livelihood greatly. They thus become both victims and agents of environmental degradation as they both need (and often exploit) the environment to survive but suffer the most when it degrades.

Economic Considerations

Just like poverty, economic growth also leads to pollution.. The impact of this growth on environment depends on the structure of GDP, the change in consumption patterns of the population and many other things.

1. Structure of GDP

Primary sector (particularly agriculture) remains the bedrock of the Indian economy, although its share in the total GDP has been declining over the years. At the same time the shares of manufacturing, transportation and banking and service sectors have doubled in last 50 years (Economic Survey 2003). The growth of the Indian economy is accompanied by a change in the structure.

2. Consumption Patterns

Consumption patterns depend on income levels. At the subsistence level, people usually consume primary goods such as cereals, milk, meat, fuel wood and so on. With a rise in income, secondary goods such as petroleum products, cement, fertilizers, etc. enter the consumption basket. Finally tertiary goods such as transport vehicles, consumer goods and appliances and services used in large quantities.

In India, consumption patterns have changed over the years. This changing consumption pattern is posing another challenge for SD.

3. Urbanization

As India urbanizes, one sees cities grow and traffic increase. This may reflect rapid economic development and industrialization but also results in high levels of energy consumption and emissions. The progress of urbanization is relatively slow in India compared to other developing countries and the bulk of the population continues to live in rural areas. The urban population increased from 19% of the total population in 1965 to 28% in 2000. It is expected that more than 50% of population in India will reside in urban areas by 2025

Story of Mewa Singh

Mewa Singh lived in a village of Punjab. He could not do well in agriculture due to unsustainable agricultural practices. He went to Mumbai in the search of a job with his family. He got a job on a construction site and he started living on the construction site with his wife and children. He hoped that here he could earn more money than he was earning in his village from agriculture. He had just four bed sheets around in a small area without the facilities of clean drinking water and toilets.

He had to move from one place to another with the construction team in the same conditions. Finally his family fed up and decided to go back to his village in Punjab. Mewa Singh continued working in the Mumbai and sending the money he earned to his family.

In the village his family had to work in the farm. Increased workload forced his children to drop studies. Mewa Singh was also disconnected from his family and started taking drugs in order to cope with the situation. His friends were also passing through the same phase. Children of most of them started begging. Health of Mewa Singh started deteriorating day by day and finally he decided to go back to his village.

4. Transportation

The transport sector accounts for a major share of consumption of petroleum products in India. It is also responsible for a large share of air pollutants.

Interestingly, total number of two wheelers in the country have shown a huge rise as compared to other vehicles. This indicates that the size of middle class and its purchasing

power have increased, as two-wheelers are more popular among middle class community in India.

Therefore, in order to develop sustainably, greater emphasis needs to be placed on developing **good public transport systems**

Political Considerations

The challenge before India is to conserve the enormous natural wealth that it has and at the same time use it to improve the living standard of its citizens. We have many laws and policies to protect environmental degradation while developing. For the protection of these laws and implementation of these policies we require governance that is democratic both in form and substance. It should also seek co-operation from the individual from every section of society in order to develop sustainably.

Support base for Sustainable Development

There are many **dimensions to sustainability.** Some of them are

- it requires the **elimination** of poverty and deprivation.
- it requires the **conservation** and enhancement of the resources base which alone can ensure that the elimination of poverty is permanent.
- it requires a **broadening of the concept** of development so that it covers not only economic growth, but also social and cultural development.
- The most important dimension is that, it requires **unification** of economics and ecology in decision-making at all levels.

But we cannot achieve these targets without getting support from all spheres.

Political and Administrative Will

Political and administrative will remains a particular challenge for all countries today, especially for developing countries. Political will refers to the desire and determination of political actors to bring significant and persistent changes in the society. It is the steering that is needed to turn the wheels of developmental reforms.

Political will in developing countries rest in the hands of the government and ruling political parties. As a result therefore, a lot of incentives have been offered by international organizations to tilt political commitment in the direction of realizing both the present and future needs of developing countries.

Politicians and policy makers have to understand that every decision they make has systemic repercussion. There will always be consequences, negative ones of course, when policies are made to disadvantage other minorities in the society. But the truth stands till this day that; whatever a political actor sows in the fields of developing countries he/she shall reap it when it has fully matured.

There are many actions that can be taken by governments to solve, the problems like unemployment and poverty. With the omission of genuine political will, it is impossible for government to move forward in a very positive way.

Dynamic and Flexible Policies

Policy makers should consider all the aspects of Sustainable development It is suggested that policies to promote sustainable development should operate at six different spatial levels connecting global, multinational, national, regional, local and individual. It is shown that, by implementing a judicious choice of policies, a sustainable corridor for a global and a national system can be achieved. These policies must include the security of livelihoods. The different ways by which Policies can ensure security of livelihoods are :

- Sustainable development demands urgent and strong policy measures to safeguard the livelihoods placed at risk. It can be done by the forces of liberalization, privatization and globalization.

  By starting the programmes of skill and versatility development. For this promotion of small-scale entrepreneurship, management and marketing must be developed for those whose occupations and livelihoods are at risk.

- Basic education for functional literacy, livelihood skills and responsible citizenship is a precondition for sustainable development. Such education must be appropriate to the social, economic and environmental context. It must be of the highest quality possible.

Appropriate Technologies

Agenda 21 emphasizes the need for access to and the transfer of environmentally sound technologies to developing countries on favorable and preferential terms as mutually agreed. Issues of natural resource conservation and agricultural growth cannot be effectively tackled in the absence of an appropriate technological base. In addition, technology is essential for increasing the competitiveness of the Indian economy in international markets

SOME APPROPRIATE TECHNOLOGIES

Energy: Electricity can be provided from solar cells (which are expensive initially, but simple), wind power or micro hydro, with energy stored in batteries. Biobutanol, biodiesel and straight vegetable oil can be appropriate, direct biofuels in areas where vegetable oil is readily available and cheaper than fossil fuels. A generator (running on biofuels) can be run more efficiently if combined with batteries and an inverter; Biogas is another potential source of energy, particularly where there is an abundant supply of waste organic matter.

Fig. 8.3CFL (Compact fluorescent lamp)

Lighting: The **Light Up the World Foundation** uses white **LED** lights and a source of **renewable energy** such as **solar cells** to provide lighting to poor people in remote areas, providing significant benefits compared to the **kerosene lamps** which they replace. Now a days **CFL** (compact fluorescent lamps) are being promoted.

Ventilation and air Conditioning : Natural ventilation can be created by providing vents in the upper level of a building to allow warm air to rise by convection and escape to the outside, while cooler air is drawn in through vents at the lower level. A solar chimney often referred to as *thermal chimney* improves this natural ventilation.

Food preparation and Cooking: Appropriate technologies can greatly reduce the labor required to prepare food, compared to traditional methods, while being much simpler and cheaper than the processing used in Western countries. Smokeless and wood conserving stoves promise greater efficiency and less smoke, resulting in savings in time and labor, reduced deforestation, and significant health benefits

Fuel: Vehicles driven by ethanol blended petrol, natural gas (CNG), Bio-diesel (from Jatropha, corn, and wheat plants), electricity and hydrogen not only save oil but also results in less pollution.

Refrigeration: The pot-in-pot refrigerator is an African invention which keeps things cool without electricity. It provides a way to keep food and produce fresh for much longer than would otherwise be possible. CFC free refrigerators should be used.

Water supply : Rainwater harvesting (which requires an appropriate method of storage, especially in areas with significant dry seasons); and fog collection, suitable for areas which experience fog even when there is little rain. Hand pumps and treadle pumps are generally more appropriate to developing world contexts than motor-driven pumps, and may provide better quality water with less travel time than surface water sources.

Comprehensive Review and Revision Mechanism: Comprehensive review involves promoting full understanding of the mechanisms and processes through which the environmental problems can be investigated and solved. Differences may be found in the definition of sustainable development. Some definitions of sustainability are mainly focused on sustaining economic development.

But now you all know that sustainable development depends upon interaction among three systems, the biological system, the economic system, and the social system. The goals of sustainable development for the three systems are:

- For the biological system, maintenance of genetic diversity, resilience, and biological productivity
- For the economic system, the satisfaction of the basic needs (reduction of poverty), equity enhancement, increasing useful goods and services
- For the social system, ensuring cultural diversity, institutional sustainability, social justice, and participation.

While sustainability has become a widely acknowledged concept, in the recent development thinking, there are considerable arguments on how to implement the concept.

Sustainable solutions can build on:

- Through understanding of the sources of conflicts, including it's natural, technical, institutional, social and its cultural aspects.

- Participation of all the related stakeholders in the process is curtail, first to arrive at common understanding of the problem and to share as far as possible vision about future and ideas about the path to sustainable solutions.
- Examining the social, environmental and economic contests of the conflict, in order to assess different policy options to make the best use of limited natural resources.

This may include regulation, financial sanctions and economic incentives and also increasing public awareness and participation, information dissemination and support for possible institutional change and finally an organization to pursue the co-operation, a means of monitoring achievement, and implementation plans

Human Approach

It is not possible for the government to monitor pollution and the corresponding acts of all industries and individuals. People must be made stakeholders in the environment through awareness campaigns. Industries are sensitive to public pressure. Through generating awareness, the public could directly affect the environmental practices of industries. **Right to information and liability laws** help a lot in this.

We have seen that we cannot afford to neglect the environment, if sustainable development is desired. The pressures on environment have to be curtailed by reducing population pressures, increasing literacy, **environmental awareness drives and poverty alleviation programmes.**

Poor are victims of environmental degradation but they can also aggravate it if the infrastructure and living conditions do not keep pace with population increase. Rather, the poor have to be turned into agents for environmental restoration by involving them in say forest management, waste management, recycling and so on in manners that create incentives for them to use natural resources in sustainable manner.

Secondly, the economic activities must be conducted using environment conserving and resource saving **technologies**. Managing environment though better urban designs, improvement in transportation infrastructures and creative use of information technologies needs to be considered seriously.

Thirdly, strategy for **environmental governance** should consist of law enforcement, providing economic incentives, people's participation, institutional reforms and support and technological improvements.

The environment is not a luxury for the rich but a necessity for the poor. Therefore, although it is not an easy task for World to develop sustainable yet it is absolutely necessary and requires tremendous cooperation and will. With the determination of the government, private sector, NGOs, and people, we can perhaps achieve sustainable development.

Development of Skilled Manpowr

Making change happen means facing up to challenges then overcoming the obstacles. **Skilled people** can help, often using proven **change models**

We see that appropriate technological intervention in almost every field leads to

prevent environmental damage to some extent. But for handling new technologies we need a man force which is well trained in the scientific field because without it these technologies can be proved harmful instead of being beneficial for the environment.

This reorientation is one of the chief institutional challenges of the century. Meeting it will require major institutional development and reform. Many countries that are too poor or small or that have limited managerial capacity will find it difficult to do this unaided. They will need financial and technical assistance and training.

Fig. 8.4 Skilled labor is necessary for sustainable development

EXERCISE

Short answer questions:

1. Who should be the Centre of Concerns for all developmental programmes?
2. What do you mean by urbanization?
3. What is the relation of industrialization with environmental degradation?
4. What do you understand by 'appropriate technology'?
5. What is the 'Humane Approach' for sustainable development?
6. Write down the role of skilled manpower for developing sustainably?

Long answer questions:

1. Write a note on 'Earth Summit'. What was its main purpose?
2. What are the most important challenges the world facing today? And what are their impacts on the environment?
3. What social challenges India is facing to-day to develop sustainable?
4. How political will can be a support base for sustainable development?
5. Mention some appropriate technologies for sustainable development?

Questions for critical thinking:

The government of Surya Pradesh wants to build a massive information technology complex outside the capital. They believe that this complex will attract many companies from all over the countries and world, and that this will provide jobs to the people of Surya Pradesh. The selected area for building the complex has about 2,000 trees. Scientists say that this area acts as 'a green lung' of the city. What would be your decision and why if you were a/an

1. Urban Planning Minister
2. Citizen
3. Industrialist
4. Environmentalist

Discussion :

The challenge of poverty and the challenge of environment are not two different challenges but two faces of the same challenge. Discuss

CHAPTER 9
SUSTAINABLE DEVELOPMENT (PART-III)

Introduction

Role of Individual

We know that our population is increasing, our environment is polluting, our natural resources are shrinking, our biodiversity is shrinking, our Earth's temperature is raising, our glaciers are melting, our islands are disappearing fastly day by day and these all are happening due to man's activities and over-exploitation and misuse of Nature by him. But we can't continue this way, as this is a question of our future generations. We have the right to live in a healthy environment and to provide this environment to every citizen is State's duty. We have the right to live in a healthy environment and to provide this environment to every citizen is State's duty. Moreover the Constitution of India also imposes a duty on every citizen 'to protect and improve the natural environment including forests, lakes, rivers and wildlife'. So we will have to change our habits, our attitudes so as to take part in nature's conservation activities. Here it is important to recognize that we do not have to be activists to bring about the required changes.

Mahatma Gandhi once said: "I think it is necessary to emphasize this fact: No one need wait for anyone else to adopt a human and enlightened course of action. Men generally hesitate to make a beginning if they feel that the objective can not be achieved in its entirety. It is precisely this attitude of mind that is the greater obstacle to progress- an obstacle that each man, if he only wills it, can clear a way himself and so influence others."

The best place to start is often at home, then your own neighbourhood, place of work, and on up towards influencing national government and international agreements.

What an individual can do

Find out for yourself how to apply sustainable development in practice by taking action at home. Learn what is involved in making the transition from where you are to where you want to be. This means ***living lightly*** on the planet. It is easier to convince others if you have done it yourself. When you "walk your talk" you become more credible and self-confidence grows.

As a student your individual and collective act can make a difference. You can participate in the work of environmental groups or organize themselves and mobilize others in their own community. You can contribute by:

- Writing letters to the editor about local environmental issues and what can be done about them.
- Bring local environmental issues to the attention of the local radio or television stations.
- Participate in local citizens action campaigns.
- Setting up an environmental group or 'Eco-Club' and recruiting other members.
- Lobbying decision makers at the local level, such as the municipal commissioner, panchayat members and MLAs etc.
- Studying disciplines useful for future careers in voluntary work (other Indian languages, economics, ecology, rural management, social work, public health, natural resource policy, hydrology, anthropology etc.) and
- When necessary, by seeking court intervention through public interest litigations.

Individual Contribution

An individual can contribute a lot **at home** level.

Individual and consumption pattern: By reducing one's needs, shopping smartly (Reducing the quantity of packaging), minimizing the use of disposable things, repairing, recycling and reusing things, encouraging consumption of products produced by more environmentally sound processes.

Individual and waste management: By recycling and composting, donating reusable items in community, segregating waste and its disposal at proper place.

Individual and water management: By saving each drop of it going waste, its proper use, harvesting rain water.

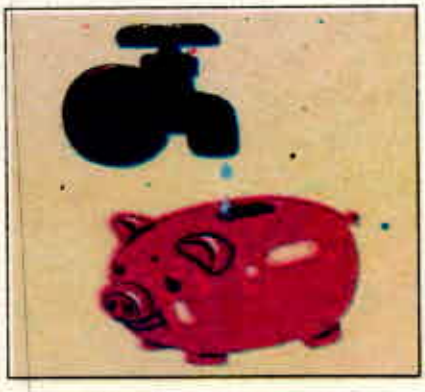


Fig. 9.1 Save Water

Individual and energy: Minimizing its use, not wasting it, using renewable sources of energy (Sun, water, wind etc.)

Individual and population: By marrying at right age, adopting small family norms and guiding other members.

Individual and education: By knowing the consequences of one's activities, becoming aware of precautionary measures to be taken to save environment and participating in related activities.

Individual and transportation: By using public transport system, keeping one's two or four wheeler tuned, going on foot at nearby places.

Individual and pollution: By not polluting the water, air or land (not throwing of waste or poisonous things in water, not burning leaves, waste of household or straw in fields).

- **Individual and natural resources** Preventing degradation and depletion of natural resources, renewing and conserving it (planting trees, minimizing the use of fossil fuels).
- **Individual and technology**: By knowing the working of and using the latest cleaner and greener technological equipments.
- **Individual and laws**: By becoming aware of all environmental laws and rules and abiding by them willingly.

Community Participation

Role of Community: It is happening all over the world that ordinary people are working for change through citizen action. By organizing into groups, they demand and persuade governments to save natural resources, build housing for the poor and halt the indiscriminate cutting of forests. They force industries to reduce pollution levels and persuade financiers to make environmentally sound investments. They are the people who share common visions. They labour to reduce poverty, advance human development and manage natural resources for the long- and short term good of the community.

Fig. 9.2 Community participation

It is not possible for the government to monitor pollution and the corresponding acts of all industries and individuals. Through generating awareness, the public could directly affect the environmental practices of industries. As already pointed out right to information and liability laws help a lot in this.

In India, the need for community participation in development activities has been fully appreciated and recognized. It is realized that developmental activities undertaken with the active participation of major groups have a greater chance of success and can also be more cost effective. In the area of education, health, family planning, land improvement, efficient land use, minor irrigation, watershed management, recovery of wastelands, afforestation, animal husbandry, dairy and sericulture, considerable progress has been achieved by creating institutions for people and encouraging community participation.

Individual Initiation and collective action:

There lied so many success stories in the past when just an individual thought has changed and compelled so many people to act collectively in order to revert the decisions taken by bureaucrats which would have led to environmental degradation.

CHIPKO MOVEMENT

The origins of the Chipko movement can be traced back to the Bisnois. On a Tuesday (The 10th day of the month of Bhadrapad according to the Indian lunar Calendar) in 1730 A.D., Amrita Devi, a Bishnoi woman was at her home with her three daughters (Asu, Ratni and Bhagu bai) when she came to know that a number of people had descended on their otherwise sleepy village of Khejarli. The name Khejarli was

derived from "Khejri", since these trees were found in abundance in the village. The people were a party of men sent by Maharaja Abhay Singh, the ruler of the kingdom of Jodhpur in the Marwar region, who wanted to fell green Khejri trees to burn lime for the construction of the Maharaja's new palace. Since there was a lot of greenery in the Bishnoi villages even in the middle of the Thar Desert, the king ordered his men to get the wood by cutting the Khejri trees.

Fig 9.3. Chipko Movement

Amrita Devi protested against the Maharaja's men who were attempting to cut green trees as it was prohibited according to Bishnoi principles. The malevolent feudal party told her that if she wanted the trees to be spared, she would have to give them money as bribe. She refused to acknowledge this demand and told them that she would consider it as an act of insult to her religious faith and would rather give away her life to save the green trees. It is at that stage she spoke these words: Sar santey rookh rahe to bhi sasto jaan (If a tree is saved even at the cost of one's head, it's worth it) Saying these words, she offered her head. The axes, which were brought to cut the trees, severed her head. The three young girls Asu, Ratni and Bhagu were not daunted, and offered their heads too.

The news spread like wildfire. The Bishnois of Khejrali gathered and sent summons to their counterparts in eighty-three Bishnoi villages in the vicinity to come and decide on the next course of action. Since the supreme sacrifice by Amrita Devi and her daughters had not satisfied the royal party, and the felling of green trees was continued, it was decided that for every green tree to be cut, one Bishnoi volunteer would sacrifice his/her life. In the beginning, old people voluntarily started holding the trees to be cut in an embrace as in the 20th Century Chipko Movement.

Despite many valiant old persons giving away their lives, the Hakim (the royal party's leader) , Girdhar Das Bhandari taunted the Bishnois that they were offering unwanted old persons. Soon, young men, women (including recently married ones) and children were sacrificing themselves in a similar manner.

There was intense pandemonium. The tree-felling party was badly shaken. They left for Jodhpur with their mission unfulfilled and told the Maharaja about what had happened. As soon as he learnt about it, he ordered the felling of trees to be stopped.

By that time, three hundred and sixty three (363) Bishnois, young and old, men and women, married and unmarried, rich and poor had already become martyrs.

Honouring the courage of the Bishnoi community, Maharaja Abhay Singh, apologised for the mistake committed by his officials and issued a royal decree, engraved on a copper plate ordering the following:

- All cutting of green trees and hunting of animals within the revenue boundaries of Bishnoi villages was strictly prohibited.

- It was also ordered that if by mistake any individual violated this order, he would be prosecuted by the state and a severe penalty imposed.
- Even members of the ruling family would not shoot animals in or near Bishnoi villages.

Although, Bishnois paid a huge price for saving a few trees, this incident had inspired, and will continue to do so in future, many others to fight and protect trees and wild life.

"Never doubt that a group of thoughtful, committed individuals can change the world. Indeed it is the only thing that ever did."

Similar movement emerged from the struggles between villagers and the state over the latter's increasingly intrusive forest policies in Alaknanda velley in Garhwal. In 1973 the refusal of the forest department in Mandal to allocate ash trees to villages while at the same time allowing a commercial firm to cut them. This led to a call by Chandi Prasad Bhatt, a leading activist, to embrace (chipko) the trees to protect them. In 1974 an attempt by contractors to fell trees at Reni village was foiled by village women as at that time their men had gone for work.

Later on, Sunderlal Bahuguna undertook a two-week fast at the Hanuman temple in Uttarkashi as a protest against the auctioning of forests, and young people from Garhwal and Kumaun went on a 700-kilometre singing

"Embrace the trees and Save them from being felled; The property of our hills, Save them from being looted."

Uttarakhand Sangharsh Vahini: In Tehri Garhwal protests took place in 1974 against the excessive tapping of chir pine. A sarvodaya leader undertook a fast and women tied rakhi bands around the wounded trees

Fig. 9.4 Sunderlal Bahuguna

Appiko movement: It started in 1983 as a reaction against the felling of trees in Uttara Kannada. Young men and women members of the Lakshami Yuvak Mandli claimed that the number of trees marked for felling in a particular area was excessive and that in the course of felling the damage done to the trees and topsoil in dragging them was unnecessary. They decided to embrace (appiko) the trees to protect them.

Anna Hazare's Efforts: Kishan Baburao Hazare, better known as Anna (elder brother) Hazare, is responsible for a remarkable programme of social and environmental uplift in the Ahmednager district of Maharashtra. His work involved extensive tree planting and effective water management with rainwater harvesting. From these small beginnings in 1975, the once poverty-stricken village of Ralegan Siddhi has been transformed into a model community which has become a source of inspiration and hope to many.

Narmada Valley Project Movement :

Narmada Project in Madhya Pradesh was strongly opposed by Medha Patekar, Baba Amte and Sundarlal Bahuguna in June 1993 as it will displace 100,000 people,mostly tribal. Similarly Silent River Valley project in Kerala was opposed by the Kerala Shastra Sahithya Prishad.

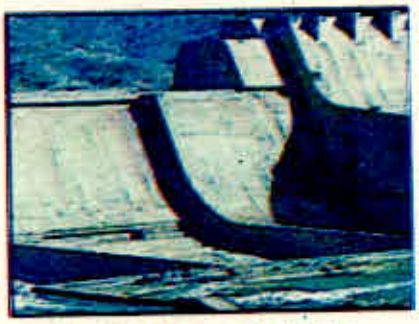


Fig. 9.5 Narmada Valley Project

Similarly Nirmal, an officer in the Indian Overseas Bank got success in removing the garbage near his home in Chennai with community support.

And there are so many other examples when individual initiation with community support not only resulted in drastic changes to support environment but also has brought changes in our legal system.

Role of National Agencies

In India, the National Environmental Council chaired by the Prime Minister, is the highest policy making body on environmental issues. The Council consists of senior representatives of Central Ministries, Chief Ministers of States, representatives of Non-Governmental groups, distinguished scientists, and academics. Almost all ministries of the Government of India are involved in decision making for sustainable development:

However, major participation is by the Ministries of : External Affairs, Environment and Forests, Agriculture, Water Resources, Finance, Industries, Rural Development-Commerce-Non Conventional Energy Sources, Finance and the Planning Commission. Coordination within the different bodies of the Government in India is mainly through consultative meetings and discussions. There are inter-ministerial and inter-departmental committees and Core Groups for coordination to formulate the optimum policy and legislation on issues concerning international cooperation/development assistance for Sustainable Development. Following are some main national agencies :

1. The Ministry of Environment & Forests:

The Ministry of Environment & Forests is the nodal agency in the administrative structure of the Central Government, for the planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programmes. The Ministry is also the Nodal agency in the country for the United Nations Environment Programme (UNEP).

The principal activities undertaken by Ministry of Environment & Forests, consist of conservation & survey of flora, fauna, forests and wildlife, prevention & control of pollution,

afforestation & regeneration of degraded areas and protection of environment, in the frame work of legislations. The organizational structure of the Ministry covers number of Divisions, Directorate, Board, Subordinate Offices, Autonomous Institutions, and Public Sector Undertakings

The Ministry of Environment & Forests has set up a National Environmental Information System (ENVIS) as a decentralized network for collecting, collating, storing, retrieving and disseminating information in the field of environment and its associated areas

Fig. 9.6 Logo ENVIS

2. The Central Pollution Control Board (CPCB)

The Central Pollution Control Board (CPCB), statutory organization, was constituted in September, 1974 under the Water (Prevention and Control of Pollution) Act, 1974. Further, CPCB was entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981.

Principal functions of the CPCB are

(i) to promote cleanliness of streams and wells in different areas of the States by prevention, control and abatement of water pollution, and

(ii) to improve the quality of air and to prevent, control or abate air pollution in the country

3. Department of Science and Technology

As part of the Ministry of Science and Technology, the Department of Science and Technology (DST) was established in 1971, to formulate policy statements and guidelines in Science and Technology. Consistent with goals and objectives, various programmes and activities of the Department are aimed at encouraging Scientific and Technological Community and promoting new areas of Science and Technology (S&T).

Major activities in the Science and Technology include:

- support to research and development projects, national facilities, special technology development programmes,
- launching of technology mission-mode projects on sugar production technologies, advanced composites and fly ash utilizations and disposal,
- promoting technology information system, home grown technologies through Technology Information Forecasting and Assessment Council (TIFAC);
- international S&T cooperation and joint programmes with developed countries;
- development of technologies for the socio-economic sector largely directed towards rural and urban poor;
- augmentation of facilities for meteorological forecasting, seismological observations etc.

4. National Environment Policy

You have already studied about all these in the previous chapters.

The National Environment Policy..... is intended to mainstream environmental concerns in all development activities.

5. The National Policy on Education (NPE):

National Policy on Education 1986 (With Modification Undertaken in 1992):

Reorientation of education towards sustainable development: Environmental education forms an essential ingredient in the education process of the country. The National Policy on Education provides for including, amongst others, environment as an integral part of curricula at all stages of education. The National Council of Educational Research & Training (NCERT), New Delhi has developed syllabi and curricula on environmental education both for Primary and Secondary School level. The country-wide movement of Science Exhibition being organised at the District, State and National levels has helped in spreading environmental awareness and motivated the children to think of the control measures for environmental protection.

Role of Non-Government Organization

All the programmes and activities in social sector cannot be implemented by Government alone. Efforts have been made to strengthen the involvement of non-governmental and voluntary organizations in reaching vast sections of population and also to promote community awareness and participation in various programmes in the social sector. In many schemes, the various Ministries/Departments have been providing funds to non-government organizations for undertaking developmental activities in sectors relating to drinking water, health, sanitation, education and environment, etc.

There are over 10,000 NGOs in India. Many of these are engaged in promoting eco-development, waste management, forest conservation, preservation of genetic diversity, and eco-friendly technologies in industry and agriculture.

Voluntary organizations have largely been responsible for ensuring the better delivery of rural services that include drinking water facilities, sanitation, road development programmes, etc. The Council for Advancement of People's Action and Rural Technology (CAPART) is the agency for financing and assisting voluntary action in the area of rural development.

SUKHOMAJRI CASE STUDY

Sukhomajri is a village nested in the Shivalik Hills near Chandigarh. It lies near Sukhna Lake, a popular boating and picnic spot for the people of Chandigarh. When the Sukhna Lake began to get silted many years ago, the Government of Chandigarh decided to find out the reason.

What they found was very interesting. Cattle and goats grazing on the hillsides had

made the hills bare. The soil was running off into the streams and river that fed Sukhna Lake, causing the lake to fill up with silt. Large chunks of land were sliding into ravines around the deep gorge of the Sukhna River. The village itself was in danger of being swallowed up.

At the same time water table in the village was very low. The barren land couldn't hold water and rainwater simply ran off the hills to the river below, carrying rocks, soil and sand with it.

The Central Soil and Water Conservation Research and Training Institute helped the villagers build three small reservoirs to collect rainwater for irrigating their land. The villagers planted trees and grasses on the hillsides and stopped letting their cattle graze freely. As a result plants grew back to cover the slopes. It helped the soil to retain water. Village wells and local springs benefited from the resulting higher groundwater level.

The village formed a Hill Resource Management Society in which every villager was an equal member. Everyone shared in the profit of water conservation project. Villagers also created a Water Users' Association. A water sharing system was also introduced by giving a 'water coupon'. One can use the coupon or sell it to someone. With the water sharing system each farmer could get the water he needed from the reservoirs.

The result of the project was less soil erosion and a constant water supply to the villagers. Sukhomajri is now covered with grasses , shrubs and trees. Local crop production is high. Other villages are also adopting the ways the Sukhomajri developed and gaining profits.

Role of International Agencies

Now it is being increasingly realized all over the world that living a harmonious and healthy life on this planet earth is man's greatest need. He has nowhere else to go to. Understandably therefore, humanity needs a new relationship with nature, a healthier bond between the 'Self' and the 'Surroundings'

In the international context, the Report of the **Club of Rome** in early seventies of the last century strongly advocated the environment factor. But the remedy prescribed, i.e.,' No-Growth' was a bitter pill.

The two **'Earth Summits'** the first one held in Stockholm, Sweden in June 1972 and the second one held in Rio de Janeiro, Brazil in 1992 discussed manmade global warming and the depletion of bio-diversity. Declarations of far reaching consequences were made at these Summits.

The Brundtland Commission Report (1987) really looked closely and critically at the environmental issues. This Report also provided an explanatory link between Third World poverty and global environmental deterioration. It also generated intellectual awareness of a new type of growth, i.e., 'Sustainable Development'.

The World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002 had the same theme.

India has become a party to international conventions which contribute to environmental protection and sustainable development. India has ratified almost all multilateral environmental conventions including the recent

- Framework Convention on Climate Change (FCCC),
- the Convention on Biodiversity,
- the Convention on Straddling Fish and Highly Migratory Fish Stocks and the
- Convention to Combat Desertification in Countries Experiencing Drought and/or Desertification Particularly in Africa.

Concrete actions have been taken to meet international obligations under these conventions to reaffirm India's commitment to pursue activities leading to sustainable development.

The Ministry of Environment and Forests functions as a nodal agency for:

- United Nations Envirohment Programme (UNEP),
- South Asia Co-operation Environment Programme (SACEP),
- International Centre for Integrated Mountain and Development (ICIMOD),
- International Union for Conservation of Nature and Natural Resources (IUCN) and various international agencies, regional bodies and multilateral institutions.

India is signatory to the following important international treaties/ agreements in the field of environment:

(i) International Convention for the regulation of Whaling;
(ii) International Plant Protection Convention;
(iii) The Antarctic Treaty;
(iv) Convention on Wetlands of international importance;
(v) Convention on International trade in Endangered Species of Wild Flora and Fauna;
(vi) Protocol of 1978 relating to the international convention for the prevention of pollution from ships;
(vii) Vienna Convention for the protection of the Ozone Layer;
(viii) Convention on Migratory Species;
(ix) Basel Convention on Trans-boundary movement of hazardous substances;
(x) Framework Convention on Climate Change;
(xi) Convention on conservation of bio-diversity;
(xii) Montreal Protocol on the substances that deplete the ozone layer and;
(xiii) International Convention for Combating Desertification.

The Ministry and its agencies cooperate with various countries such as Sweden, Netherlands, Norway, Denmark, Australia, U.K., U.S.A., Canada, Japan , Germany among others bilaterally and from several UN and other multilateral agencies such as the UNDP, World Bank, Asian Development Bank, OECF (Japan) and ODA (U.K.) for various environmental and forestry projects.

India believes that environmentally harmful processes should be stopped and that over-exploitation of non-renewable resources should be controlled.

India is signatory to various regional and international agreements, which provide financial assistance for development cooperation.

Programmes and Projects

Several activities and programmes involving multilateral financing are ongoing in India which include

Global Environment Facility through the World Bank, UNDP and UNEP: India is the second largest recipient of GEF funding. The salient feature of the GEF portfolio are: a diverse and varied portfolio comprising projects that are environmentally, socially and financially sustainable; projects involving a range of issues and approaches to address the questions of innovation, experimentation, demonstration, cost effectiveness.

Montreal protocol: The Protocol sets out a time schedule for freeze and reduction of ODS(Ozone depleting substances). A Multilateral Fund was established by the parties to assist developing countries to meet the control measures as specified in the Protocol. It assists the Government and the industry to design, implement, monitor and evaluate ODS phase-out projects and programmes in the aerosols/foam/solvent refrigeration and fire extinguishing sectors, covering large, medium and small scale enterprises. The MOEF is the national executing agency for the Institutional Strengthening projects for the phase-out of ODSs under the Montreal Protocol. In Asia, India is number three in receiving funds for CFC phase out programme, next to China and Malaysia.

Capacity 21 Initiative: There is only one Capacity 21 project in India which is being implemented by the Indira Gandhi Institute for Development Research (IGIDR) through the Ministry of Environment & Forests. The main objective of the project is to build capacity at various levels of Government, national institutes and the community at large through NGOs by introducing concepts of environmental economics into their resource use and planning decisions which include – Air quality, Water Quality, Biodiversity etc.

LIFE programme of UNDP: . The Local Initiative Facility for Urban Environment (LIFE) was launched by UNDP at the Earth Summit in Rio de Janeiro in 1992 The main goal of the programme is to help city dwellers to help themselves, to find local solutions to local problems.

SDNP: The Sustainable Development Network Programme is a UNDP initiative launched globally in 1990 to make relevant information on sustainable development readily available to decision-makers responsible for planning sustainable development strategies.

Kyoto Protocol: In December 1997, more than 160 nations met in Kyoto, Japan, to negotiate binding limitations on Green house gases for the developed nations, pursuant to the objectives of the framework convention on Climate Change of 1992. The out come of the meeting was the Kyoto Protocol, in which the developed nations agreed to limit their greenhouse gas emissions, relative to the levels emitted in 1990.

In India there are several ongoing projects which are being implemented through various bilateral programmes. The main thrust of these programmes is on Basic human needs; Women in development; Support to infrastructure; Private sector development; Environment; Good governance; Developing Eco Friendly goods and technologies. The largest share is for poverty eradication , natural resource protection and capacity building in that order.

EXERCISE

Short answer type questions:

1. One can set an example in application of sustainable development. How?
2. What is 'Chipko movement'?
3. What is CPCB?
4. Write some major activities in the Department of Science and Technology?
5. What are the roles of international agencies in sustainable development?
6. What is ENVIS?

Long answer type questions:

1. What role you can play in improving the environment of your locality?
2. How individual efforts can be changed into community participation? Discuss.
3. What is the role of 'The Ministry of Environment & Forests' in sustainable development?
4. How international agencies are helping India to develop sustainably?
5. What are the roles of NGOs in environmental protection?

Question for critical thinking:

Read the following:

The Harika river passes through the Girivar Hills. The hills are covered with forests. Many dozens of tribal villages are inhabited on the hills. In the valleys are located hundreds of small villages. The government is thinking about building a huge dam to generate hydroelectricity. The electricity will be useful in meeting the huge demand for more electricity in the growing cities and industrial complexes. The tribal communities and villagers protest that the dam's reservoir will submerge their homes and fields. Environmentalists are concerned that the dam may not yield as much electricity and water as is promised and that it will submerge vast area of forest land. They also feel that the dam may increase chances of earth quake in the area.

Now answer the following questions:

1. How would this developmental decision effect the local ecology of the illage?
2. Do you think it necessary to build a dam in the village?
3. As a villager, what steps you would have taken to stop the building of dam?

Discussion

We can contribute a lot in making our city/ village a better or a worse place to live in. Discuss.

CHAPTER 10

SUSTAINABLE AGRICULTURE (PART-I)

Introduction

Food is the basic necessity of all living organisms for their survival. In the story of civilization, agriculture was perhaps the turning point which changed the man's course of life i.e. from food gatherer to settled life. The term 'Agriculture' derived from Latin word 'Ager' means 'fields' and 'culture' means 'cultivation'. Agriculture is the science of growing plants and raising animals useful to man. The land where plants are cultivated is called a **field** and the plants grown or cared for in a field are called **crop plants**.

Various activities which are undertaken for successful cultivation of a crop in a field are called agricultural practices. The various agricultural practices are preparation of soil, sowing, application of manures and fertilizers, irrigation, weed control, crop protection, harvesting, threshing, winnowing, storage, crop improvement, rotation of crops, mixed and multiple cropping

The above agricultural practices include.

- The crop production management
- Crop protection management
- Crop improvement

Agricultural practices have probably changed faster in the past 200 years than ever before. Modernizing agriculture in the country has made India self-sufficient in food grains. But it has been felt that these changed practices will not keep sustaining our agriculture for a long time.

Sustainable Agriculture : Need

When we talk in terms of agriculture, sustainability is a dynamic issue because of changing requirement of the fast growing human population.

Agriculture is sustainable when it is **ecologically sound, economically viable, socially just, culturally appropriate and based on a holistic scientific approach.**

Now a day, there is change in process of land usage as well as excessive consumption of natural resources which will lead to unsustainabilty. We will have to conserve and protect our natural resources in order to meet the needs of forthcoming generation. Thus:

"Sustainable agriculture is defined as the successful management of resources for the purpose of agriculture to satisfy the changing human needs along with maintenance and enhancement of the quality of environment and conservation of natural resources."

In other words ssustainable agriculture is the use of farming systems and practices which maintain or enhance:

- the economic viability of agricultural production;
- the natural resource base; and
- other ecosystems which are influenced by agricultural activities.

Sustainable agriculture integrates three main goals—**environmental health, economic profitability, and social and economic equity.**

There are some fundamental principles of sustainable agriculture. Those are:

- Farm productivity is enhanced over the long term;
- Adverse impacts on the natural resource are minimized
- Residues resulting from the use of chemicals in agriculture are minimised;
- Net social benefit (in both monetary and non-monetary terms) from agriculture is maximized; and
- Soil erosion is prevented.
- Wastage of under ground water is minimized.

Sustainable agriculture includes a range of practices such as

- integrated pest management (IPM);
- crop rotations designed to reduce pest damage, improve crop health, decrease soil erosion, and in the case of legumes, fix nitrogen in the soil; and tillage and planting practices that reduce soil erosion and help control weeds. Sustainable agriculture is an effort to curb erosion by modifying plowing techniques and to protect water supplies by minimizing, if not eliminating, artificial fertilizers and pest controls.

The present global agricultural practices are placing unnecessary pressures on the sustainability of the earth's resources, therefore it is absolutely necessary to make a change.

How does "organic agriculture" differ from "sustainable agriculture"?

Organic agriculture has strict restrictions as to which, if any, synthetically compounded chemical pesticides can be used on crops; does not allow the use of inorganic fertilizers or additives to be used in the soil nor antibiotics to be used in animal production. Crop fields must be certified chemical-free for three years before a farmer can market crops as organic. None of these restrictions apply to sustainable agriculture systems.

Green revolution

Now you all know that sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs.

In India, there has been a four times increase in the production of food grains from 1960 to 2005. We have been successful in bringing about what is called **Green Revolution** i.e. increase in production of food grains. Green Revolution has been brought about by using better quality of seeds, better methods of irrigation, better use of fertilizers, pesticides & insecticides and better methods of storage. But this green Revolution has negative effect

on our environment. Let us see how?

Green Revolution- Impact on Environment

We know that Green Revolution aimed at increase in productivity by using high-yielding variety of seeds, increasing the input of fertilizers and pesticides and using more water. The credit of making India self-sufficient and surplus goes to Green Revolution, but after two decades of the high input intensive agriculture, the ill effects started to manifest.

Let us talk about Punjab, where the best and the worst effects of Green Revolution have been witnessed. During the period of Green Revolution, which was essentially a **'seed and fertilizer package'**; fertilizer consumption in Punjab increased thirty-fold. After some years of bumper harvests in Punjab, crop failures at a large number of places were reported in spite of liberal application of NPK (Nitrogen-Phosphorus-Potassium) fertilizers.

Why did this Happen?

1. Nutrients' Deficiency: Actually the plants need more than just NPK. They need micronutrients such as zinc, iron, copper, manganese, magnesium, molybdenum, boron etc. Zinc deficiency is the most widespread of all micronutrients deficiencies in the Punjab. As a result of soil diseases and deficiencies, the increase in NPK application has not shown a corresponding increase in the rice and wheat out-put. The productivity of rice and wheat has been fluctuating and even are declining in the most districts of Punjab, in spite of the increased level of fertilizers application.
2. Change in Land use Pattern: The Green Revolution brought in **monocultures** of wheat and rice which are known to be soil depleting crops. This replaced the existing mixtures and rotation of the diverse crops like wheat, maize, millets, pulses and oil-seeds. Reduction in leguminous crops (soil building crops) means depriving the soil of a natural fertilizing agent. Repeated cropping of wheat and rice led to draining the soil off nutrients. The shift in agricultural land use was from legume to wheat and rice, to wasteland.
3. Intensive Irrigation: The **intensive irrigation** has been a major component of Green Revolution. This demand for water had put pressure on Punjab's groundwater resources. Today more than 80 percent of Punjab's groundwater resources are used for agriculture. Further irrigation without proper consideration of drainage of excess water can be dangerous. The water table rises if water resources are recharged at a greater rate than the water is taken out. Moreover water logging is associated with another problem-**salinization**. Salt-pollution diminished the productivity of soil and sometimes ruins it forever. Both water logging and salinization can lead to **desertification.** Today, rich alluvial plains of Punjab suffer seriously from desertification caused by the introduction of excessive irrigation water to make Green Revolution farming possible.
4. Use of Chemicals: Besides irrigation, the Green Revolution type of agriculture requires **intensive chemical and technological inputs**- for example new seeds, more fertilizers and pesticides, tractors & other agricultural machinery and tool, and irrigation. It also needs a large area of land for making use of these inputs and technologies viable.

5. **Inequity :** Green revolution had greater impact on those farmers who were poor and had small land because bigger farmer were more accessible to fertilizers, seeds, tools etc. As a result, rich farmers became richer and poor became poorer. Another drawback was over mechanisation of rural areas lead to unemployment.

6. **Reduction in Genetic and Species Diversity:** There were thousands of varieties of grains and vegetables before the advent of modern agriculture. Take the example of rice. There were about 30,000 strain of Rice (Oryza sativa). After the Green Revolution, only 10 varieties are used for most of rice production. When the high yielding varieties were developed, it led to the reduction of genetic diversity when the genetic diversity is reduced; we have genetically similar plants, which are most prone to disease, insects and pests etc.
Green Revolution has also led to decrease in **species diversity** in the crops. Newly developed crops weren't resistant to diseases and insects. Local wild varieties are adapted to their environments. The varieties produced during Green Revolution are less resistant to draught and floods.

Alarming Signs

- About 60 percent of India's cultivated land area suffers from soil erosion, water logging and salinity problems.
- About 30 million hectares of fragile land now under cultivation is progressively degrading.
- About 30 percent of the area is drought-prone.
- It is estimated that from 4.7 to 12 billion metric tones of top soil is lost each year as a result of soil erosion.
- Our live stock requires 932 million metric tones of green and 750 million metric tones of dry fodder annually. But only 250 and 414 million metric tones respectively are available. Inadequate fodder affects live stock productivity and health.

Effects of Green Revolution in Punjab (between 1965 and 1980)

Benefits

1. Increase in rice production from 292 to 3228 thousand metric tons.
2. Increase in wheat production from 1916 to 7694 thousand metric tons.

Costs

1. Decline in pulses production 370 to 150 thousand metric tons.
2. Decline in oilseeds production from 214 to 176 thousand metric tons.
3. Destruction of genetic diversity with introduction of rice and wheat monoculture.
4. 40 new insects pests and 12 new diseases in rice monocultures.
5. Soils diseased with salinity, soil toxicity, micro nutrient deficiency.
6. 2.6 lakh hectares waterlogged.

Importance of soil for crops

Soil is defined as the uppermost weathered layer of earth's crust. Humus (dead remain of plants and animals) is present in this layer. Soil is a complete mixture of inorganic and organic material with variable amount of water and air.

Soils have many important functions

- **A Medium:** Perhaps the best appreciated is the function to support the growth of agricultural and horticultural crops. Soil is the **medium** in which growth and ultimately the yield of food producing crops occurs.
- **Provides nutrients:** Soil also plays an important role for our fauna. Undoubtedly the soil flora and fauna play a vital role in cycles which help the soil to support natural and semi-natural vegetation without additions of fertilizer. They breakdown plant debris, take in components from the atmosphere; aerate the soil together.
- **Supply Water:** The soil, coupled with the landscape and its vegetation is responsible for the distribution of all rainwater falling upon it. The nature of the topsoil will influence greatly whether the rainwater will run away across its surface, where it can supplement surface bodies of water, e.g. lakes, rivers, and in extreme situations lead to flash flooding or it will infiltrate to become stored in the soil for use by vegetation growing on it and by the soil based organisms. Or whether it will flow through the soil to the reach the groundwater and at what rate it will do this.

Think about it

It is quite staggering how much variety of life exists in soil. It has been identified that 1 gramme of soil in a good condition can contain as many as 600 million bacteria belonging to up to 20,000 species! Even a similar amount of apparently barren desert soils can contain 1 million bacteria from up to 8,000 species. Now you can understand how we damage our soil when we burn something on it!

Importance of Soil: Soil is very important for growing crops because all the crops derive their nutrient requirement from the soil. A good quality soil increases our crop yield. What are the features of good soil? Anyone amongst you can tell this. It:

- feels soft and crumbles easily
- drains well and warms up quickly in the spring
- does not crust after planting
- soaks up heavy rains with little runoff
- stores moisture for drought periods
- has few clods and no hardpan
- resists erosion and nutrient loss
- supports high populations of soil organisms
- has a rich, earthy smell
- does not require increasing inputs for high yields
- produces healthy, high-quality crops

All these criteria indicate a soil that functions effectively today and will continue to produce crops long into the future.

A Good soil is made up of mineral matter, organic matter and air as follows

1.	Mineral Matter	50-60%
2.	Organic Matter	7-10%
3.	Soil water	25-35 %
4.	Soil Air	15-25 %

Clay, silt, sand, gravel and rocks account for the inorganic material present in the soil while organic components of soil consists of living and non living plants and animals. Living organism include insects, earthworm and micro organism while non living matter is made up of plant and animal wastes and dead remains of plant and animals.

The Living Soil: The Importance of Soil Organisms

An acre of living topsoil contains approximately 900 pounds of earthworms, 2,400 pounds of fungi, 1,500 pounds of bacteria, 133 pounds of protozoa, 890 pounds of arthropods and algae, and even small mammals in some cases. Therefore, the soil can be viewed as a living community

Fig. 11.1 Living Soil

THE ONLY SOLUTION TO ALL PROBLEMS- DUNG, DUNG AND ONLY DUNG

No other fertilizer in the world is as cheap and harmless as dung fertilizer. The Indian farmer is able to grow the best and cheapest food grains in the world with the help of dung manure. This alone is capable of providing stability to the Indian economy. However, due to western influence farmers are forced to use costly and harmful chemical fertilizers

As a result, the once independent Indian farmer has now become dependent on others for availability of chemical fertilizers and tractors. He has become dependent on fertilizer plants, railways and money lenders or banks. Besides, he is left with no other option because natural dung manure is not available to him. The use of chemical fertilizers might have marginally increased agricultural production. However, the cost of production has increased manifold and in addition the taste as well as the nutritional value from food grains have

been lost. If the nutritional elements from soil which are consumed by crops are not replenished after each crop season, the soil loses its fertility gradually. The food grains grown on such soil become nutritionally poorer and eventually the land becomes barren and gets transformed into a wasteland.

"We abuse land because we regard it as a commodity belonging to us. When we see land as a commodity to which we belong, we may begin to use it with love and respect." *Aldo Leopold*

EXERCISE

Short Answer Type Questions

1. Define sustainable agriculture?
2. How organic farming is different from sustainable agriculture?
3. What was the need for Green Revolution?
4. Write down the importance of soil for crops?
5. Why it is necessary to conserve the soil?

Long answer type questions:

1. What is the need for Sustainable Agriculture?
2. Write some principles of Sustainable agriculture?
3. What are the environmental impacts of Green Revolution?
4. What are the basic elements of Green Revolution?
5. How is soil polluted and how soil can be conserved?

Questions for critical thinking

The slow poisoning of Punjab

When India's Green Revolution started, Punjab had a pioneering role. Here was India's northern state with its hardy farmers toiling to transform their fields into gold. They worked hard, experimented with new seeds and invested in fertilizers and pesticides. Punjab prospered and developed into the rice and wheat bowl of India. But now, in districts like Bhatinda, there is a new story playing out in the fields. The water table has collapsed, water bodies are poisoned with chemicals, the land has been degraded with excessive use of pesticides, and yields are falling.

All was fine till the cotton crop was introduced. The first few years were good and brought in good returns. But when the American bollworm attack came, the crop got destroyed. Panic stricken, the farmers guided by pesticide dealers, started pumping in

huge amounts of pesticide. Initally, the pests died, but later on, year after year, the pest started developing immunity to pesticide sprays and continued to attack the cotton crop and destroy it. The pests developed immunity fast as pesticide was often adulterated. The body mechanism of the pest fought against the excessive spraying. Result-crops were failing year after year, their debts increased. Many have sold their lands to pay debts.

Also pesticide use increased the incidences of cancer. With excessive use of pesticides, there was a rise in infertility clinics, diabetes, heart attacks, mental retardation and abortions. Magher Singh, a farmer from Banginihalsingh village in Bhatinda district found himself in hospital one day. He has sprayed in the fields for over five hours. The water in Harkishanpura has been certified as unfit for drinking by the government, but everyone continues to drink it as there is no alternative. The water was found to have high concentrates of chloride. Excessive pesticide use has destroyed the topsoil in many areas of Punjab and it has even crept into the water table endangering health of the villagers.

The pesticides have already crept into the food chains in Punjab. Many families use the attractive plastic containers of pesticide to store foodstuff once the spray is over. Chemical farming has brought with it disorders of endocrine glands, cancer, asthma, skin diseases, digestive track complications and infertility. Studies have shown pesticide in breast milk samples from Punjab.

Seeing the dangers to everyone's health, now there is need of complete shift to organic farming. The yield will fall initially. However, with the land regenerating with organic manure, the profits will climb. So will our health. India gloated over the success of the Green revolution that introduced pesticides and agro-chemicals. But it failed to see what this did to the rich biodiversity of the land.

Amidst all this, Punjab, the land of five rivers, has turned into the Be-aab, as water tables have dipped everywhere. Even the water is often unfit for human consumption. In some cases, it is even unfit for irrigation. The water has residues of nitrate, selenium and chloride

"Every Punjabi has to save Punjab without waiting for government intervention. In their prayers, each Punjabi exclaims: *Sarbbat da bhala*, which means 'may goodness come to all'. But what we are doing in Punjab is *Sarbbat da vinash*, which is destruction for all. All of us who live in Punjab have good reason to worry."

Discussion:

In India Green Revolution was the need of the hour.

CHAPTER 11

SUSTAINABLE AGRICULTURE (PART-II)

Introduction

Irrigation is the artificial application of water to the soil usually for assisting in growing crops. Irrigation helps in overcoming the problem of insufficient rainfall and helps in boosting productivity by maintaining soil water balance. We make use of surface water and ground water resources for irrigation.

Irrigation requirement of crop depend on the

- Nature of crop &
- Nature of soil.

Each crop has its specific period when water is needed, e.g. Paddy needs continuous irrigation and seedlings are transplanted in standing water but if the same water is standing in the field of wheat or cotton, water logging will occur which will lead to damage of crop. Water is needed before ploughing the field in case of wheat, gram and cotton.

Similarly, the nature of soil is an important factor in determining the irrigation requirements for example. The crops which grow in sandy soil have to be frequently irrigated since sandy soil has low water retaining capacity. In contrast, clayey soil which has higher water holding capacity, needs less frequent irrigation.

Irrigation System

Although agriculture in India is mostly rain fed and the two important factors which are responsible for getting good yield are timely monsoons & sufficient rain fall, yet several irrigation systems are used in our country to supply water to the field these include well, tanks, canals and rivers.

Irrigation systems used other than rainfalls in India are:

1. Wells: There are two types of wells- dug wells and tube wells. Tube wells are much deeper than the dug wells. Water from wells, whether dug wells or tube well, is lifted by various means such as manually or electric pumps.
2. Tanks: These are small storage reservoirs which intercept and store the run off water from catchment areas in addition to rainfall.
3. Canals: These are usually an elaborate and extensive irrigation system. The main canal is divided into branch canals which are further divided into distributaries. As a result a number of fields get connected by means of small distributaries.
4. Rivers: A number of river irrigation projects are working in our country. The river water is diverted by constructing barrages, dams and bends which are provided with sluice valves to regulate the downstream flow and the height of upstream flow.

Type of Irrigation

Various types of irrigation techniques differ in how the water obtained from the source is distributed within the field. In general, the goal is to supply the entire field uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little.

1. **Furrow Irrigation** In this type of irrigation, water is supplied to the field in between the two furrows. It is usually used for row crops e.g. cotton, sugarcane, potato etc.

2. **Flood Irrigation** Flood irrigation is a wasteful method and thus it is undertaken only where water is available in plenty. It is used when land is flat and well leveled. Water is supplied to the field with the help of an irrigation pump the crop field is at a comparatively higher level. This water is available all over the field by spreading.

3. **Check / Basin Irrigation** It is being practiced in India. Checks, rectangles or square of different sizes are used to collect water.

4. **Sprinkler Irrigation system** Water pressure is supplied to crop in the form of thin spray from above. It acts like artificial rain. Following are the advantages of this method.

   - Water can be applied at the control rate.
   - Uniform distribution and high efficiency can be ensured.
   - The system is helpful in cooling the crops during high temperature.
   - It is a popular method in case of some cash and orchard crops.

5. **Water lifting devices** These are the devices for lifting water from low-level water reservoirs such as wells, lakes and rivers. Water can be lifted manually, dish box by animals, wind and mechanical power generated by electricity or oil engines. Pumps running on petrol or diesel are commonly used devices for lifting water.

   Swimming basket system is a manual method of lifting water. Persian wheel or basket wheel is a water lifting method in which animal power is used

6. **Drip Irrigation System** This system is also called Trickle irrigation; It involves the slow application of water, drop by drop to the root zone of a crop.

Water requirements for proper Irrigation

Food production can be greatly increased by providing right amount of water at right time. Application of required amount of water to different crops lead to:

- Better aeration of soil
- Reduction in loss of nutrients by the leaching
- High efficiency of water use by crops.

Importance of Irrigation is

1. Irrigation helps in absorption of nutrients elements by the plants from the soil. The irrigation water dissolves the nutrients present in the soil to form a solution which is then absorbed by the roots of plants.
2. Irrigation provides moisture to the soil, which is needed for germination of seeds because seeds don't grow well in dry soil.
3. Irrigation is necessary for the growth of the roots. It is because the roots can't grow well is dry soil.
4. Irrigation supplies two essential elements; Hydrogen and oxygen to the crops. These are essential for the growth of plants.

Problems in irrigation

- Competition for surface water rights.
- Depletion of underground water.
- Buildup of toxic salts on soil surface in areas of high evaporation. This requires either leaching to remove these salts and a method of drainage to carry the salts away or use of mulch to minimize evaporation.
- Over irrigation because of poor distribution uniformity or management wastes water, chemicals, and may lead to water pollution.

Manure and Fertilizer

In recent past, there has been a record increase in food production. One of the factors responsible for this increase has been the use of fertilizers to maintain the fertility of the soil. Due to repeated growing of crops in the same field, the fertility of the soil decreases resulting in decrease in crop yield. In order to regain the fertility of the soil we have to add nutrients in the fields. The major sources of nutrients in the field are **manure and fertilizer**

Manure : A Manure is organic matter used as fertilizer in agriculture. Manures contribute to the fertility of the soil by adding organic matter and nutrients, such as nitrogen that is trapped by bacteria in the soil. The term "manure" was used for inorganic fertilizers in the past.

The main properties of them are:

- Manures contain nutrients in small quantities and hence are needed in large quantities.
- Manures are not nutrient specific. It is the reason that they aren't of much help when a specific nutrient for a particular crop is needed.
- Manures are bulky so it is not convenient to store and transport manures.
- Manures are recycled and don't cause pollution.

Role of Manure: Manures affect soil fertility and crop productivity by following way :

1. They enrich the soil with nutrients
2. They provide food for soil organisms like earthworm and bacteria.
3. Since they are rich in organic matter, manures improve the soil aeration and texture.
4. They increase the water holding capacity of any soil while drainage in clayey soil.

Types of Manure

(Farmyard Manure FYM) **(Compost)** **(Green Manures)**

1. **Farmyard Manure :** As the name suggests, it is produced by decomposition of cattle dung, urine and residues of the crop. The farm waste is dumped in a pit and covered with soil. This mixture is kept wet from time to time where it is acted upper by microbes and converted into manures.

   FYM contains nitrogen- 0.5% , potassium- 0.5% and phosphate- 0.2%.

2. **Compost:** Compost is prepared from rotten vegetable matter (like straw and vegetable peels etc) and animal refuse, which are heaped together and allowed to decompose.

   Decomposition takes 3-6 months and involves the action of both aerobic and anaerobic micro organisms. Compost can be prepared from farm refuse or town refuse (firm garbage) etc.Compost prepared from garbage contains about 1.4% nitrogen, 1.4% potassium and 1.0% phosphate.

3. **Green Manure :** A quick growing leguminous crop is cultivated and ploughed under to incorporate into the soil. Leguminous crops are chosen because they have nitrogen-freaking fixing bacteria in their root nodule. These bacteria fix up atmosphere nitrogen and enrich the Nitrogen content of the soil. A Green manure supplies organic matter as well as nitrogen to the soil it also forms a protective soil cover and prevents soil erosion and leaching of nutrients. Some manure crops are mustard, clover, cluster beans etc.

B. Fertilizer

These are compounds given to plants to promote growth; they are usually applied either via soil, for uptake by plant roots, or by foliar feeding, for uptake through leaves. Fertilizers can be organic (composed of organic matter), or inorganic (made of simple, inorganic chemicals or minerals). In the past, both organic and inorganic fertilizers were called "manures," but this term is now mostly restricted to man-made manure.

Main properties of fertilizer are:

1. Fertilizers are inorganic or organic compounds containing the necessary plant nutrients.
2. The nutrients content of fertilizers is very high as compared to manures so they are required in very small quantities.

3. They are manufactured commercially from chemicals and marked in concentrated form.
4. They are soluble in water so they are easily absorbed by the plants.
5. They are generally nutrient specific, i.e. they supply only one or more specific nutrients.
6. They are easy to use store and transport.

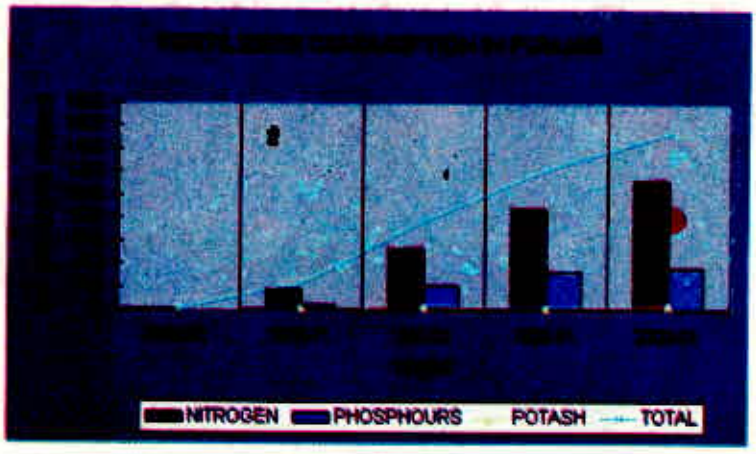


Fig. 11.1 Fertilizer consumption in Punjab

Hazards of using fertilizers

Though there has been a significant increase in crop yield with the use of fertilizers but continuous use of fertilizers affect soil quality and brings about pollution of water bodies. Repeated use of fertilizers leads to loss of organic matter, a deterioration in soil structure and decrease in porosity. As a result, the plant roots don't get sufficient oxygen and cannot absorb the salts effectively.

Further, the soil is more likely to become dug and powdery and can be blown by the wind, when not protected by a plant cover.

Biofertilizers :-

Bio-fertilizers are the micro organism (like bacteria, Algae and fungi) or biological active products, which are used to enrich soil fertility.

Some of the bio fertilizers commonly used are:

1. Legume- Rhizobium symbiosis
2. Azolla- Anabaena Symbosis
3. Free-living bacteria living in soil symbiotically.
4. Cyanobacteria Mycorrhiza (Symbiotic association of fungi with roots of higher plants.

Difference between Manures and Fertilizers

	Manures	Fertilizers
1.	Manure are organic natural substances produced by decomposition of plant and animals waste and dead bodies.	Fertilizers are inorganic
2.	Manures Contain organic matter in large quantities.	Organic matter is absent
3.	Manures contain nutrients in small quantities so they are needed in large amount	Fertilizers have high amount of nutrients thus they are needed in small quantities
4.	They are not nutrients specific	They are nutrients specific
5.	Manures are bulky so they are difficult to store, use and transport.	They are available in concentrated form. So they are easy to store, use and transport.
6.	Manures don't cause pollution	They cause pollution of water.

Application of fertilizers

The fertilizers can be applied before sowing, during irrigation and on standing crops.

1. Before sowing, fertilizers like potassium and phosphorous are applied.
2. In solution form: Few fertilizers are applied during irrigation of crops by dissolving them in irrigation water.
3. By Spraying: Some fertilizes are sprayed over the standing crops e.g. urea. Such fertilizers are water soluble, they are easily available to plants for absorption.

Crop Protection : When the crops is growing in the field, it is susceptible to be attacked by certain agents like birds, bacteria and insects which may lead to the loss in crop yield. So, we have to take timely steps to protect our crops from these factors. Any agent which causes the diseases is called a **Pathogen**. These may be bacteria fungus or virus. Pests are the birds rodents or insects. About 20% of potential crop yield in our country is lost every year to pest action.

Terms related to plant diseases

1. **Mildews** – The Pathogen appears as a superficial growth.. In downy mildews the Pathogen is internal and produce downy growth of white cotton mass of fungus . In powdery mildews, the Pathogen is external forming superficial growth of fungal hyphae.
2. **Necrosis**- The death or killing of host due to attack of pathogen.
3. **White busters** – These are white, shining , blister(swelling) like areas developed on the stem, leaves etc. e.g. White rust of crucifers.

4. **Wilt** – The drooping of entire plant due to loss of turgidity is called wilting.

5. **Blight** – It means burnt appearance of any plant due to attack of pathogen.

6. **Smut** - It means sooty or charcoal like mass of spores e.g. loose smut of wheat.

7. **Dampness off** – Young seeding become weak and soft thus they become incapable of bearing the load of upper part of plant. As a result seeding collapse and die.

8. **Rust**- This disease produces dusty symptoms which appear on host surface as small coloured areas which may be yellow red, brown or black e.g. black stem rust of wheat.

9. **Scab** – It refers to crust like rough lesions which appear on the surface of host making it very rough e.g Apple Scab.

10. **Cankers** – Sometimes, local necrosis results open wounds surrounded by living tissue e.g. citrus cankers

Mode of transmission of diseases-

Water born diseases: - The pathogen may be transmitted by water during irrigation.

Seed born diseases:- If the infected seeds are sown, the disease will spread.

Soil born diseases:- The pathogen may be present in the soil in which crops are grown.

Air born disease : - The Pathogen may be transmitted by air.

Diseases in plants :-

The crop plants may be attacked by bacteria, fungus or insects.

1. Diseases of Wheat

a) Rust of wheat caused by agent **Puccinia graminis**

b) Smut of wheat caused by **Ustilago**

Symptoms - Brown, Black or Yellow lesions appear on leaf sheaths.

Fig. 11.2 rust of wheat

Control Measures

1. Early sowing
2. Use of disease resistant varieties.
3. Spray dithane M-45 with concentration of 2g/l water at regular intervals of 10-15 day.

2. Diseases of Rice

a) Blast of Rice

Symptoms:- Brown boat shaped lesions appear on the leaves of rice plants.

b) Brown spot of rice

Symptoms : - Dark brown to purple brown spots seen on the leaves

Control Measures

1. Spray Bavistin at the rate of 2g/l water at regular intervals of 10 days.
2. Treat the seeds with thereon at the rate of 2.5 g/kg before sowing.

C. Diseases of Cotton

1. Cotton root Disease : It is caused by fungus present in the soil and its peculiar symptom is wilting of the upper leaves without any discoloration

Control measure

(i) Crop rotation for 3-4 years.

(ii) Treating seeds with brassicol at the rate of 5kg/kg seed or Brassicol is applied to soil.

2. Alternaria Leaf spot – It is a fungal disease that infect the leaves, bracts and bolls. Its early infection is more destructive than later stage infection

Control measure : It can be controlled by spraying any fungicide.

3. Boll rot : It is caused by fungus and bacteria both. It reduces the cotton seed quality and quality of fibre

Control : By spraying with copper oxy chloride at boll formation stage

4. Diseases of sugarcane

Red-rot of Sugarcane

(a) Red Rot of Sugar Cane

Symptoms:- It starts with appearance of small red spots on leaf midrib. The pith turns red and cracks appear on the stem with red streaks.

Fig. 11.3 Red rot of sugarcane

Control Measure

1. Crop rotation
2. Disposal of infected host debris .
3. Dip the sets in 0.25% Agallol solution. It should be done before sowing for five minutes.

5. Diseases of Potatoes

Late blight of Potato (Fungal disease)

Symptoms:-

1. Initially, lesions on the margins .
2. Necrotic areas turn brown to black in colour.
3. During humid condition, the entire leaf may be affected.
4. Potato tuber may also be affected during later stage.

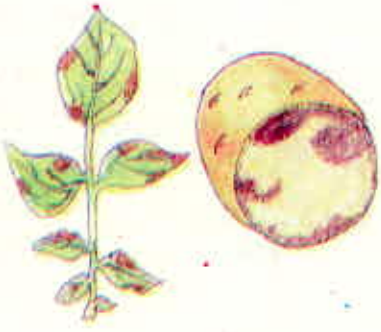


Fig. 11.4 Late blight of Potato

Control measures

1. Disease resistant variety should be grown .
2. Spray Bavistin at the rate 0.05% within interval of 15 days.
3. Crop rotation.

Agrochemicals and their Impact on the Environment

The chemicals which we use to increase the agricultural output are known as **agrochemicals.** These chemicals including insecticides, pesticides, herbicides and various fertilizers, have played very important role to bring Green Revolution.

A rise of 17902 thousand metric tons in food grain production from 1971 to 2000 has largely came due to intensive use of inputs like fertilizers, pesticides, insecticides and herbicides by the Punjab farmers. Unfortunately, the gains resulting from these practices have affected the environment. The main effects include:

- The excessive and non-judicious use of chemicals inputs leads to environment degradation such that Land degradation, air pollution, water pollution etc.
- The excessive use of pesticides and fertilizers have led to their accumulation in different compor ıt of the environment.
- The water run off . ɔm agriculture land pollutes lakes and streams causing eutrophication.
- **Bio-magnification** – Biological magnification is characterized by increase in the concentrat' ' of harmful chemical as if passes from one tropic level to another for exan.,.ıe when DDT is sprayed on the crops, this DDT being non biodegradable, leeches into river when rain occurs. This DDT is taken by algae and passed on to fish that eat them. The concentration of DDT is more in fish. When fish is eaten by man, it enters human beings. It has been seen that the level of DDT is quiet alarming in man than fish.

  DDT → river → Algae → Fish →Man
- Death of other Organism – Non target species may also get killed by use of many pesticides.
- Creation of Super pests – Due to over use of such pesticides the pests may develop resistance to pesticide.
- Water logging - Due to inadequate drainage and over irrigation, problem of water logging may occur.
- Salinization of soil – Soil becomes saline due to accumulation of salts like Sodium Chloride, Sodium Sulphate, Calcium Chloride etc. in soil profile. Salinity takes place mainly due to excessive irrigation.

Effect of Salinity

(i) Stunted growth

(ii) Reduction in crop production

Method to remove salinity

(i) Use good quality water

Use underground network of perforated drainage pipes for removal of salts

DDT (Dichloro Diphenyl Trichloro Ethane) bioaccumulation

Starting in the 1940's, the chlorinated hydrocarbon DDT was used in vast quantities all over the world for killing insects. It was cheaper and much more effective than other insecticides against nearly all insects. It saved millions of lives by killing the mosquitoes that spread malaria and saved millions from starvation by killing crop pests. Paul Müller of Switzerland won the Nobel prize for discovering it.

But: in the 1950's and 1960's there was an alarming decline in the populations of several predatory birds, particularly fish-eaters such as bald eagles, cormorants, ospreys and brown pelicans but also including the Peregrine Falcon, which is a predator on other birds. The Brown Pelican, bald eagle and osprey almost went extinct.

DDT is toxic at high levels; but at lower levels it interferes with calcium deposition in eggshells, causing them to be thin, fragile, and often crushed by the parents in the nest.

Although DDT was suspected, the levels to which the birds had been exposed were nowhere near high enough to have killed them. But when the bird's bodies were analyzed, they were found to have up to one million times the concentration that was present in the sprayed water. This led to the discovery of **bioaccumulation**, which means the steady increase in concentration of a contaminant with increasing level in the food chain. In the case of DDT, it results from the following factors:

1. DDT is not metabolized, and does not break down in the body.
2. It is much more soluble in fat than in water. So it accumulates in body fat and is not excreted.
3. The transfer of energy from lower trophic levels to higher ones is inefficient -so herbivores eat large quantities of plant material, and carnivores eat many times their body weight of prey during their lifetime. Since DDT is not excreted, the carnivore accumulates most of the DDT that was present in all of the prey organisms.

The DDT episode led to the publication of a famous book, **Silent Spring** by Rachel Carson in 1963. It led to a great increase in environmental awareness. DDT was banned in the U.S. in 1972 by the federal government, which found that it "had an adverse impact on wildlife" and "should be considered a potential carcinogen". However, DDT released before that time is still present in the environment and in various organisms in the process of bioaccumulation.

Impact of Fertilizers' use:

1. **Ground Water Pollution:** Once the ground water becomes polluted, it remains in this state for extended period of time. Ingested nitrate from polluted water can, however, be reduced to nitrite by gastrointestinal bacteria present in the tract of ruminant animals and in the human infants during first few month of life. It is harmful for human health.

2. **Surface Water Pollution:** Surface waters too receive largest contribution of nutrients from agricultural lands. It results into Eutrophication. Nutrient enrichment of waterbodies results in intense prolification and accumulation of algae and higher aquatic plants in excessive quantities which can result in detrimental changes in water quality and can significantly interfere with man's use of water resource.

Water pollution and Eutrophication

Excessive use of fertilizers, particularly nitrogenous one, increase the nitrogen content of the soil. Form the soil, the nitrates as well as phosphates are washed by rain and carried to lakes, ponds and river. These stimulate the growth of algae in water bodies called algal bloom. This algae grow quickly, die and decompose. During its decomposition, it depletes the oxygen content of water bodies which results in the death of fish and other aquatic animals. The algae growth coupled with depletion of oxygen content of water bodies is called **eutrophication.** Fertilizers therefore, must be used carefully and judiciously

3. **Soil Pollution:** Application of Nitrogenous fertilizer to soil always leads to gaseous lose. The extent of loss depends on type of fertilizer applied, besides soil, crop and fertilizer management practices. Formation and escape of gases, viz. Ammonia and various oxides of nitrogen in to atmosphere are cause of pollution. While there may not be any threat to terrestrial life from atmospheric ammonia, it contaminates water bodies, impairs visibility and causes corrosions. The nitrous oxide emanating from N fertilizers applied to soil contributes to global warming (green house gases) and it is also known to diminish stratosphere ozone layer. **Nearly 40% of the fertilizer used in India is applied to rice and about 50% of applied N fertilizer is lost.**

4. **Health Hazards:** There has been increasing concern on health hazards associated with heavy metals entering the food cycle via soil. Fertilizers contains heavy metals as impurities; rock phosphate being the potential source. The application of rock phosphate or its product to soil always implies the addition of significant amount of lead and cadmium into the soil.

Reckless use of chemical pesticides in animal husbandry, agriculture and public health operation have been reported as an emerging and a long term irreparable environmental damage concern throughout the world. Majority of these chemicals are beneficial when used judiciously. However, many of them contaminate the ecosystem and can be traced in animal and plant products. When eating such food the residual compounds reach the tissues of man and animal. Besides causing acute and chronic toxicity these pesticides are affecting the immune system in general causing varied metabolic and genetic disorders. The excessive use of pesticides has resulted in environmental pollution

CAUTION

As per a study conducted by Kheti Virasat a Patiala based NGO on impact of pesticides on human health in Punjab , the excessive use of chemical fertilizer like urea, DPK, NPK, etc and pesticides (insecticides and weedicide) have resulted in the disorders of endocrine glands e.g., thyroid, parathyroid, pituitary, kidneys and adrenals. The incidence of cancer, asthma and diseases of kidney, skin and digestive tract has increased by 20-25% in Punjab. Youngsters at the age of 25-30 are suffering from heart ailments and male infertility.*The* food we eat, the water and milk we drink are contaminated with one or other chemicals. So much so the traces of BHC, endosulphan, DDT & HCH the banned pesticides have been found in the most safe & sacred mother's milk in many cases in Punjab.

EXERCISE

Short Answer Type Questions:

1. Define irrigation?
2. What do you understand by chemical fertilizers?
3. Name some plant diseases?
4. What are Bio magnification ?
5. What are the differences between manure and fertilizers?

Long answer type questions:

1. What is the importance of irrigation?
2. Write down the methods of irrigation and difficulties for it?
3. What is manure ? Writes the type of manure?
4. How agrochemicals affects environment?
5. Why application of fertilizers is necessary on crops?

Questions for critical thinking:

BHOOMLA KHEDI FIRST EVER BIO VILLAGE OF MADHYA PRADESH

Bhoomla Khedi one of the village under Chanchoda block of the district is getting fame as a first ever bio village of M.P state. The project is being developed by Rajiv

Gandhi Water Shed Mission under drought eradication development programme. The basic aim behind this project is to establish a bio village, which uses bio techniques to improve not only crop production but also get the quality, crop free from the harmful pesticides. Firstly the local soil was minutely examined for the presence/absence of various elements and suitability of soil for type of crops. The farmers were advised about the elements required for the soil to get a better crop. The soil was tested for the presence of quantity of Zinc, molybdenum, magnesium, magnese, iron and copper. Besides these soil was also examined for nitrogen, phosphorous and potassium. Based on these tests reports farmers were guided accordingly about the type of crop most suitable for the soil. The treated seeds were given to the farmer and after that bio-fertilizer was used. The seeds were being treated to make them free from fungus, germs and bacteria Fifteen pits were formed in Bhoomla Khedi. These pits were further filled with organic waste, soil & cow dung. These pits were also treated with fungus named "TRICODERMA" along with garbage, soil and cow dung. This makes soil/fertilizer ready in 60 days instead of usual 90 days period. Use of bio technique resulted in production of onion, papaya, zira, ajwain etc. The results were astonishing and the production was almost double then it used to be in previous years. The most important thing was that no chemical insecticide is being used. An equipment is placed in the center of the fields, which attracts the insects, and they are automatically caught in that instrument. The price of this instrument is also nominal. The production of crops with clinical aroma started but the problem was how to extract the oil from it. As the oil is the main source of income for the farmers. An instrument was prepared at a nominal cost in consultation with local farmers and project officer of the micro water shed mission. The problem of extraction of oil was solved. The farmers are now happy, as the concept of Bio Village has brought prosperity in their lives. (Source : http://guna.nic.in/deve.htm)

Now answer the following questions:

1. Which changes have brought about by villagers to convert it into a bio-village?
2. Who helped the farmers to bring about these changes?
3. "Bhoomla Khedi has adopted the path of sustainable agriculture". Do you agree? Why?

Discussion:

If you are a farmer, which ways of sustainable farming you will adopt? Discuss.

CHAPTER 12

SUSTAINABLE AGRICULTURE (PART-III)

Introduction

You have already understood the concept of sustainable agriculture, green revolution, importance of soil, irrigation systems and crop production in chapter 10 and 11. Now you will study the element of sustainable agriculture application of biotechnology in crop production and management of agriculture products.

Elements of Sustainable agriculture

We all know that sustainable agriculture integrates three main goals—environmental health, economic profitability, and social and economic equity. People in many different capacities, from farmers to consumers, have shared this vision and contributed to it. Following are some common practices which should be adopted by the farmers to attain the goal of sustainability.

Mixed Farming: This practice includes managing different crops and/or animals in farms. Mostly it involves feeding different animals and their excreta is used as nutrients for crops. In other forms of mixed farming animals are allowed to graze grass to keep it short under fruit trees or excreta of pigs is used to feed fish.

Fig 12.1 Mixed farming

Mixed farming is very common in all parts of world. Advantage of this system is that it helps producing essentials of livelihood for farmers by producing food and other commodities at same place. Mixed farming type depends on the biophysical conditions such as rainfall, radiation, soil type and diseases common in that place as well as market price, political stability and technological developments of the area.

1. **Mixed Cropping** – Mixed cropping is the practice of growing two or more crops simultaneously in the same field. The purpose of mixed cropping is safeguard risk and monetary losses against total crop failure under poor rainfall condition.

Some mixed crops Grown in India

1. Groundnut + Sunflower
2. Sorghum + Pigeon pea
3. Barley + Chickpea
4. Wheat + Mustard
5. Wheat + chickpea
6. Soya bean + Pigeon pea

Inter–cropping

Inter cropping is the practice of growing two or more crops simultaneously in the same field in rows. Definite row patterns are followed in intercropping like 1:1, 1:2, or 1:3.

1:1 means that there is one row of main crop with one row of intercrop. Similarly, in 1:2 row patterns, one row of main crop is followed by two rows of intercrops.

Advantages of Inter-cropping

1. It maintains the soil fertility
2. It helps in increasing productivity.
3. It economizes space and time of cultivating two or more crops.

Differences between Intercropping and mixed cropping

Inter cropping	Mixed Cropping
1. Sowing is done in definite rows.	1. No row pattern is there.
2. Seeds of component crops are not mixed.	2. Seeds of component crops are mixed before sowing
3. It aims at increasing productivity per unit area.	3. It aims to minimize the risk of crop failure.

When same crops are grown in the field year after year, it derives the same nutrient from the soil and as a result the soil gets depleted of its nutrients. Its fertility goes down and productivity decreases. The weeds, pests and diseases specific to the crop keep on multiplying and bring down the productivity further.

These problems can be overcome when different types of crops are grown alternately in the field **The practice of growing different crops in the same field alternately is called crop rotation**. To increase the fertility of the soil, particularly Nitrogen and organic matter content, legume crops and green manure crops are included in the rotation.

A possible alternative to the Rice-Wheat cropping pattern could be Maize-Potato-Sunflower. The advantages in these cropping systems are the lower requirement of water, low input requirements and better commodity prices. Such cropping system would not only benefit the farmers by providing them with more income per acre but is also well suited for sustainable agriculture for ensuring food security in future.

Advantages of crop Rotation

1. When different crops are grown in the field one after another, the yields of produce obtained are greater than when the same crops are grown year after year.
2. All crops don't require nutrients in the same proportion. By crop rotation, the fertility of the soil is utilized more evenly and the soil does not get depleted in a particular nutrient.

3. The incidence of weeds, pests and diseases is reduced.
4. When different crops are grown, the activities concerned with the preparation of soil, sowing, harvesting and other activities are spread throughout the year, thus reducing the work pressure at any particular time.

Biological and Economical considerations

We know that in order to adopt the path of sustainable agriculture, we have to mend the method of farming So we have to follow practices like mixed farming, mixed cropping, crop rotation etc. These practices will not only help regaining the nutrition value of our soil but also save our environment. For example when we grow two crops simultaneously in one field, the fertility of our soil will not reduce much because different crops need different nutrients. Moreover when we grow one legume crop with some other crop its potential to fix atmospheric nitrogen will reduce the need of fertilizes or manure in fields. The pests are crop specific and if they attack crop, they cannot damage the whole crop. This reduces the economic lose to farmers.

Similarly in crop rotation, when different types crops are grown alternative, pests growth reduces because of the break down of their cycle. This also decreases the need of pesticides and results into more output which help us giving quality products with economic benefits. You know in Punjab, we daily read & hear the news about the suicides of farmers. This all happens of the wrong practices adopted by Punjab farmers.

Organic Products

In Punjab, main problem at hand is to **come out of the paddy-wheat cropping** pattern. There is an urgent need to diversify into new areas like vegetables and fruits, oil seeds, pulses and allied fields such as dairy farming, poultry, piggery, etc.

Our products are of poor quality and have traces of chemicals used to control weeds and pests and residues of chemical fertilizers. The contamination of food material with pesticides is becoming a very serious problem. Punjab uses the maximum amount of chemicals in agriculture as compared to any other state of the country.

In the world market, people are very much conscious of the purity of the products. So, special emphasis is being laid on organic farming i.e. farming without the use of chemicals. Such products are known as **organic products** and are sold at a premium.

Use of Biofertilizers and Bio-Pesticides

Modern agricultural production has been enhanced enormously by using chemical fertilizers. The incidence of many diseases has reduced by the application of chemical pesticides. Our agriculture is therefore heavily dependent upon the use of chemical fertilizers and pesticides. However, these agricultural chemicals are not always beneficial to the mankind. Indiscriminate use of these chemicals cause some deteriorating effects on the environmental quality and ecological stability. (You have already studied about the

impact of the use of these agro chemicals on environment). In addition to this, chemical fertilizers are very harmful as given below:

1. Due to lack of awareness farmers are notable to use chemical fertilizers in right amount so it becomes more harmful for the plants.
2. The chemical fertilizers and pesticides applied to crops are mostly lost in surface run off and finally pollute the water reservoir. Accumulation and persistent concentration of some pesticides in the environment poses hazards to many other living organisms, including human beings.
3. The manufacture of chemical fertilizers is a highly energy requiring process. On an average single unit of Nitrogen production requires about two units of fossil fuel (Such as petroleum and coal) (these sources of energy are non renewable and their availability is definitely going to decrease after sometime.
4. Most of the chemical pesticides are not specific. In addition the pests usually develop resistance to a particular pesticide. There fore, the formulation of pesticides is periodically changed in order to have their affectivity.
5. The production and management of chemical fertilizers and pesticides releases several pollutants which ultimately damage the crop, soil and the environment.

Fertilizers of Biological Origin

Fertility of soil is very important. From view point of an agriculturist the fertility of soil depends not only on its chemical composition but also on quality and quantity of useful microbes present in it. Moreover, if the composition of the soil is not upto the mark and poor in fertility, materials of biological origin are added to it to improve and maintain its fertility. These materials are grouped under **two broad** categories

(A) Manures (B) Biofertilizers

(A) Manures : Manures are partially decomposed organic materials added to the soil to increase the fertility of soil and productivity of the crop. They contain almost all the essential nutrients required by plants.

The manures are of three types.

1. Farmyard manure 2. Compost 3. Green Manure

These have already been discussed in chapter 11

(B) Biofertilizers : Bio- fertilizers are the micro organisms which bring about soil nutrients enrichment, maximize the ecological benefits and minimize the environment hazards. For this purpose the specific micro organisms (such as bacteria, cyanobacteria, fungus etc) are cultivated in specific laboratories and then supplied to farmers so that they can be utilized in the field.

Advantages of using Biofertilizer in Agriculture

1. Biofertilizers increase 15-35% additional yield in most of the vegetable crops.
2. Some of the bio fertilizers enhance crop yield even under ill irrigated condition where chemical fertilizers are not of much advantage.

3. They don't cause atmospheric pollution
4. Bio fertilizers are cheap and economical. They can be used even by poor farmers.
5. Some Biofertilizers excrete antibiotics and thus act as biopesticide.
6. Bio fertilizers improve physical and chemical properties of soil.

Biopesticides

The toxic chemical substances which are used to eradicate the pests and protect the useful plants and other organisms are commonly called pesticides.

An ideal pesticide is one which possesses the following characteristics :

1. A good pesticide should be easily available in the market and shouldn't be costly.
2. It should control only the specific target organism.
3. It shouldn't be toxic to other living organisms.
4. It should be bio degradable.

Unfortunately most of the chemical pesticides don't possess the ideal qualities. On the contrary, they are costly, harmful, pollute the biosphere and create ecological imbalance. Many chemicals like DDT are known to have carcinogenic effects some cause dermatitis and allergy when come in contact with the skin. Therefore, scientists are searching for new approaches to control the insects and pests. A fascinating progress has been achieved in controlling weeds, insects and pests by the use of bio pesticides.

Biological Pest control

Bio pesticides are the pesticides which are used to control the weeds and pests. They are of two types : Bioherbicides and Bioinsecticides.

(a) Bio Herbicides: Herbicides are the chemical substances used to eradicate the weeds. There are more than 550 herbicides available in the market.

The biological methods of controlling weeds are more effective and economic which dose not cause pollution.

The biological control of weeds involves utilization of biological agents (such as insects, fungi, bacteria, nematodes which suppress or kill the weeds without significant injury to other plants. Chemical from any biological agent may be effective on herbs as well as on insects. If is effective on (herbs) plant system, it is called Bio herbicide and if it is effective an animal system (insects)it is called Bio-insecticide.

Some examples of weed control by Bio herbicides

1. Extensive growth of cacti in India and Austrialia was checked by Introduction of its natural herbivore –Cochneal insect.
2. Water Hyacinth has been successfully controlled in florida (USA) with the application of an indigenous fungus. Similar attempts to control water hyacinth in India are also being made.

3. Specific insects have been introduced which feed on the weeds. However, the specificity of insects should be carefully tested so that it may not switch over to useful crop in case the original host food get eliminated.

4. Certain crop plant don't allow the weeds to grow nearby eg alfa alfa, Soyabean, Sunflower these crops having seeds with good germination rate give a vigorous growth first and compete with weeds.

Bio insecticides

Several methods of biological control are being used in the pest managements to keep the environment pollution free and yield clean, non toxic and good quality products for human consumption. Some of them are given below:

1. Pathogens, Parasites and predators : In this method, the harmful insects and disease causing pests are controlled by the application of their natural parasites and predators. Some of the common example are given below

- Baculoviruses (A group of viruses) are known to infect the larval stages of many harmful insects such as ants, wasps and beetles. These biological weapon are not only effective as potential biological control of these insects but are also harmless to non target organisms.
- A bacterial species namely bacillus thuringiensis (Bt) is known to kill a wide range of insects (such as moths, flies, beetles, mosquitoes) some strains of this bacteria can kill animal and plant parasite nematodes, snails, protozoans and even cockroaches.
- Aphids are controllec by the use of lady bugs or the praying mantis.

2. Sterilisation strategy : In this method, a large number of male insects are made sterile by irradiation. They are reared in the laboratory and released at the time of mating. The fertile female mate with sterile males and fail to produce offsprings. More over the sterile male, compete with the fertile population So that the pest population declines.

3. Pheromones : Pheromones are high volatile chemicals which help in communication and sending signals between insects. Pheromones are secreted by the females and detected by males. These are species specific. The population size of insect pest can be controlled by controlling their mating behavior by using pheromones. For example gypsy moth have been controlled by this method.Traps containing pheromones of the female gypsy moth are placed in the infested fields. Males are lured into the trap and cannot reproduce with the female.

4. Natural insecticide : The insecticides obtained from plant sources are natural, non persistant, less toxic to mammals and easily biodegradable. There are a large number of natural insecticides. Some common one are given below :

a. Rotenones : Are obtained from roots of a plant which are used as effective insecticides in India. The insecticidal properties of rotenones were first discovered by Chinese.

b. The alkaloids of Tabacco are used as effective natural insecticides.

c. Neem extracts contain an insect repellant and is used as a good natural insecticide.

d. A Chemical extracted from the leaves of a wild bush of South and Central America kills the larvae of yellow- fever spreading mosquito.

Integrated pest management (IPM Programme)

Integrated pest management programme is an important step taken by the government of India, which involves the harmonious application of various **cultural** controls to **insure** minimum environmental pollution and proper maintenance of ecological balance. Use of chemical pesticides is not only **hazardous contaminate food** and water but also have low efficacy. Pesticide poisoning may lead to asthma and skin disorder, liver ailments, psychological problems and even paralysis.

To counter all these disadvantages of chemical pesticides, biological control of insects and pests offer the best resources. The biological control includes the application of biological organisims (such as bacteria, fungi) or the products of biological origin (Such as certain Neem Products, bio pesticides etc) The biological control methods may be accompanied with soil conditioning, rotation of crops and improved sanitation practices. Crops can also be protected from pests by methods of starvation. A preferred trap crop may be planted around a field or mixed with economic crop to attract the insects so that they do not concentrate solely on agricultural crops.

Integrated pest management programme therefore favours biological control methods which are ecologically safe, target specific and harmless to other life forms. Beside they don't develop resistance in insect pests. The vegetables and fruits of these plants which are treated with bio pesticides have better taste and shine.

Applications of Biotechnology in-crop improvement

Agriculture has evolved since the dawn of civilization, first as a mean to guarantee food supply, and then, as a source of family income & improved profitability and finally becoming the back bone of economies of both Punjab and India. It still needs to evolve further as so far the emphasis has been more on Productivity than on sustainability.

But, we all know that in Punjab, agriculture has started suffering from various limitation like

- reduced land and water availability,
- constraints associated with conventional breeding and
- increased soil, water, and air quality deterioration due to intensive use of farm chemicals.

In this scenario, biotechnology is fast emerging as a very powerful technological force to bring about a balance between agriculture and environment

Biotechnology in agriculture refers to the techniques that allow scientists to modify DNA, the genetic material of crop plants and livestock, to enhance their tolerance to pests and diseases, increase yield and improve quality and nutritional value. Such plants are called GMOs. (Genetically modified organism)

It has a wide range of possible applications in agriculture and food. Biotechnology can also bring many benefits to medicine, the environment and industry.

Scope

There is great scope for agri-biotech inputs and products. In the country, the transgenics of wheat, rice, brassica, moong, bean, pigeonpea, potato, tomato, cabbage and cauliflower etc. are ready for large-scale production. Transgenic wheat contains more protein content, better quality and also higher lysine contents.

The work on development of edible vaccines by incorporation of an expression gene in tomato, cabbage, and banana is in progress particularly for cholera, rabies and hepatitis B. This has significant implication for developing countries like India where immunization against common diseases is difficult and expensive. Hence, genetic modification of crops for production of edible vaccines could make a major difference in time to come.

March 26, 2002, marked the beginning of an era in Indian agriculture. That day the government gave the green signal for the commercialization of the first transgenic, or genetically engineered crop (GEC). It comes in the form of hybrid Bt-cotton, a transgenic cotton variety resistant to American Bollworm, which is known to destroy over 50 per cent of the crop in India.

The biotechnology benefite to agriculture include

1. Improving Crop Yield:

Genetically improved plants (GIPs) have been developed to be **more tolerant to disease, weeds insects, and drought and be able to grow in difficult environmental conditions**. Increasing a crop's yield enables us to use less land to produce the same amount or more food. This also allows us to preserve other lands such as native forests and delicate ecosystems for the benefit of the environment and wildlife.

2. Less Chemical Usage

Biotechnology can also help farmers **reduce the amount of pesticides** they need to use on crops. For instance, by making crops tolerant to a specific herbicide, weeds can be killed without damaging the crop. The amount of herbicide used per acre of crop can also be reduced relative to regular practices. Insect-tolerant crops not only reduce the volume of **insecticide** sprayed but also encourage natural and biological control by not affecting the beneficial insects.

3. Improved Food Quality

Biotechnology can improve the quality of our food. Scientists have the ability to improve the **taste, appearance and the nutritional quality** of fruits and vegetables.

Another advantage created by biotechnology is genetically improving the gene responsible for ripening. For example, **delayed-ripening** tomatoes reduce the waste that occurs during transport. In India much of fresh produce is destroyed on the way to market due to unsuitability of these crops for transport. Delayed-ripening fruits and vegetables would benefit consumers living far from agricultural areas.

4. Environment Friendly

Among the environmental benefits of biotechnology is a reduction in the use of pesticides and herbicides, the prospect of more food production from the same unit of land and more nutritious food produce. In addition, scientists have developed methods utilizing biotechnology to clean up pollution (bioremediation), caused by, for instance, oil spills.

Management of Agriculture products

Production of sufficient quantities of various food materials is the first necessary condition to meet the food and nutrition requirements of our people. But crop yields are seasonal and vary from one region to another. Therefore, even if we produce enough food, there is no guarantee that it would be regularly available to each citizen. To make this possible, it is necessary to ensure that food materials are available at all places, throughout the year and at reasonable price. This, in turn, needs elaborate operation designed to conserve, preserve and distribute food materials efficiently.

An effective management system which will ensure that the basic needs of all section of the population are fulfilled, thus involves a host of matching activities : Planning, production, procurement, processing, packaging, transportation and distribution.

Let us look at the important elements of this system.

Storage : Most crops, as you know, are harvested only once a year. That is, they are available in plenty during a particular period. Similarly fruits and vegetables also have their special seasons,

Storage of food materials is not as simple as it appears to be, for during storage they have to be protected against all possible causes of damage or loss. Damage to food materials in storage may arise from both abiotic factors and biotic factors.

Abiotic Factors: Change in humidity, moisture and temperature during the period of storage are some abiotic factors responsible for damage to stored food materials. For example a mature grain contains about 16% to 18% water by weight. For safe storage this must be reduced to 14% by drying.

High moisture content as well as high temperature accelerate the growth of moulds.

The material of the containers, used for storage of food grains also plays an important role for example, citrus fruits often react with copper to produce toxic compounds. Some metals like lead (Pb) are poisnous and should not be used for storing or packaging of food materials. Containers should, there fore, carefully selected for different types of food materials.

Biotic Factors : Man shares his food with many other living organism, which eat away a large portion of it. The maximum loss of food materials on this account, perhaps, take place during storage. Let us discuss some of the main path ways of this loss.

(a) Rodents, Birds and Animals : These animals attack almost all crops in the fields, in godown and even in our home. Six rats on an average consume as much food grains as one man eats. In addition, they destroy about five to six times of what they eat, by cutting the

grains into small pieces with their teeth. Birds also contaminate stored food material with their droppings and feather. Food thus contaminated could become unfit for human consumption, as birds' excreta is a carrier of many microorganisms such os bacteria Salmonella which is a major source of food poisoning.

(b) Infestation due to insects and micro organisms :

Food materials are frequently spoiled and degraded by insects, worms and micro organism. An attack by these organism is called infestation. Insect pests which damage stored food grain are weevils, grain borer, red flour beetle etc.

Micro organism like moulds, yeasts and bacteria also cause considerable damage to stored food materials. You might have seen spoilage of bread due to fungal growth and of milk by bacteria. The action of micro organism on stored food grain may result in loss of weight, failure to germinate, discoloration, heating and production of toxins.

Activity : Take a sample of wheat or any other food grains (25 to 30g). Examine it with a hand and

* Count the number of living or death insects.
* Also count piece of broken grain, excretes of birds and rodents, stones and straw.
* Look for the presence of moulds. Tabulate your observation and compare it with that recorded by your friends.

Essential features of storage structures : Different types of Containers are used for storage of different types of food material. The following are essential features of a good storage structure for storing food grain on a large scale:

- Easy to clean
- Proof against water and moisture
- Protection against variation in temperature and humidity.
- Protection from entry of rodents birds insects and other animals.
- Convenient for periodical inspection of stored food materials.

Pest Control during Storage: In spite of all precaution taken for safe storage of food grains. Infestation by pests such as insects and rodents cannot be entirely prevented. The deterioration set in the stored grain may often go unnoticed. Stored grains therefore need regular checking. Atleast every fortnight samples should be taken from different parts of the stock and carefully examined to detect the presence of insects. If insects are found to be present in the sample, it may contain one or more of the following .

- Webs
- Cocoon, living insects
- weevil led grain

Patches of white powdery material, if seen on the bags or on the floor, or a general rise in grain temperature, are indications of the presence of insects. Presence of rodents can be detected by their excreta or holes made in the bags.

Pesticide are used for controlling pests. These chemicals are either applied by

spraying or by fumigation. Spraying is more suitable while disinfecting the storage structure before the arrival of fresh stock. A variety of pesticides under different commercial names are now available in the market .

Fumigation, on the other hand, is the most convenient and effective method for checking the growth of insect population in the stored grain. Fumigants consists of volatile chemicals which quickly vaporize and kill the insects without affecting the grain.

So what measure, do you take to check rodents at home?

Food Preservation

Wastage of perishable food material can be reduced by using appropriate methods and technique of preservation. Food preservation, in fact, offers several advantage :

1. Augmenting food supply
2. Reducing food wastage
3. Making up for dietary inadequacy
4. increasing the storage period of food stuff
5. Ensuring their availability in distant places.

Food preservation essentially means longer retention of the nutritive value of perishable materials.

The basic steps in the food preservation are

(a) elimination of micro organisms responsible for spoilage, or

(b) creation of condition unsuitable for their growth and action.

Let us now study a few methods of preserving food.

(a) Dehydration and Sun drying : Removal of water from fruits and vegetables is called Dehydration. Dehydration reduces the moisture content of food materials and inhibits, the growth of micro organism. This can be done by drying fruits and vegetables in the sun or by removing their water content under controlled conditions of temperature and humidity for eg. Spinach, Methi leaves, cauliflower are generally preserved by sun drying. Meat, fish and their products are dehydrated by a process called smoking.

(b) Preservation by salting and Sugar : Salt and sugar are widely used for the preservation of fruits and vegetables. The presence of a high concentration of salts (15% to 18%) drains out the water from food materials through osmosis and prevents their spoilage by inhibiting bacterial growth. Salt is used both in the dry form as well as in the aqueous solution. It is extensively used in the preservation of tamarind, beans, raw mango, amla, fish and meat. Sugar syrup containing more than 68% sugar also inhibits bacterial growth as it has very little free moisture available. The micro organisms already present in food materials there fore gradually die due to lack of moisture.

Besides salt and sugar, vinegars, oils, spices and citric acid etc. are also used for preservation. You would have noticed these being used in the preparation of pickles, chutneys, ketchups and squashes.

(c) Deep freezing : Deep freezing is a direct method for inactivating enzymes and inhibiting bacterial growth. It is used for storing fruits, vegetables, meat, fish, and their products.

(d) Chemical Preservation : Two common chemical preservatives permitted for use in our country are (a) Benzoic acid (benzoate) and (b) Sulphur dioxide .

Potassium metabsulphite is also an effective preservative. It is used for the preservation of colour less fruit like apples. Litchis, raw mango chutney and lemon squash.

Besides these, a large variety of techniques are used for preservation of food materials. In a commercial scale. Canning, bottling, vacuum dragging and irradiation are some such examples. Some common food products obtained from preservation of fruits and vegetables are pickles, Jam, Jelly, Marmaladi, Squash and chutney.

Transportation : Food stuffs can be destroyed easily by microbes and insects. So immediate transportation is required. In India, specially in rural areas, short distances can be covered by tonga, bullock carts, tractors etc. long distances can be covered by trucks, trains, aero planes etc.

Food Processing : Try to think about the food you ate at your previous meal How many of the raw materials used in its preparation were present in their original forms? You will realize that only a few food materials are consumed in the raw form in which they are derived from plants and animals For example wheat is threshed and ground, rice is husked & polished.

The process of changing raw food material into a more readily usable form is called food processing. Husking, Threshing, polishing and grinding are example of elementary methods of food processing, Many a time, the product obtained after processing are very different in appearance. Sugar, edible oils, instant coffee, tea, butter, ghee are some examples of processed foods.

Food processing is in fact as old as agriculture it self. The basic purpose of food processing remains the same, that is to prevent food from spoilage, to retain its nutritive value as well as to ensure its availability through out the year.

Examples:

1. Tea leaves are processed by withering, drying, sorting and then packaging.
2. Coffee beans are dried, fermented to get coffee powder.
3. Milk products are processed in processing units by pasteurization method.
4. Sugar cane is processed to get jaggery, gur, white crystal sugar etc.
5. Barley is processed to make wine, bear etc.

Processing of food material often results in loss of nutrients for examples, cereals suffer substantial loss of food value when they are processed into the form that we use. In the matting of wheat for while flour (Maida) about 28% to 37% of grain by weight is discarded. This involves a loss of 66% iron, 75 % B Vitamins, mainly thiamine and niacin some percent of Vitamin E is also lost during processing. Rice and other cereal grains also lose much of their nutrients in processing and polished rice contains much smaller amounts of iron and B vitamins than either parboiled or known rice. In fact, the nutrients value of food decrease with each step in refinement, besides the loss in quantity.

EXERCISE

Short Answer Type Questions:

1. What is Mixed cropping?
2. How monoculture in agriculture affect soil?
3. What is biofertilizer?
4. What are GM crops?
5. Why food preservation is necessary?

Long answer type questions:

1. What are the advantages of biofertilizers over chemical fertilizers?
2. Discuss various types of farming/cropping which can be helpful in sustainable agriculture?
3. Write down the role of biotechnology for crop improvement?
4. What are the methods of food preservation?
5. Write down the steps involved in management of agricultural products?

Questions for critical thinking:

Will genetically modified crops help the Punjab farmers to increase the productivity of crops?

Discussion:

- Discuss with your grandmother about the tips, she used to preserve the food.

CHAPTER 13

ENVIRONMENTAL ACTION (PART-I)

Meeting basic human needs Food, water, shelter and fuel for all

Ever since the man appeared on the earth's surface, he has been dependent on gifts of nature for his existence. He needed land to live, plants and animals to get food water to drink and wash, sunshine to get heat and energy. Forests and wild life to get so many things for his sustenance.

Resource is a source of supply or support held in reserve, for example wood obtained from forest is used to make furniture, coal petroleum and so many other things.

Continuous increase in human population and unending desires of man has resulted into increasing demand for natural resources.

Action Strategies for meeting Human Needs.

1. Bring the population growth under control.
2. Reduce the waste of energy resources.
3. Reduce the waste of matter.
4. Conserve natural resources like water, forests, biodiversity and soil.
5. Protect the natural habitant for wild species.
6. Use water, soil, fuel judiciously
7. Make things that last longer and are easier to reuse, recycle and repair.

(1) Food : You all know that all organisms depend on food to get energy. Only green plants are able to manufacture the food from raw materials like carbon dioxide and water. The food mainly consists of carbohydrates, fats, proteins, organic acid, vitamins and enzymes.

An individual on an average needs 2500 calories per day but many people go to sleep without taking their meals due to unavailability of food which lead to malnutrition. Malnutrition is the deficiency of nutrients due to hunger and faulty diet. The demand for food is increasing due to population explosion in developing countries. There are about 300 million people who are undernourished.

Some effects of Malnutrition

1. High child mortality rate
2. Higher maternal mortality rate
3. Delinquent children
4. Poor school performance

It is the duty of our government to make some strategies and policies so that, nobody go to sleep without food. World Food Summit, 1996 has set the target to bring down the number of undernourished to half by 2015. Major Cause of malnutrition is poverty due to which parents cannot buy sufficient and nutritious food for their children.

(2) Water : Water is an important natural resources needed to sustain life. All the physiological activities of plants and animals take place in water. Water is required for agriculture as well as industries. It is a renewable resource. It is found in following foams.

(I) Fresh Water : Fresh water resources range from ponds to lakes and large rivers. Its is exhaustible, however it is made available again through water cycle. It is very essential to sustain life on the earth. But only 3% of total water occurs in form of fresh water remaining 97% is present in the oceans which is not worth drinking for human beings.

(II) Ground water : This water is found under Earth's surface and it can be drawn out with the help of hand pumps & tubewells.

Importance of Ground water.

1. It provides moisture to the soil for growth of plants.
2. It is commonly used for drinking, cooking, bathing, cleaning etc. by human beings.
3. It is used for Construction of buildings.
4. It is used in irrigation.

III. Ocean Water

Oceans water can be used in the following ways :-

1. For producing many useful products such as Algin, Agar, etc.
2. As a sources of edible sea weed e.g. kelps.
3. For making floating cites on the ocean surface.
4. For obtaining Pearls from oysters.
5. For extracting common salt.
6. For generating power from sea tides.

In India, 70 percent of water with drawn is utilized in agricultured sector. Global average water consumption for industries is 25 percent. In developing countries this consumption may be as low as 5 percent.

(3) Shelter : Shelter is another basic need of human beings. Land is required for this purpose. We all know that word's population has already crossed 6 billion and due to this increase, land requirement is increasing day by day. We need more agricultural land to feed more mouths, more industries to meet their basic needs and luxuries. But the land is limited. That's why there is a dire need to use our land resources judiciously in order to provide shelter for all.

4. Fuel :

Man needs fuel

1. for cooking and 2. to get energy .

Fire Wood:- Deforestation for fuel wood is still a common practice in India . It is the cheapest and only source of energy in remote area. To check the deforestation, we should use non-conventional sources of energy like biogas and solar energy. Afforestation is not being done at desirable level especially on those places where trees have been cut down for the purpose of getting timber for making of houses, furniture and use as fuel & etc.

Fossil fuels: Coal, petroleum and natural gas are the most commonly used fossil fuels. Such fuels are obtained from underground. But their reserves are limited since they have been used at a tremendous rate will be exhausted in near future. So we have to conserve these fossil fuels and switch over to alternative sources of energy in order to save them for future generations.

Coal : It is mainly made up of carbon, hydrogen and oxygen. It is the most widely used conventional fuel as it releases a large amount of heat on burning.

Uses of coal

The important uses of coal are

1. It is used to make coke.
2. It is used as a reducing agent for extracting metal.
3. It is used to prepare many organic compounds like benzene, toluene, aniline, anthracene etc.
4. It is used as a fuel.
5. Coal can be converted to other energy form like coal gas, electricity etc.
6. Coal is used in the manufacture of synthetic petrol and synthetic natural gas.

Coke : When coal is heated in insufficient supply of air, coke is produced. This process is called destructive distillation of coal. It is rich in carbon content i.e. upto 98%. It is used as a fuel.

Advantage of using coke as a fuel :-

Following are the advantage to use coke in place of coal as a fuel.

1. Coke has a higher calorific value than coal. Hence it produces more heat than that produced by burning same mass of coal.
2. Coke is a cleaner fuel as it burns without producing smoke therefore it does not pollute air while burning of coal produces a lot of smoke hence pollutes air.

EXERCISE

Short Answer type Questions :

1. Man is dependent on gifts of nature, which are those ?
2. What do you mean by malnutrition?
3. What is the importance of water in our life?

Long Answer type questions :

1. What is the importance of under ground water ?
2. What type of pressure is caused on Earth's resources by population explosion?
3. Why coke is considered better fuel than coal?

Questions for critical thinking.

Today you find luxurious cars every where around you. Minimum two or three cars are parked almost outside every house. Everybody is in search of the better one. Who knows where this race will end? However, for moving cars, we need energy and for that we depend upon fossil fuel. This fossil fuel is limited.

Do you think we should participate in this competion until some renewable source of energy is found? Is it advisable to continue this mad race of unlimited human wants? Give your opinion.

Discussion

"Earth refuses to increase further and questions us why do we increase." Comment.

CHAPTER 14

ENVIRONMENTAL ACTION (PART-II)

Population

Population : Population is a group of organisms of one species occupying a definite area and usually isolated to some degree from other similar groups Clark defined it as **"the organisms living at a particular place and at a particular time constitutes the population".** Statistical study of human population like sex ratio, birth rate, death rate etc is called **Demography.**

Populations are of two types.

1. Single species population : in which only one type of organisms are found.
2. Mixed or Multiple Species population : in which two or more than two types of species are present.

Population Density:

The Population density may be defined as the number of individuals per unit area or volume.

Population Growth:

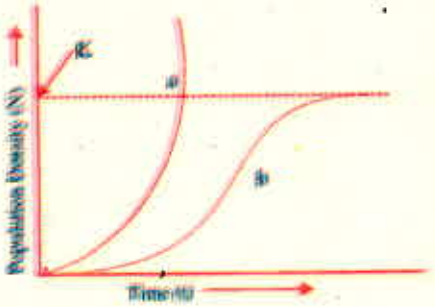
The population growth is represented by population growth Curves. In this curve the number of individuals are plotted against time factor.

Zero Population Growth

Zero population growth denotes static population. This means that a death rate is equal to birth rate and hence there is no increase in population

Population Growth Curves are of two types

(I) J Shaped Growth Curve **(II) S Shaped Growth Curve**



(a) **J Shaped Growth Curve**

(b) **s Shaped Growth Curve**

K

Fig. 14.1

J Curve : Whenever there is no check (abiotic or biotic) on population, the number of birth exceeds the number of deaths and thus population continuously increase.

S Curve : On the earth, the resources are limited for example food and shelter. So environmental factors don't allow population to grow indefinitely. In this case first the graph goes up but when the environmental resistance doesn't allow the population to grow, the population growth becomes zero and thus resultant population growth curve becomes S shaped. This is called a Sigmoid Curve.

Human Population of India

It constitutes 15% of the world's population. In 1901, the population of India was 235 millions. In 1981, the Indian population became 655 million and today our population is over 1 billion. To cope with this rapidly increased rate of population, we need about 2.5 million new houses, about 120 million metric tons of food grains and innumerable new employment openings every year. This is really a difficult task to accomplish for a poor country like ours.

Impact of population growth in India.

With the present scenario in view, India is bound to face the following problems : -

(1) Shortage of land for housing agriculture.
(2) Shortage of food grains for nutrition.
(3) Increase in poverty and unemployment.
(4) Poverty and unemployment will lead to increase in crimes.
(5) Development will be slow and so the progress will be slow.
(6) Per capita income will decrease.

The future picture seems to be grim. Due to shortage of so many things, there will be struggle for existence which will lead to destruction. Therefore, it is the right time for the government and people of India to make sincere and effective efforts to reduce the rate of growth of human population at the earliest so that our future generation may live in comfort and peace.

Date	Estimated world population	Time required for opulation to double
8000 BC	5 million	1500 years
AD 1650	500 million	200 years
AD 1850	1 billion	80 years
AD1930	2 billion	43 years
AD 1988	5.1 billion	40 years
AD 2010	8 billion	?

Control of growth of Human population:

We are at least intelligent enough to anticipate our future and plan accordingly by imposing a check on the populations. Following are the inexpensive safe, reversible and acceptable methods of birth control.

1. **Awareness :** The masses can be made aware or taught through mass media such as radio, television, newspaper, magazines, hordings, posters etc, about the necessity of birth control.

Methods of Birth control : There are two methods birth control.

(a) Temporary (b) Permanent

(a) Temporary methods of Birth Control can be classifield into three categories namely. Mechanical, Chemical and Natural.

Temporary methods of Birth Control

Mechanical	Chemical	Natural
(a) IVCD	(a) Pills	(a) Safe period
(b) Condoms	(b) Cream	(b) outside ejaculation
(c) Diaphragm		

1. **Mechanical Methods :** Fertilization can be prevented by avoiding the meeting of sperm and ovum. This can be achieved by

(a) **Use of IUCD :** Intra-uterine, contraceptive device like loop or copper T, which prevents the entry of sperms.

(b) **Use of Condoms :** These are used by the male. These don't allow the sperm to reach the ovum.

(c) **Use of Diaphragm :** These are used by the female.

2. **Chemical Methods**

(a) **Oral Pills :** There are certain contraceptives or oral pills which alter the ovulatory cycle in women. Pregnancy can be prevented by suppressing the production of ova by hormones.

(b) **Creams :** Use of spermicidal cream which kill the sperms or make them immobile.

3. **Natural Methods**

(a) **Safe period :** Sexual inter course can be done during safe period ie seven days before and seven days after menstruation.

(b) **Outside ejaculation :** This method is very safe. The penis should be withdrawn from the vagina a little before discharge so that ejaculation be performed outside vagina.

B. Permanent methods of Birth Controls : The permanent methods of Birth Control can be classified into three categories.

1. **Male sterilisation :** It can be done either by vasectomy (cutting of vas deferens) or castration (of testis)
2. **Female sterilisation :** It can be done either by tubectomy (cutting of fallopian lube) or ovariectomy (Removal of ovaries)
3. **Abortion :** Abortion has been legalized in our country. Hence people go for abortion in case of unwanted child.

The population control devices are available at community health center and are at very normal prices, affordable to common man. There should be adopted under the able guidance of any qualified medical practitioner.

Our government has also developed a national programme of family planning.

EXERCISE

Short answer type questions :

1. What are the different types of population?
2. What is meant by Zero population Growth ?
3. What are the different chemical methods of population control? Name them.

Long answer type questions :

1. What are the effect of population increase in India?
2. What are the various types of population Growth curves?
3. What are the various methods of population control?

Questions for critical thinking

China is the country where increasing population problem was dealt with making strict rules and regulations, so that there is not more than one child in one family. As a result population is under control in China. Do you think similar measure are possible in India? Why/why not? Comment.

Discussion

"Children are the gifts of God." Do you agree? Why/why not? Give reasons.

CHAPTER 15

ENVIRONMENTAL ACTION (PART-III)

Changing Consumption Patterns

When man started leading a settled life, there were a large amount of resources available to him. When population grew and there was progress in development of science, he started exploiting these resources. This has led to over exploitation of the resources and if this trend continues, the day is not far when these gifts of nature will vanish from the earth.

Consumerism is the consumption of natural resources by man. Consumption by man in mid nineties was very low but with the industrial revolution, technological advancements, consumerism and better life style has shown exponential increase. There are several causes for increase in consumerism which are given below :

(1) **Change in life Style :** Earlier man had a simple life. With the progress of science and technology, man's life style has changed for example earlier man depended on fans now A.C. is being used. Earlier man used to do his work manually but now we have all modernized gadgets to do our work eg. Microwave, Food Processor etc. This has led to increase in Consumption of energy resources.

(2) **Use and throw policy :** We are now adopting use and throw policy. If ink of a ball pen is finished, we throw it away and buy a new one. This type of approach although promotes manufacturing but discourages repair.

Technologically, we are also developing at such a pace that a new model develops every six months. We are attracted to these models and throw away the previous ones because we can afford to buy these models but when we throw away the previous things, it leads to increase in waste. So as a result, Environment is polluted.

(3) **Competition in the market:** Competition in the market also leads to increase in consumerism. There are more attractive packings and we are used to buy these packings.

Problems associated with Consumerism.

(1) Energy crises

(2) Pollution of water, air and soil

(3) Ozone depletion

(4) Global warming

(5) Spread of diseases

(6) Health Hazards

(7) Problem of Waste disposal

Do You Know

Although the population of India is 3.4 times more than that of USA but the energy consumption per capita in USA is much more than that of an India. Similarly, wastes generated and CFCS produces are much more in USA than those in India.

This comparison between USA and India clearly shows that waste generation has a direct relation with the rate of Consumerism.

Solution to save resources

1. We can use paper bags in place of polythenes.
2. Biogas or Bio diesel in place of petrol can be used. This will not only control pollution but also save fossil fuels for future generations.
3. Polyvinyl Chloride and non woven fabrics may be used in place of leather.
4. An electric crematorium can replace the traditional method of burning dead human body.
5. Use of CNG (Compressed natural gas) is less polluting than petrol and diesel.
6. Solar gas Chulhas can be used instead of traditional Chulhas.

Solution to minimize wastes:

1. We can use glass bottles for soft drinks instead of using cans.
2. In place of polypacks for milk, glass bottles can be used.

Solution to minimize pollution

1. Use of Chloro fluoro carbons should be restricted.
2. We should use biopesticides in place of DDT as DDT enters food chain and causes various diseases in humans.

Solution to Health Problems :

We can practice organic farming. In farming, crops are raised without using synthetic fertilizers, pesticides and antibiotics. It has been seen that crops raised by organic farming provides 40 nutrients (Micro as well as macro) as compared to crop raised by using fertilizers and pesticides.

Shoe story

We all wear shoes and an average middle class family have 3-4 pairs per person. My athletic shoes pair bought from USA weighs about a pound and is composed of dozens of different, mostly synthetic, material. These shoes are assembled in a Korean-owned factory in Tangerang, an industrial district outside of Jakarta, Indonesia. But almost all components are made elsewhere.

My shoes have three parts : the logo-covered upper, the shock absorbing mid-sole, and the waffle-treaded outsole. The upper has almost 20 different parts, mostly made up of leather. The animal is raised, slaughtered and skinned in Texas. The hide is cured with salt and stacked with 750 others in a 20 foot container and carried by freight train from Amarillo to Los Angeles from where it is shipped to Pusan, South Korea.

These hides are exported for tanning which is a 20 step process with large spinning drumps and solutions of chrome, calcium hydroxide and other strong chemicals. This tanned leather is sent to Jakarta by airplane. Tanning plant discharges hair, epidermis, leather scraps and processing chemicals into the Naktong river. The mid sole is a custom designed EVA (ethylene vinyl acetate) foam which include ethelene. The ethelene is distilled and 'cracked' from Saudi petroleum shipped in a tanker to a Korean refinery.

The outer soles are made of styrene-butadiene rubber which is synthesized from Saudi petroleum and local benzene in a factory in Taiwan. This factory gets its electricity from one of the island's three nuclear power plants. This rubber is formed into large sheets and flown to Jakarta. In the shoe factory, machines cut the sheets and mould to be the bottom of the shoe.

The factory in Tangerong have heavy machines. Though the hi-tech equipment helps, putting shoe together remains the domain of hand labour. Many Javanese women assemble it i.e. cut, sew and glue it. The air smelled of paint and glue and the temperature neared 100 degree F. These solvent fumes cause the health problems.

These shoes are hand stuffed with light weight tissue paper (made from Sumatran rain forest trees) and put in card board shoe box which is 100% recycled and bleached. Folded stacks of empty boxes are shipped west across the Pacific from Los Angeles, Boxed shoes are shipped east in a super container ship carrying 5,000 20 foot containers. Each journey takes 3 weeks.

And to-day, one year after I purchased the shoes, I saw a small tear on my left shoe. Should I throw them away and buy a new pair? Or should I use them while walking more softly and save my money as well as enviornmental degradation linked with their manufacture?

EXERCISE

Short answer type questions

1. Name two causes of consumerism.
2. Give any one use of CNG.
3. What are the harmful effects of DDT?

Long answer type questions

1. What are the problems associated with consumerism?
2. What are the solutions to save resources, minimise the wastes Pollution?
3. How can we conserve the resources?

Question for critical thinkking

All know Diwali is an important festival of India. Everybody celebrates it in his/her own way but one thing which is common among all these celebrations is the cleaning of their houses, exchange of gifts, decoration. No doubt this custom is really good as it increases feelings of brotherhood but can't we change it a little bit by avoiding the use of cardboard boxes and attractive wrapping papers? Instead of this, we can use longlasting things. By doing this, there will hardly be any waste of boxes or papers on the next day of Diwali. In decreasing the use of cardboxes & papers, less number of plants will be cut; less water will be used hence less waste will take place, would you plan that for the next Diwali such a way you exchange gifts without packing?

Discussion

Higher standard of living means producing more waste." Express your opinion.

CHAPTER 16

ENVIRONMENTAL ACTION (PART-IV)

Prevention and Control of Invironmental Pollution

"Pollution is an undesirable change in the physical, chemical or biological characteristics of our air, land and water that may harmfully effect human life. Any substance that causes pollution is called a **pollutant**. Pollution can be of many types as given below:

Air Pollution: Air pollution may take place by several means but industries play an important role in polluting our air. The magnitude of air pollution in an industrial city is much more as compared to other city. Air pollution may be caused by burning fossil fuels like coal or petroleum. These fossil fuels release sulphur-dioxide, carbon monoxide, nitrogen dioxide etc. which are harmful gases.

Effects of Air pollution on humans

(a) Carbon monoxide is toxic gas which causes difficulty in breathing.

(b) So_2 is absorbed by soft tissues due to which ear, nose throat and eyes are affected badly.

(c) Hydro carbon may cause cancer.

Control of air pollution

(1) To control air pollution, the photo chemical smog should be eliminated as far as possible. Photochemical smog is the product of automobiles.

(2) Particulate which are produced by industries can be controlled by scrubbers, precipitators and filters.

(3) The smoke coming out of kitchen is the main cause of air pollution . These also can be minimized by using smokeless chulhas, solar cooker and biogas.

(4) Installation of catalytic convertors in the automobile to oxidize the exhaust gases before their emission.

(5) Chimneys of the factories should be tall to reduce ground pollution.

(6) Use of generators in the residential area should be avoided.

(7) Shifting over to alternative and less polluting fuels like CNG (compressed natural gas)

(8) An urgent need of traffic management.

BOOST YOUR KNOWLEDGE

Most of the industries emit Sulphur dioxide and Nitrogenous-oxides, which reach with water in the atmosphere. These gases combine with water vapour present in the atmosphere and form sulphuric acid and Nitric acid respectively. These acids formed in the air, come down to the earth alongwith rain. Now this rain is called acid rain.

1. It causes direct damage to leaves of plants. Forests in many industrialized country are drying due to acid rain.
2. It causes leaching of nutrients out of the soil eg. Calcium & Magnesium are very essential for plant growth.
3. Acid rain corrodes materials such as marble, stone.
4. Fish fail to breed and also die.

Prevention of Acid Rain

1. Sulphur free fuels and Coal should be used.
2. Scrubbers should be installed in tall chimneys of furnaces to prevent SO2 from entering the air.

Water–Pollution

Polluted water is a great threat to living organisms. Water pollution is caused due to wastes produced by industries city sewage etc. These pollutants greatly affect the life of aquatic animals. Moreover, these pollutants ultimately go to the ocean alongwith the river water and thus polluting marine water. This adversely affects marine life also.

Fresh water pollution is the most dangerous environmental problem of the world. Fresh water pollution makes fresh water unfit for drinking and cause a number of water born diseases namely jaundice, cholera, Hepatitis, diarrhoea, dysentry etc. Sources of water pollution are industrial wastes of power plants, fertilizer factories, community wastes i.e. Sewage and garbage, Fertilizers, Pesticides, insecticide, oilspills etc..

It means excessive nourishment. It happens when organic wastes from milk plants, canneries, paper mills causes an increase in water productivity. The green algae grow in abundance. This is called algal boom. When these algae die, the decomposers use in lot of oxygen for breaking down dead green algae. This creates oxygen deficiency in water. Due to depletion of oxygen in the pond, the aquatic life dies prevention. Sewage should be processed thoroughly to remove nutrients to prevent 'algal boom' or use this nutrient rein water to irrigate croplands, to grow algae and aquatic plants in man made shallow pond.

Prevention/control of fresh water pollutin

Following steps should be undertaken to control water pollution.

1. Bathing and washing clothes should be banned in rivers, lakes or ponds.
2. Sewage treatment plants should be installed and sewage should be discharged only after treatment.
3. Weedicides, Fertilizers, Pesticides should be used to a minimum quantity.
4. Non biodegradable wastes should be used to fill the low lying areas.
5. Pollution Control Board must deal strictly with industrialists who don't follow the norms for treatment of industrial waste.
6. Minimize developmental activities in coastal areas.
7. Last but not the least an awareness should be created amongst masses about water pollution. So that people may know the harmful effects of water pollution.
8. Promote research to evaluate the impact of climate change on fresh water resources.
9. Incorporate a special component i.e. afforestation programmes on the banks and catchments of rivers to prevent soil erosion and improve green cover.

Pollution of Ground water

Pollution of ground water is linked to the agricultural practices. Ground water Chemical Pesticides are main source of pollution.

Prevention and control of ground water

1. Promote efficient water use techniques such as sprinkler or drip irrigation, among farmers.
2. Ensure availability of ground water potential maps through a designated institution.
3. Support practices of rain water harvesting and artificial recharge and revival of traditional methods for enhancing ground water recharge.
4. Promote Research and development, suitable for rural drinking water projects for remedial measures and removal of Arsenic, fluoride from the water.
5. Suitable sites for dumping the toxic waste material may be identified and remedial measures may be taken to prevent the movement of the toxic waste in the ground water.
6. Excessive use of fertilizers, pesticides and insecticides are the main non point source of the pollution.

Soil–Pollution

Due to population explosion, the need of food has also increased and thus large area of land are cultivated. Artificial fertilizers used to enhance productivity, pollute the soil. To protect the crops, insecticides and pesticides are used which cause soil pollution.

Soil is important for plants as roots of most plants grow in the soil and absorb nutrients from it. The life of animals living in polluted soil is badly affected. Soil may be polluted due to acid rain, excessive use of fertilisers pesticides, industrial water, defecation heavy metals like cadmium, zinc, Nickel from mines.

Control and Prevention of soil pollution

1. Solid wastes such as tin, copper, iron, should not be dumped into the soil.
2. Government should make provisions for latrines and people should not litter in open fields.
3. Biological control should be adopted for killing pests instead of using pesticides.
4. Sewage should be changed into biogas.
5. solid waste should be recycled to from materials.

Noise Pollution

Noise pollution is a threat to quality of man's life. Noise is unwanted sound which is dumped into the atmosphere regardless of its adverse effects.

The sources of noise pollution are high intensity sounds produced by machine, air craft, motor cars, scooters, crackers. These sources are disturbing man and also cause permanent damage to hearing. Automobile and their horns produce loud sound. Railways produce unwanted loud noise.

Effects of Noise Pollution

(1) It cause irritation and headache .
(2) Noise pollution doesn't allow sound sleep and comfort.
(3) Extra loud noise leads to puncturing of ear drum and man may become deaf.

Control and Prevention of Noise Pollution

(1) Sound producing machine should be installed in sound proof hall.
(2) The laborers and other workers should plug their ears by cotton.
(3) Those machine should be produced which don't produce sound.
(4) The public address system should be used only when it is essential
(5) There should be tree plantations along side the roads which will reduce the noise pollution this is called **green muffler scheme.**
(6) Blow of horns should be banned under normal circumstances.
(7) Radio and transistors should be kept at low volume.
(8) Noise producing industries, aerodromes, Railway station, etc. should be away from the residential areas.
(9) Silence zone should be established near educational institutions, hospital etc.

Do you know ?

1) The use of public address system is banned in Japan. It can be used only after seeking permission from the civil authorities.
2) To control noise pollution and for the comforts of people at Narita Airport Tokyo, the arrivals and departure of planes don't take place between 10 p.m. to 4 a.m.

Radiation Pollution

The pollution caused by ultra violet rays or radiation is called Radiation pollution.

The emission of radiation by certain elements is called Radioactivity. We are continuously exposed to radiation of weak intensity due to sun.

In 1945, America bombarded two prominent cubes of Japan –Hiroshima and Nagasaki by atom bomb. Everything was destroyed due to this. Scars of atom bomb devastations are also visible in the people of Japan today. The nuclear wastes contain radio active elements which remain active upto 1000 years. Only because of this, radiation pollution is considered to be the most dangerous for life.

Effects of Radiation Pollution

1. Constant exposure to radiations causes cancer in man.
2. Radiation causes changes in the genes by means of mutation and are passed on from one generation to next

Prevention and Control of Radiation Pollution

1. (1) The atomic reactors should be established away from human habitation.
   (2) Wastes from nuclear power plant should be discharged only after proper treatment
   (3) To avoid leakage of radiation, proper care should be taken and all the security measure must be taken.
   (4) Nuclear explosion and wars should be avoided.
   (5) Workers using radioactive materials should wear protective garments.

Safety measures should be taken against accidents in nuclear power plants

EXERCISE

Short answer type questions

1. What is meant by Pollutant?
2. What are the harmful gases, which are produced on burning of fossil fuel?
3. Write two methods of prevention of air pollution.

Long answer type questions

1. What is Acid Rain. What are the preventions of Acid Rain?
2. What is Eutrophication? How does it effect the aquatic life?
3. How can we control fresh water pollution?

Question for critical thinking:

How Radiation pollution and Chernobyle is related? Write about this with the help of your teacher.

Discussion

In Mohali city of Punjab people residing near phase 9, 10, and 11 are regularly disturbed by noise of planes. Do you think this will effect their health?

CHAPTER 17

ENVIRONMENTAL ACTION (PART V)

Waste Management

Waste can be defined as all discarded things (may be solid, liquid or gas) that no longer has any value to the holder. It may be either solid, liquid or gas.

The continuous increase in the amount of waste has become a major problem. The unscientific disposal and management of municipal solid waste poses considerable environmental and health hazards. To prevent environmental pollution and check health problems, proper management and disposal of municipal solid waste is extremely essential.

(a) An ideal situation

(b) Present situation

(c) Generation of garbage in future (if not controlled)
Garbage Increasing day by day

(a) An Ideal Situation (b) Present Situation

(c) Generation of garbage in future

Fig. 17.1

Solid Waste	
Activities	**Waste Generated**
Agricultural	Plant remains, processing wastes, animal wastes
Domestic	Paper, plastic, glass, metal, rags, food, fruits, vegetable peels, garden litter, packaging
Municipal	Sweepings from streets, schools, colleges, office, factories, hospitals, clinics, petrol bunks, shops, etc.
Industrial	Wastes generated from mining operations, manufacturing, construction work, thermal stations, chemical industries, paper making units, textile mills, cement factories, factories manufacturing engineering goods, etc.
Health care	Health care establishments generate wastes like needles, syringes and other potentially infectious wastes

There is no single solution to the challenge of solid waste disposal but a combination of processes like reduction at source, segregation, reuse, recycle and environmentally safe disposal of garbage may help to a greater extent.

Reduction, Reuse and Recycling of waste is generally referred to as 3R principles.

A **Reduce :** On an average , it is estimated that an individual generates about 500 gms solid waste daily . It should be reduced to the maximum possible extent.

Children can help in following ways:

1. Use paper carefully. Use both sides of the paper. (In this manner paper waste can reduced by 50%).
2. Use slates for writing and learning practice instead of paper.
3. Keeper your books neat and clean so that other children can use them.
4. Stop using disposable goods like paper plates, paper cups and napkins .
5. Use Refillable lighter and writing pens, non disposable razors and cameras.
6. Use cloth napkins and cloth bags instead of paper napkins and paper bags.
7. Avoid heavy packaging. Sell consumer products in concentrated forms as it will use less raw materials.

B **Re use** Many products that have the potential to be repaired, reused or recycled are simply throw away. There should be tendency to reuse the products with proper safeguards.

1. Children should wrap gift instead of using adhesive tapes so that gift wraps, string and ribbons can be used again..
2. Vegetables waste can be used to feed domestic animals.
3. There are many empty cans are around us. We can make pencil holder out of soda cans.
4. Maintain and repair furniture, clothing and other useable item.
5. Sell or donate good instead of throwing them out.
6. They are many empty plastic bottles lying in our home. We can make flower pots from them.
7. The rock Garden in Chandigarh created by Sh. Nek Chand is a good example of reused things.

Kids did it

As part of a campaign called "clean-up Kodagu", initiated by CEE-South in partnership with the district administration of the coorg district in Karnataka, school children collected recyclable waste such as plastic and paper from the streets, and their homes. This was then sold to recycling agents. Fifty per cent of the money generated from collected and sellling in the waste was kept by school as corpus to from Eco-clubs, and was used for camps, excursions and other environmental education activities. The clean-up Kodagu campaign over the last few years has managed to remove littered plastic bags and paper from the street of coorg district. The clean-up kodagu drive by CEE along with district authorities resulted in setting-up of a small units. Plastics bags littering landscape are systematically collected and reach the unit, where they are segregated by colours, cut into strips, and woven into pretty patterns. Thus, plastic bags are transformed to beautiful handbags and mats.

C Recycle : It is a profitable proposal. Some analysts believe that one half of the consumer waste can be effectively recycled. Recycling means turning things into new items like making brand new paper out of used paper. Paper abundantly used for recycling includes newsprint, magazine, cardboard and cartons of all kind.

It is possible to recycle many materials found in solid waste. Recycling is always preferred because it conserves our natural resources and is more environmentally benign.

Following are some examples of recycling :

(1) Agricultural waste sugarcane bag can be used for manufacturing of paper and cardboard.
(2) Heavy metals present in the industrial waste can be recovered by chemical treatment.
(3) Agricultural wastes like rice husk and groundnut shells can be used to produce fuel.

(4) Wastes like silt from waste work, fly ash from thermal power plants can be used to produce construction material like brick.

(5) Industrial and urban wastes can be used as a sources of energy .

(6) Skin of animal is used for producing leather.

(7) Old tyres are used to produce rubber by microbial action of some bacteria.

(8) Aquatic weeds (eg water Hyacinth) can be used to produce fertilizers and animal feed.

Besides these 3R principles, the most important strategy for management of waste is to educate people. People should be told the importance of proper waste management and harmful effects of unscientific waste management. The concept about waste should be clear that it does not mean **"filth"** but it is simply **"matter at a wrong place".** If this matter is treated and recycled properly it can result in wealth out of waste.

Suggestions for proper solid waste Management

The continuous increase in the amount of solid waste being generated is the major problem particularly because of lack of proper disposal sites and knowledge of disposal methodologies. There is no single solution or a single suggestion to solve this problem but a combination of solutions which have already been discussed earlier as how to manage solid waste at school level, at home level and at municipal committee level.

Solid waste management adopted in India is mostly unscientific, inadequate, out dated and lack public participation while the municipal corporation authorities have ambitious plans to manage solid waste but it is not possible without the support and active cooperation of citizens.

Top priority should be given to reuse and consequently reduce the solid waste around us. Every individual should make conscious efforts for safe and scientific disposal of garbage. For improving solid waste management, it is necessary to incorporation suitable provisions to ensure public participation. Local laws also need to provide for punishment on the spot who do not follow the direction given for maintaining appropriate solid waste management in that area.

In some cities of Punjab, the municipal authorities have declared a cash award of Rs.500/- and an appreciation certificate to the residents for cleanliness of the area and to penalize those found dumping garbage at any public place which is not desighated for garbage disposal. Awareness programme can prove the most important tool to manage solid waste efficiently.

Role of students

- Students should throw waste at places specified for waste collection. Always use dustbin to keep the surroundings clean (Fig.).
- Student should tell parents and others about harmful effects of improperly disposed waste.

At school and at home level

Once students come to know about the types of solid waste on the basis of nature and its origin, they can easily segregate the garbage at the source itself. There are some substances like kitchen waste, garden waste etc. which can be decomposed by micro-organisms. These substances are called **biodegradable.** Other substances which can be decomposed by micro-organisms are called **non-biodegradable.** For example glass, metal, plastic etc. Biodegradable substances are organic in nature and can be used for making compost.

Gainful Utilization of wastes

Activity- Marking of a compost pit: Marking manure is one of the methods of gainfully utilizing waste materials which are organic in nature. If you have an open space in your house and school it is easy to make a compost pit.

First, make a pit. Dump dead plants, leaves and kitchen waste materials (especially vegetable peels) in the pit. Do not put all kind of waste materials in the pit as all solid materials can not be decomposed and converted into manure only biodegradable waste can be used for composting. Now cover the pit with soil. The Decomposition and decay process is carried out by billons of bacteria which convert the organic matter into compost.

Role of teacher

(1) Teacher can organize awareness workshop for illiterate parents.

(2) The teacher should launch a clean-green campaign at school level to make solid waste management a big success.

(3) Involve students in waste management activities and give exercise to students.

Vermicomposting is a process of using earthworms for conversion of bio-degradable waste into compost vermicomposting is a biotechnological process. In this process, the organic material is dumped into especially designed vermipits where earthworms are released. The earthworms convert the organic material into vermicompost over a period of 45-50 days. The manure, thus formed is very rich in all nutrients.

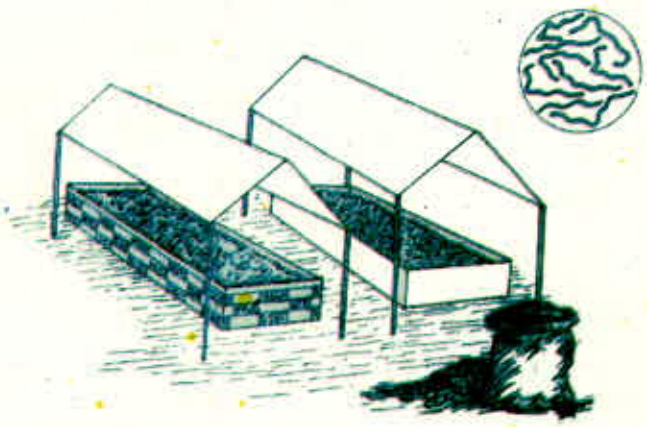


Fig. 17.2 : Vermicompost unit

EXERCISE

Short answer type questions

1. What is meant by solid waste?
2. How vegetables waste can be used in villages?
3. What type of filling can be used in rag toys?

Long answer type questions

1. Differentiate between recycle and reuse (any two points)
2. What do you man by Reduce? How Children can help in reducing the waste?
3. What do you mean by 3R principle?
4. What should be the role of students to keep the surroundings clean?

Question for Critical thinking

Chandigarh, the capital of Punjab is starting a Garbage treatment plant with the help of German technology in sector 25 so that the waste of Chandigarh can be managed, which will help in keeping the city clean.

How garbage plants help in improving the Ecosystem?

Discussion

As a student, what type of project can be started to keep your colony clean discuss it with your teacher and comment.

CHAPTER 18

ENVIRONMENTAL ACTION (PART-VI)

Community Movements

A. Van Mahotsava

It was started in 1950, by Sh. K.M. Munshi, then minister of food and agriculture. The aim was to increase forest resources and also to reduce soil erosion. Van Mahotsava is celebrated during first week of February and July, every year.

Soil erosion is a big problem and it can be controlled by many ways.

1. By thick vegetation and extensive plantation as
   a) Roots of plants hold soil particles
   b) fallen leaves of plants decrease the speed of water flow.
2. By rotation of crops.

   (already studied about it in Agriculture unit)

B. Chipko Movement - Already discussed in Chapter -9

C. Silent Valley Project

There is a small secluded forest in the Western Ghats of Kerala known as silent valley is surrounded by high ridges. It is one of the few places in India with no human habitation. It always remained a well preserved forest as it is very difficult to reach silent valley even on foot.

Importance of Silent Valley : This forest is a storehouse of rare and vulnerable plants and animals. Several plants have medicinal value also such as the evergreen forest tree-Hydnocarpus, whose seeds contain the soil used to treat leprosy. Rare fauna include the lion tailed macaque (the most threatened monkeys in the world), Great India hornbill etc.

Dispute of Project : In 1972 a proposal was put forward by the Kerala state electricity board (KSEB) to build a 130-metres – high dam across the Kuntipuzha river to create a reservoir in silent valley. This was aimed to generate more energy for the power-deficit people of Palghat and Mallapuram districts of Kerala, enhancing. Irrigation facilities to increase agricultural production and to generate employment for thousands of people.

This project required the large scale deforestation. It is one of the richest biological heritage as this forest has approx. 900 species of flowering plants and ferms, large number of rare spcies of plants and animals.

Solution : KSEB had started work on it in 1973 but shortage of funds had delayed it till 1976. the issue came up before the then. Prime minister, Indira Gandhi who had shown more interest in environmental matters. She appointed a committee in 1980 to look into whether the western Ghats as a whole were in danger of damage.

Report of committee : The committee pointed out that silent valley was the last remaining example of flora and fauna that had evolved the best possible extent and it was an ecosystem undisturbed by human interference. So the dam should not be built to save the biodiversity.

Final decision : Finally, on the basis of an examination of the costs and benefits, as well as prime minister's support, the Govt. of India advised Kerala to abandon the project. Silent Valley was declared a National Park in 1985. Which meat that no project could come up in the area.

Courtesy/Source
CEE understanding Environment

D. Project Tiger : Already discussed in unit-1

E. Ganga action plan :

The river Ganga arises from gangotri glacier some 4000 metres above the sea level in the garhwal Himalayas unde the name Bhagirathi. Down the Himalyas, the river streams of mandakani and Alaknanda meet at the place called Devapryag. It is below this confluence that the river gets its name Ganga. The Ganga runs its course of over 2500 km from gangotri in the Himalayas to Ganga Sagar in the Bay of Bengal.

The Ganga Action Plan (GAP) initiated in 1985. It's aim was to improve water quality, permit safe bathing all along the 2525 km stretch of the Ganga from the Himalayas to the Bay of Bengal. GAP covers 25 towns located along its basin, 6 are in UP, 4 in Bihar and 15 are in West Bengal.

UP/Uttaranchal	Bihar	West Bengal
1. Haridwar	1. Chapra	1. Behrampur
2. Ferrukabad and Fatehgarh	2. Bhagalpur	2. Chandan Nagar
3. Kanpur	3. Mungher	3. Kalyani
4. Allahabad	4. Patna	4. Bally
5. Varanasi		5. Bhatpalia
6. Mirzapur		6. Hugli Chinsura

		7. Serampore 8. Nabadwip 9. Titagarh 10. Naihati 11. Howrah 12. Kolkata 13. Kamar Hatti 14. Panihatte 15. Baranagar

Important of GAP

Garbage and excreta is poured into the ganga from towns/cities on its way. Other sources of pollution in Ganga are open air defecation sites, on banks of river, washerman's cloth washing sites, animal wallowing sites, mass bathing, floral offerings, dumping of unburnt /half burnt dead bodies or carcasses. Industries contribute chemical effluents to ganga's pollution load and toxicity kills fish in large sections of river.

Measureable factors to know quality of water:

1. Biological oxygen Demand
2. pH of water
3. Dissolved oxygen.

Phases of GAP – It is divided into two phases. In phases I, the main task was to intercept and treat the waste from 25 cities in the states of UP, Uttaranchal, Bihar (Including Jharkhand) and west Bengal. Phase I was to be completed by march 1997, but it was later extended as GAP phase II till march 1999 and included 29 towns and cities.

Later, the Yamuna Action plan, the Damodar Action plan and Gomti Action plan river added to include tributaries of the Ganga.

More Information on GAP

- Ganga Project Directorate has been established in the Ministry of Environment and forests to control the level of pollution of Ganga water.
- Pollution Control Research Institute (PCRI) of Bharat heavy electrical Ltd. a Haridwar has been conducting monthly studies to analyse the quality of Ganga riv water.

Out come of the Project

Studies indicate that the water quality of Ganga improved but there is still a lot of s some parameters like DO and BOD have improved due to reduction in water pollut

The programme has not been able to achieve what it was really meant for. Th colour and bad odour are still there so this water can not be used without treatme

Dr. M.C. Mehta has commented that GAP has not been so successful bec is no public participation.

(F) Joint Forest Management (JFM)

It is a forest management programme, started in 1990, in which forest department and the village community work jointly to manage and protect the degraded forest land adjacent to the villages. It is kind of partnership between Government an local community.

The village community is represented through an institution which is commonly called the forest protection committee (FPC) in 2003, 17 states had adopted JFM progromm and through them over 63,000 FPC were managing around 14 million hectare of forest land.

Objective of JFM : JFM has the objective of providing fire wood, fodder and small timber to village communities. It also looks at development of forest Approximately 17 states have programme. Management of forests can be done in following ways :

- Involvement of NGOs, Government department and local community.
- Fruits and other trees can be grown in identified places.
- Grazing is not allowed
- Ownership should not be given to beneficiaries.
- Financial help is given to beneficiaries.
- Village community (beneficiary) is entitled for share prescribed by state Government.
- Products like grasses, top of branches and minor forest produce etc can be used by beneficiaries.

Student Participation in Tree rearing

Students participate actively in all afforestation and tree rearing programme.

- Students can plant tree in the school campus, house backyard or anywhere.
- Student can give pet name to that plant according to convenience and they should take care of that plant.
- On every birthday, student is supposed to plant a tree and watch its growth.

It is important to plant a tree but it is more important to protect it.

Encouraging Citizens

In July 2005, following an initiative by Kalpavriksh, the citizens of Pune organised themselves under **Pune Tree Watch (PTW)** to protect trees where possible. More than 100 citizens have joined hands (Punetreewatch@yahoogroups.com) and saved more than 500 trees since its inception. A website (www@Punetreewatch.org) enables documentations and dissemination of the group's work.

Very few people know that they act is operational in Pune, that it punishes offenders with a fine ranging from Rs. 1000 to 5000 and/or imprisoned ranging from a week to one year.

source : Survey of the Environment 2007, The Hindu.

Social Forestry : Social forestry is a kind of afforestation programme. The aim is to utilize all unused land by planting different kinds of trees which are useful to the society such as fruit trees, fodder giving trees, shady tree etc.

Objective of Social Forestry

1. To provide folder to animals
2. To provide fuel wood to rural people
3. To understand importance of forests
4. To maintain ecological balance
5. To provide timber, fruits to some extent.
6. To provide shade
7. To protect soil erosion.

Social forestry was earlier under National Rural Employment Programme Now it has been merged with Integrated Rural Development (IRDP). This programme is administered through district Rural Development Agencies.

Classification of Social Forestry

It has been further classified into

(a) Farm Forestry

(b) Community Forestry

(c) Agro Forestry

(a) Farm Forestry - Farmers plants trees in their farms for non-commercial purpose. These plants hold soil, provide shade to the farmers, maintain water table and also used as wind breakers. Plants like safeda , popular, mango, shisham, kikar and Jamun are commonly pentad for Farm forestry.

(b) Community forestry- Community's unused land is used for planting trees. Trees are usually planted at round about in villages, panchayat land, railway lines, roadsides, infront of houses etc. The aim is to provide benefits to entire community. Government has the responsibility provide seedlings, fertilizers and inturn community has the responsibility to take care of plantation.

(c) Agro Forestry- Planting of trees on and around agricultural boundaries. It is an old practice where land is used for agriculture, forestry and animal husbandry. Plants like kikar, mango, safada, poplar, siris are grown for this kind of programme. Infact agro forestry is not a new practice but it is a new name of an old land practice where land was used for agriculture forestry and animal husbandry. Agro forestry is better than traditional for-

estry as agro forestry does not require any special care to prevent illegal cutting, grazing & cleaning. Traditional forestry requires surveillance to prevent illegal cutting, grazing etc.

EXERCISE

Short answer type questions

(1) Who started Van Mahotsava ?

(2) Where is Silent Valley Situatated?

(3) Name the place from where River Ganga arises?

(4) Define Social forestry

Long answer type questions

(1) How soil erosion can be controlled by means of Van Mahotsava?

(2) What are the functions and objectives of Joint Forestry Management (JFM)?

(3) How students can participate in tree rearing?

(4) How community forestry is different from Agro forestry?

Questions for Critical thinking?

People in Punjab are polluting River Satluj by throwing ritual ingredients & left-overs and using in the similar manner as Ganga was used. Don't you think it will affect the water quality of Satluj river because its water is used for drinking purpose also?

What measure do you think should be taken to save it?

Discussion:

What are the ideal conditions for a forest to grow to serve as healthy bio diversity. Discuss.