



ENVIRONMENT EDUCATION AND WATER SECURITY

STANDARD TWELVE



The Constitution of India

Chapter IV A

Fundamental Duties

ARTICLE 51A

Fundamental Duties- It shall be the duty of every citizen of India—

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom;
- (c) to uphold and protect the sovereignty, unity and integrity of India;
- (d) to defend the country and render national service when called upon to do so;
- (e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities, to renounce practices derogatory to the dignity of women;
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures;
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;
- (k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

The Coordination Committee formed by GR No. Abhyas - 2116/(Pra.Kra.43/16) SD - 4 Dated 25.04.2016 has given approval to prescribe this textbook in its meeting held on 30.01.2020 and it has been decided to implement it from academic year 2020-21.

ENVIRONMENT EDUCATION AND WATER SECURITY

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Download DIKSHA App on your smartphone. If you scan the Q.R.Code on this page of your textbook, you will be able to access full text and the audio-visual study material relevant to each lesson provided as teaching and learning aids.



2020

**Maharashtra State Bureau of Textbook Production and
Curriculum Research, Pune.**

**First Edition : 2020
First Reprint : 2021**

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Enviornment Education and Water Security Subject Committee

Dr. Kranti Dhananjay Yardi,
(Chairman)

Dr. Bapusaheb Jivanrao Bhosale,
Member

Mr. Parmeshwar Arunrao Jadhav,
Member

Dr. Rajkumar Ramesh Khapekar,
Member

Dr. Zelam Dilip Kanhere, Member

Mrs. Anushka Ajay Kajbaje, Member

Shri Ravikiran Jadhav, Member Secretary

Environment Education Study Group

Mr. Shekhar Shankarrao Salunke
Shri. Pradip Dhondiram Koli
Shri. Manik Patil
Dr. Ansari Mohd. Rafique Abdul Sattar
Ku. Jameela Khatoon Shariful Hasan
Dr. Nitin Mahadeo Valanju

Illustrations : Ms. Anagha Inamdar

Cover : Ms. Anagha Inamdar

Translation Coordination :

Shri Ravikiran Jadhav
Special Officer (Environment)

Typesetting : DTP Section, Textbook Bureau, Pune

Paper : 70 GSM Cream Wove

Print Order :

Printer :

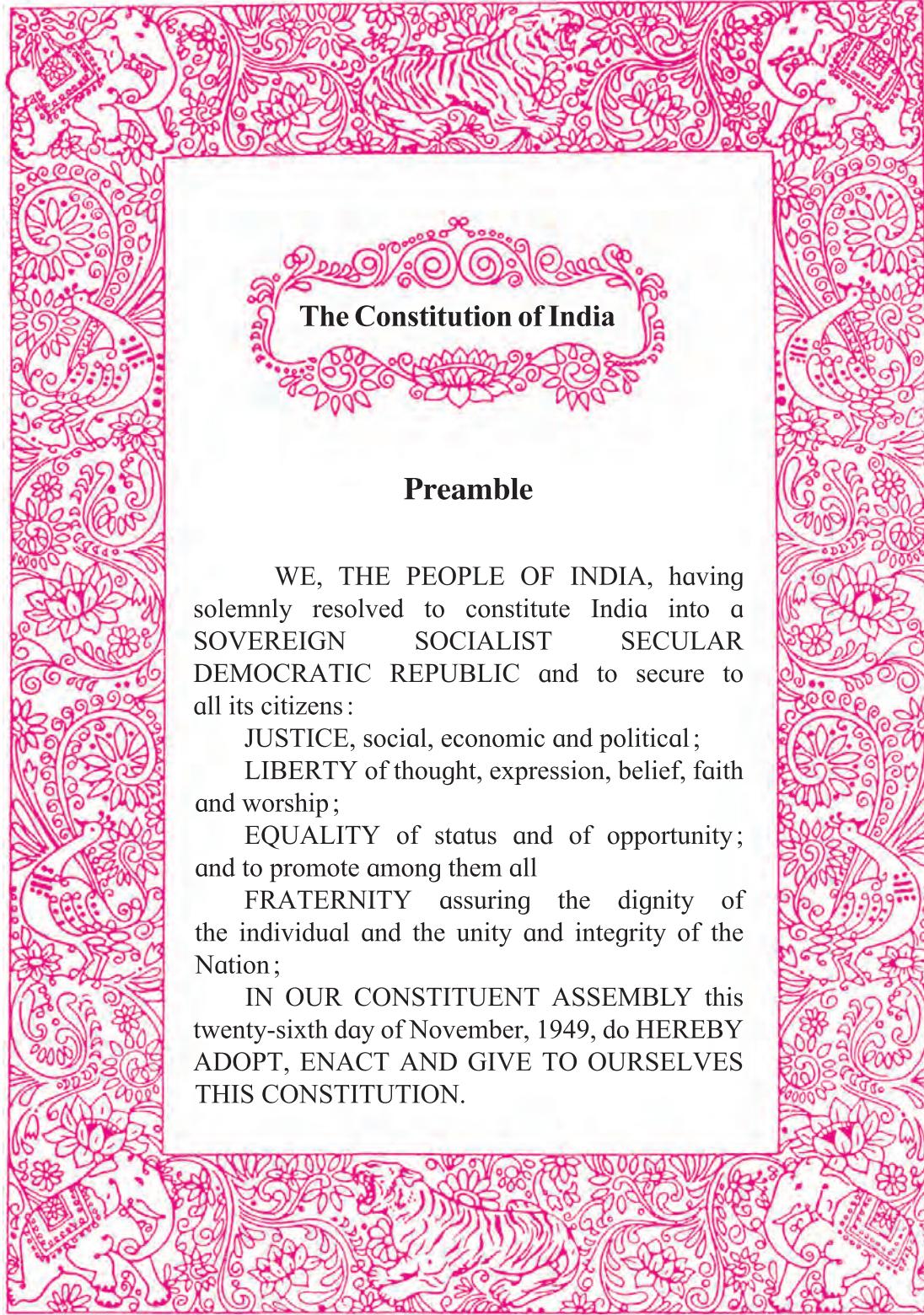
Production :

Shri Sachchitanand Aphale
Chief Production Officer

Shri Liladhar Atram
Production Officer

Publisher :

Shri Vivek Uttam Gosavi
Controller
Maharashtra State Textbook Bureau,
Prabhadevi, Mumbai - 400 025



The Constitution of India

Preamble

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political; LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

NATIONAL ANTHEM

Jana-gana-mana-adhināyaka jaya hē
Bhārata-bhāgya-vidhātā,

Panjāba-Sindhu-Gujarāta-Marāthā
Drāvida-Utkala-Banga

Vindhya-Himāchala-Yamunā-Gangā^ā
uchchala-jaladhi-taranga

Tava subha nāmē jāgē, tava subha āsisa māgē,
gāhē tava jaya-gāthā,

Jana-gana-mangala-dāyaka jaya hē
Bhārata-bhāgya-vidhātā,

Jaya hē, Jaya hē, Jaya hē,
Jaya jaya jaya, jaya hē.

PLEDGE

India is my country. All Indians
are my brothers and sisters.

I love my country, and I am proud
of its rich and varied heritage. I shall
always strive to be worthy of it.

I shall give my parents, teachers
and all elders respect, and treat
everyone with courtesy.

To my country and my people,
I pledge my devotion. In their
well-being and prosperity alone lies
my happiness.

Preface

Dear Student/Readers,

The Maharashtra State Curriculum Framework 2010 (SCF 2010) has been prepared in accordance to the National Curriculum Framework 2005. The present book is organised according to teaching and learning approaches and materials based on SCF 2010. Hon'ble Supreme Court (SC) has directed that Environment Education (EE) be compulsory at all levels of education. Following the directions given by the SC, EE has been decided to be a separate and compulsory subject at the level of 11th and 12th standard.

Maharashtra State has prepared the text book which includes major concepts of environment which shall encourage collaborative learning and group activities to facilitate peer learning. The text book has been prepared for constructivist approach and activity based teaching-learning. The content has been presented in a graded manner to facilitate knowledge building with the illustrations relevant to the content of the syllabus. The textbook highlights the measures for protection and care of the environment, prevention of pollution and conservation of energy. The topics are included to facilitate understanding of the environment in its totality. Both natural, social and economic processes and their impacts on environment are given and the ways and means to preserve the environment are discussed.

The core focus is on interconnected nature of the physical, biological, social, economic system pertinent to environmental issues. The textbook considers appropriate environmental case studies exemplifying how one may view environmental issues from a systems perspective. The teachers are encouraged to emphasise this view and try to apply it during transaction of the syllabus. The students are expected to have acquired adequate understanding of the basics of the various topics by 11th standard and through this book, the students are given a comprehensive view of the environment while dealing with the topics. The curriculum, emphasises student activities as the main vehicle of learning. At the higher secondary stage, to ensure the continuation of proactive action towards the environment, the core course, is considered compulsory qualifying course with a project and activity-based evaluation mode.

The textbook expresses concern over the prevailing drought like condition across our country and the state of Maharashtra, where we are facing acute water crisis and witness over-exploitation of groundwater. The textbook calls for immediate water conservation, rainwater harvesting, renovation of water bodies, reduce & reuse of water, watershed development, and afforestation, and drinking water sanitation through community participation at each block or city. There is a pressing immediate need to make this as a mass movement to ensure water security!

Different exemplar activities and projects are suggested (but not restricted to) in the textbooks to provide exposures to the practical environmental issues providing live contact with the world around them. The project-based learning would ensure learning in the affective domain which would bring forth good, sensitive, rational citizens. A careful planning and preparation can lead to successful implementation of this approach. Expert views and suggestions are included in this book. Use Q.R. Code given in the text book for extra information and reference. Hope that the content of this book will help students and teachers understand and act upon.

The Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune, looks forward for feedback and suggestions from teachers, parents and other readers.



Vivek Gosavi

Director

Maharashtra State Bureau of Textbook
Production and Curriculum Research, Pune

Pune

Date : 21 February 2020

Bharatiya Saur : 2 Phalgun 1941

CLASS 12 : ENVIRONMENT EDUCATION AND WATER SECURITY

Learning Outcomes

Chapter	Learning process suggested; The teacher is expected to provide opportunities to students facilitating learning in groups/ individually {With the help of examples, audio-visuals, images, diagrams, models, flow-charts etc.}	Learning outcomes:- The students shall be able to ;
Chapter 1 Human and environment	<ul style="list-style-type: none"> ➤ Develop an understanding of the concepts - Population explosion, Rural and Urban settlement, Tribal communities and their traditions. ➤ To realize the environment and health issues. 	<ul style="list-style-type: none"> ➤ Explore the concepts - Population explosion, Rural and Urban settlement, Tribal communities and their traditions. To understand the correlation of the practices of people and its impact on environment. ➤ Comprehend the correlation between environment and related health issues.
Chapter 2 Environmental Pollution	<ul style="list-style-type: none"> ➤ Understand the types of pollution as air, water, noise and solid wastes and its impacts etc. ➤ Understand the concept of events of climate change and its impact. 	<ul style="list-style-type: none"> ➤ Generate an understanding of the pollution issues of air, water, noise, and solid wastes. ➤ Understand issue of climate change and its impact.
Chapter 3 Sustainable Development	<ul style="list-style-type: none"> ➤ Elucidate the meaning of sustainable development. ➤ Develop a realization of the need for sustainable development. ➤ Outline the goals of sustainable development. ➤ Comprehend the meaning and importance of sustainable consumption and sustainable agriculture. 	<ul style="list-style-type: none"> ➤ Expose to the concept of sustainable development and generates an understanding about the meaning and need. ➤ Understand the challenges for sustainable development. ➤ Able to grasp importance of sustainable agriculture.
Chapter 4 Practices for Environmental Protection	<ul style="list-style-type: none"> ➤ Comprehend the meaning of 'consumer education' ➤ Acquaint with the concept of Reduce-Reuse-Recycle-Recover (4R), Environmental Impact Assessment, Environmental Audit, Energy Audit, Eco-labelling, Ecotourism and elaborate the importance. ➤ Discuss the International conventions and agreements with their role in environment protection in India. 	<ul style="list-style-type: none"> ➤ Acquaint with the meaning of the consumer education, Environmental Impact Assessment, Environmental Audit, Energy Audit, Eco-labelling, Ecotourism and understand the importance as virtuous practices for the environmental protection. ➤ Familiarize with the objectives of different world conventions, agreements and their role in adopting practices for sustainable development.
Chapter 5 Water Security	<ul style="list-style-type: none"> ➤ Make aware of the prevailing drought like condition across our country and in the state of Maharashtra. ➤ Portray the situation of acute water crisis and witness over-exploitation of groundwater. ➤ Make aware regarding the immediate water conservation, rainwater harvesting, renovation of water bodies, reduce & reuse of water, watershed development, afforestation, drinking water and sanitation. ➤ Generate the attitude to contribute for the community programmes for water conservation. ➤ Ultimately make 'Water Security' as an immediate concern and convert this to a mass movement to ensure water security across our country, making it an added duty of citizen! 	<ul style="list-style-type: none"> ➤ The student realizes the meaning and the facts of drought conditions across our country and the State of Maharashtra ➤ Students realize water crisis situation and the meaning and impacts of overexploitation of ground water. ➤ Become conscious regarding the meaning of water conservation, rainwater harvesting, renovation of water bodies, reduce & reuse of water, watershed development, and intensive afforestation, drinking water and sanitation. ➤ Students realize the need of their role to actively participate and contribute in their area for water conservation. ➤ Students collectively sense the water security and take up their responsibility for water conservation.

- For Teachers -

To begin with, get familiar with the textbook yourself.

- ✓ Please refer to the related textbooks of earlier classes before teaching the topics of this textbook.
- ✓ Please plan carefully and independently for the activities of each chapter.
- ✓ The teaching-learning interactions, processes and participation of all students is necessary through your active guidance.
- ✓ Please use proper teaching aids in the class room for appropriate understanding of the subject such as audio-visual aids, apps etc.
- ✓ You are expected to use the given number of periods fully. Do not finish the chapter in short. This will help the students to assimilate the content without feeling the ‘burden of learning’.
- ✓ Major concepts of environment have a scientific base and they also deal with social aspects. Encourage group activities, learning through each other’s help etc. Facilitate peer learning as much as possible by recognizing the class structure frequently.
- ✓ Do not ask questions on statistical information. Instead, ask questions on their trends or patterns.
- ✓ The present book has been prepared for constructivist and activity-based teaching-learning.
- ✓ Follow the order of the chapters as given because the concepts have been introduced in a graded manner to facilitate knowledge building.

- ✓ Use QR code given in the textbook. Some websites have been given for reference. A list of references used is provided. You as well as the students are expected to use these references. These references will surely help you to go beyond the textbook. Please bear in mind that extra reading is always helpful for understanding any subject in depth.
- ✓ The thought-provoking, activity-oriented, journal assignment work is considered for evaluation. Some examples are given at the end of the chapters in the ‘exercise’.
- ✓ The project work is compulsory for each student. It should be completed according to the guidelines in ‘Project and journal/seminar book’ provided. List of some projects work is provided at the end of the book.

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Front cover : Water security and all environment protection measures are shown.

Back cover : Sustainable agriculture, use of non-renewable energy resources, eco-friendly articles and water conservation are shown.

1. Humans and Environment

- 1.1 Population growth
- 1.2 Rural and urban settlements
- 1.3 Indigenous communities and traditions
- 1.4 Environment and health
- 1.5 Right to live, human rights and value education

1.1 Population growth

The human species dates back to 3 million years ago. Until about 12,000 years ago, humans were mostly hunters and gatherers who typically moved as they needed to find enough food for survival. Since then, there have been three major cultural changes :

- (1) Agricultural revolution (which began 10,000-12,000 years ago),
- (2) Industrial revolution (which began about 275 years ago), and
- (3) Information and globalization revolution (which began about 50 years ago).

These major cultural changes have

1. Provided much more energy and new technologies with which to alter and control more of the planet to meet our basic needs and increasing demands.
2. Allowed expansion of the human population, mostly because of increased food supplies and longer life spans.
3. Increased human environmental impact because of increased resource use, pollution and environmental degradation.

By 1st Christian Era (C.E.) there were more than 170 million human beings on earth. They

had acquired enough skills and tools to manipulate the natural world and to some extent had begun to carve niches, which were entirely man-made. This led to a faster growth of population, which is indicated by an addition of more than 100 million members to the human race, by 1000 C.E. By then various civilizations of human beings were prospering in different parts of the world, and man was ready to take a giant leap.

The next 1000 years saw unprecedented growth in human population, from around 300 million to 6000 million. The industrial revolution boosted the growth of human population tremendously. The human population increased by 2000 million in a span of just 25 years between the years 1975 and 2000.

Terms frequently used with population growth are described below :

- **Birth rate (Nativity)** : The number of live births per 1000 population in a given year.
- **Death rate (Mortality)** : The number of deaths per 1000 population in a given year.
- **Growth rate** : The number of persons added or subtracted from a population in a year due to natural increase and net migration.
- **Doubling time** : The number of years required for the population of an area to double its present size given the current rate of population growth.
- **Carrying capacity** : The maximum number of individuals of a species that an area can support. Many environmentalists, however believe that there are definite limits to growth and the earth's carrying capacity. The growing population has

affected the carrying capacity of the planet eventually resulting in a number of problems like inadequate resources, standard of living, unhygienic and improper sanitation facilities etc. Today, due to population pressures and human impact, the natural elements like air, water and soil have been polluted to a great extent.

- **Ecological balance :** The fine balance that exists between living and non-living things, food webs and environmental conditions of an ecosystem.
- **Population growth rate :** The net annual percentage increase in population.
- **Exponential growth :** The growth of a quantity with time in such a way that the curve is relatively flat in the beginning, but becomes steeper and steeper with time (see fig. 1.1)

Increase in world human population over time

The Fig 1.1 shows the growth of population over time.

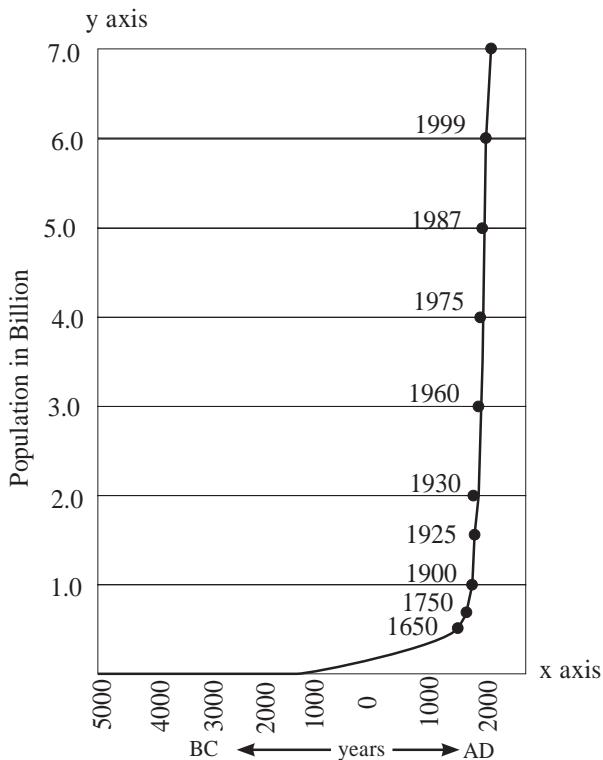


Fig 1.1 World Population Growth

It can be seen that curve was flat for a long time and from about 1650 C.E. it started spiking and became parallel to y axis.

Mathematically, this is called an exponential curve. The world population started increasing rapidly with the onset of the scientific and industrial revolution in Europe. Between 1850 and 1950 the population doubled to 2 billion. The 5 billion mark was reached in 1987 and 6 billion mark in 1999. Right now the world's population is 7.7 billion and India's population is approximately more than 1.25 billion.

Demographic Transition

There is a close relationship between population growth rate and economic development. Due to improvement in economic conditions, natality as well as mortality declined resulting in low population growth rate in developed countries. This process is known as demographic transition.

Demographic transition occurs in four stages due to development in industrialization and consequent urbanization.

1. **Pre-industrial Phase :** Harsh living conditions lead to a high birth rate (to compensate for high infant mortality) and a high death rate. Thus, there is little population growth
2. **Transitional Phase :** As Industrialization began, food production increased and health care improved. At the same time death rates dropped and birth rates remained high, so the population growth was rapid. Many countries such as India, Bolivia and Saudi Arabia were in this category.
3. **Industrial Phase :** Industrialization is widespread. The birth rate drops and the death rate also decreases. Reasons for this convergence of rates include better access to birth control, decline in the infant mortality rate, increased job opportunities for women

and increased investment in basic education for children and other social changes. Most developed countries are now in this third stage. This stage is characterized by sudden decline in birth rate and death rate. e.g. China and Indonesia.

- 4. Post-industrial Phase :** The birth rate declined even further, equaling the death rate and thus reaching a stable population growth. Most of the European Countries are in this category.

Age and sex structure of a population in a country may be represented by age and sex pyramids through the proportion of males and females in a specific age groups

- Population Pyramid :** The population pyramid is a plot of the number of people belonging to various age groups. Population pyramid is an important feature to understand a country's demographic situation. This information is very useful for the government to plan for improvement.

- i) **Pyramid for Developing Countries :** In this type of population pyramid, there is large number of young population and the proportion of old people is less.

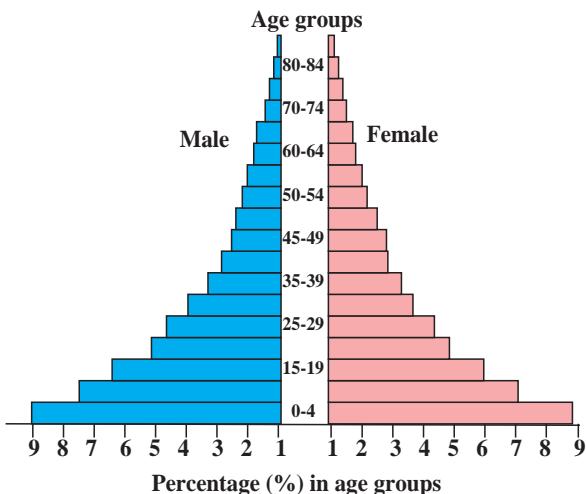


Fig 1.2 Pyramid for developing countries

- ii) **Pyramid for Developed Countries :** In this type of pyramid, the birth rates and death rates are low.

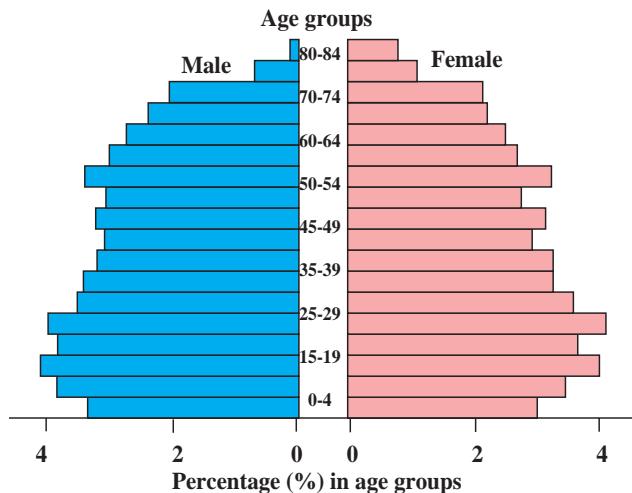


Fig 1.3 Pyramid for a developed countries

- iii) **Urn shaped Population Pyramid:** In this type of pyramid, the proportion of pre-reproductive age group population is very small in comparison to people belonging to reproductive age group. This represents countries in the post industrial phase.

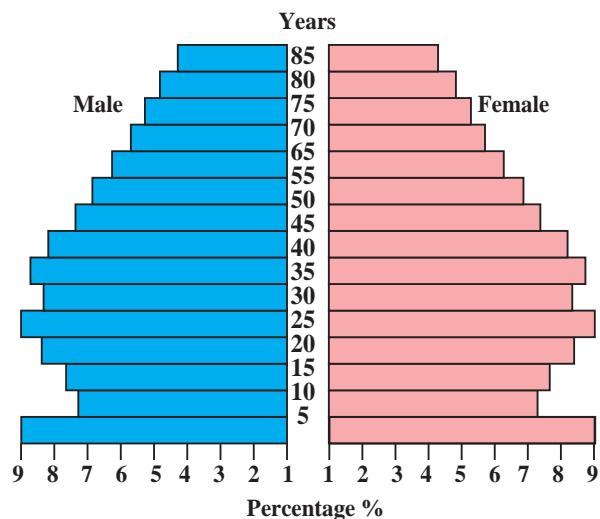


Fig 1.4 Urn shaped population pyramid

Do you know?

There is a big difference in the population growth pattern between the developing and the industrialized (developed) nations. Nearly 99 per cent of population increase takes place in developing countries. The population remains the same or even declines in the industrialized nations. By 2050, the population

of developing countries is likely to go up by 55 per cent. However, the total population of industrialized countries is expected to increase only by about 4 per cent.

Table 1.1 shows the ten most populous countries as of 2018.

Rank	Country	Population (crores)
1	China	142.8
2	India	135.3
3	US	32.7
4	Indonesia	26.8
5	Brazil	20.9
6	Pakistan	21.2
7	Russia	14.6
8	Bangladesh	16.1
9	Nigeria	19.6
10	Mexico	12.6

Source: United Nations (UN), 2018

- **Migration of people**

Migration is the movement of people from one place to another. It leads to increase/decrease in population of a place. Recently migration is becoming major issue all over the world.

- **Process of migration**
- **Emigration** - Movement of people out of certain area.
- **Immigration** - Entry of people in an area.
- **Factors affecting migrations**

Table 1.2 Factors affecting migration

Push factors	Pull factors
Unemployment and under employment	Better economic prospects
Economic underdevelopment	Higher salary and income
Low wage and salary	Better standard of living
Political instability, wars etc.	Good Governance
Disputes and conflicts	Safety and stability
Lack of freedom	Intellectual freedom
Discrimination based on religion and politics	No discrimination
Lack of medical care	Better medical care facilities

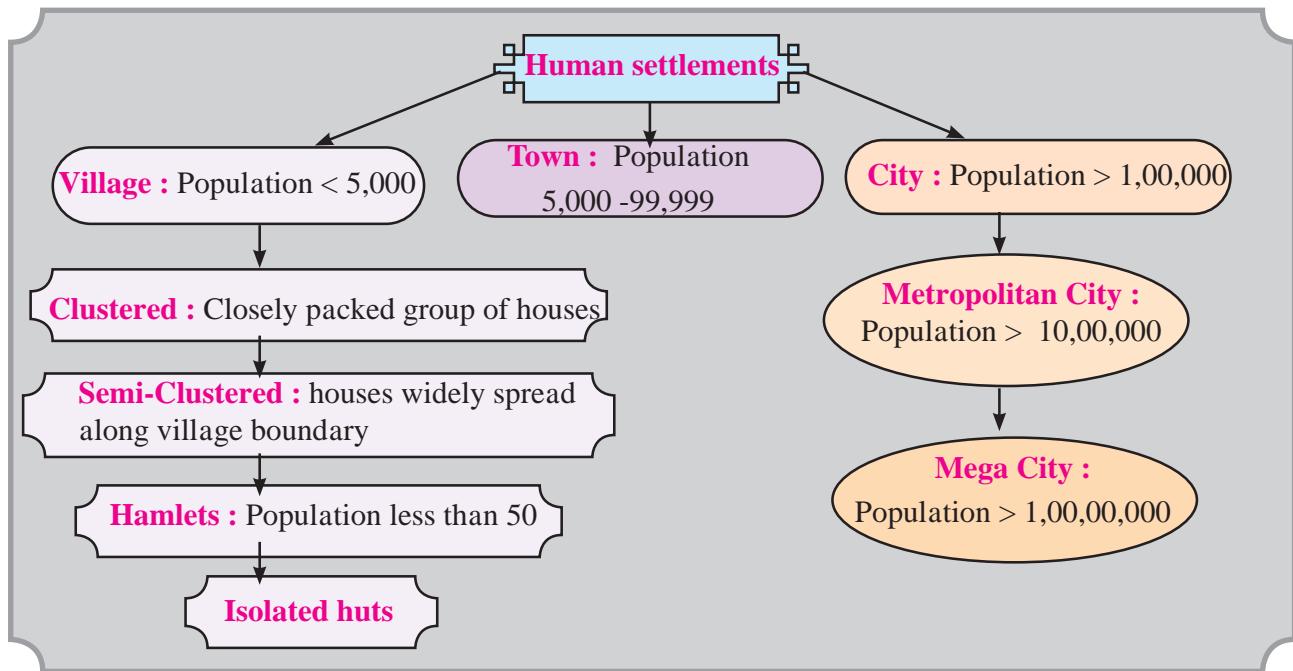
1.2 Rural and urban settlements

People build houses and develop their settlements to protect themselves from harsh weather conditions and to enjoy their social life. The physical components of settlements comprise of :

1. **Shelter** : It includes houses with different sizes, types and building materials that people make for security, privacy and protection.
2. **Infrastructure** : It includes networks such as roadways, railways, pipelines, cables; which are used for network for information, goods, water, education, entertainment and electricity etc.

Classification of human settlements

On the basis of the number of people and their activities, settlements are classified in two groups - rural and urban settlements in India.



Problems related to urban and rural settlements :

Urban areas have more environmental problems as compared to rural areas.

• Urban environmental problems

1. Land and Biodiversity

- Loss of cropland
- Loss of forests and grasslands
- Loss of wetlands
- Loss and fragmentation of wildlife habitats
- Increased wildlife roadkill
- Increased soil erosion

2. Human health and aesthetics of city

- Contaminated drinking water
- Environmental pollution
- Traffic congestion
- Reduction in aesthetic value of city due to waste

3. Water

- Increased surface runoff
- Increased surface water and groundwater pollution

- Decreased storage of surface water and groundwater
- Increased flooding
- Decreased natural sewage treatment

4. Energy, Air and Climate

- Increased energy use and waste
- Increased air pollution
- Increased greenhouse gas emissions
- Enhanced global warming
- Ozone depletion

5. Economic effects

- Higher taxes
- Decline of business
- Increased unemployment in city

• Rural environmental problems :

- Poor sanitation
- Conversion of farm land to residential lands
- Lack of drainage facilities
- Indiscriminate use of pesticides and fertilizers
- Salination, desertification and degradation of land.

1.3 Indigenous communities and traditions

Indigenous knowledge

Indigenous knowledge is the traditional and local knowledge held by the members of a given community. It is related to the environmental conditions of the community and enables the community to survive in those conditions. Indigenous Knowledge (IK) can be integrated in teaching, so that students can improve their awareness on environmental conservation and protection.

- Local crops that are used by the communities are protected. This helps to conserve the biodiversity in their area.
- Indigenous methods of seed storage help to conserve the genetic resources of crop plants.
- Some wild plants which serve as food crops are known to indigenous people. This helps during droughts when regular food crops cannot be grown.
- Indigenous people understand weather patterns and are therefore able to predict cyclones and storms.
- Sustainable natural resource management is driven by the beliefs and behavior of human communities and local cultures.

Tribal people not only in India but also in other parts of the world have been known for their unique cultural identities since time immemorial. They are very close to nature and know about plants and animals. Various plants and animals have religious as well as medicinal and economic importance among the whole tribal India.

Tribal people are keen to save these biological resources. Indigenous people and traditional communities have a growing interest in being more directly involved in recording, presenting and representing their own cultures to the public. They also wish to own, control and access cultural heritage materials held by cultural institutions.

Do you know?

The Warlis of Maharashtra

A group of forest tribal communities called the 'Warli's live around 100 km from Mumbai. They are a good example of the harmonious relationship that existed between many tribal communities and forests.

The 'Warli's worship forests and all of nature as the God Hirva (Green). They consider nature's produce as Hirva's gift and not as the fruit of their own labour. The 'Warli' culture conserves many plants and animals based on customs and religious beliefs. Sacred groves, which are maintained without any interference of human beings, by tradition and fear of God, are examples of 'Warli' conservation.

The 'Warli's act as the caretakers and not as exploiters of the forest. They take from the forest just enough for their immediate and basic needs. Trees are never destroyed, but twigs and dry fallen branches are collected. They cut branches only from those trees whose growth will be improved by such chopping.

The 'Warli's practice organic farming. They have evolved a complex system of multicropping, best suited to the short and irregular monsoon. They plant many traditional varieties of crops and are able to get some harvest even during droughts.

Tribal communities like the 'Warli's are now in trouble. Forest policies and displacement due to development project are changing their lives. When they leave the forest, their knowledge disappears with them!

Activity 1

- Visit your nearby vegetable market.
- Observe and identify varieties of fruits and vegetables.
- Observe the difference between indigenous and hybrid varieties.
- Why are the indigenous varieties not cultivated on large scale as compared to hybrid varieties?
- What action is needed to conserve these local indigenous varieties?

Indigenous community practices

These include local practices of farming, natural resource conservation, environmental protection etc. which have been passed down from generation to generation.

These practices play a key role in the protection of biodiversity. A number of sacred groves thrive in India and its neighboring countries due to the efforts of the indigenous people. They practice their traditional beliefs that help them to live in harmony with nature. For example -

- a) The Bishnois worship the Khejari tree and the Black Buck. The tree provides food, fodder and building material to these people.
- b) Devrais in Maharashtra are the small patches of forests, conserved by local people in the name of local deities.

The indigenous people of India have played a vital role in preserving bio-diversity of several virgin forests and have conserved several flora and fauna in sacred groves of tribals.

These flora and fauna might have been disappeared from natural ecosystem. The sacred groves are the natural forests which are located in North - East, Central and Peninsular India including Maharashtra. The interference of all

kind of human activities are prohibited in sacred groves.

Case studies : Beej Bachao Andolan (save the seed movement)

This movement began in the Himalayan foot-hills. The members have collected seeds of diverse crops in Garhwal. The movement has successfully conserved hundreds of local rice varieties, rajma, pulses, millets, vegetables, spices and herbs. Different varieties are being grown as an outcome of this programme in local farmer's fields. This has also been supported by local women's groups.

Activity 2

Make a group of students and prepare seed banks and seed balls of indigenous species.

Sacred groves

These are tracts of forests that are protected in the name of deity. They have religious significance and are, therefore, protected by certain local communities. Hunting, logging, grazing and collection of fire wood are usually strictly prohibited within these patches. The flora and fauna in these forest patches are worshipped by the local people.

Sacred groves play an important role as a gene bank for biodiversity conservation in many areas.

- 1) Some groves have ponds and streams which supply water to local communities and at the same time help to recharge ground water in the area.
- 2) They are considered as biodiversity areas, providing a refuge for a number of species of flora and fauna, which are otherwise affected by habitat destruction and hunting in surrounding area.

Threats to Sacred Groves in India :

- Sacred groves are under threat due to -
- Urbanization, over grazing and excessive fuel-wood collection
 - Environmental degradation by visitors to these groves who go there to perform religious practices.
 - The changing values, the cultural and religious attitude of the people, have created threats to sacred groves.

What can we do to protect the sacred groves :

- Locating sacred groves properly.
- Preparing a detailed inventory of the flora and fauna in such groves.
- Assessing the impacts of man-made activities on sacred groves.
- Assessing external threats to these groves such as cyclones, forest fires, floods etc.

Do you know?

Conservation of indigenous crops - A community movement

Seed mother, Rahibai Popre is an Indian farmer from village Kombhale, Ahmadnagar district and is a seed conservationist. She has no formal education, but she established a seed bank in her house for the conservation and revival of indigenous crop diversity.

She has conserved and multiplied about 43 types of native crop varieties from Farmers of 17 crop varieties including paddy, hyacinth bean, millets, pulses, oil seeds etc.

She works with 3,500 farmers in Ahmadnagar district, sharing her traditional knowledge and experiments thus promoting agro-biodiversity. For this, she has been honoured by 'Padmashri' award.

Eco-friendly practices

- In India, eco-friendly and affordable bullock carts are used by rural folk. Such carts meet the transportation needs without any danger of greenhouse gases emissions.
- Rural women use cow-dung cakes to meet their energy requirements for cooking and heating.
- Use of insect-repellant plants, that suppress diseases and harmful pests.
- Indigenous plant materials that are more drought- and pest-resistant should be grown.
- Multi-cropping, planting of perennial crops, categorization of soil and planting of appropriate crops, planting of leguminous crops, allotting land for watershed.
- Preserving traditional seed varieties are found to be beneficial in conserving the environment.

1.4 Environment and health

Natural resources are gift to human life. Good conditions of air, water, soil and biodiversity enhances our health and wellbeing. When these resources degrade, it ultimately results into ill health, morbidity and shortening of life span.

World Health Organization (WHO) has defined, "Health as a state of complete, physical, mental and social wellbeing; not merely absence of disease or infirmity."

Unhealthy environment increases mental stress, anxieties, chances of cancer and other

diseases. It also increases the disabilities of body organs. It increases strain on physical capabilities and affects reproductive capacities also.

Industrialization and consumerism are main causes of natural resources pollution. The destruction of natural habitat by pollution affects agriculture, animal husbandry, aquatic flora and fauna. Increasing malnutrition, poverty etc. changes environmental conditions resulting in outbreak of different diseases.

• Water and Health

The availability of water resources and quality of water is being degraded day-by-day in India. It results into harmful effects.

1. More than 50% of population of the country does not have access to potable water.
2. 80% diseases are water borne. Unclean and poor water conditions kill more than 13 million people per year.
3. Discharge of untreated sewage and organic load in water bodies increases chances of cholera, typhoid, diarrhea and hepatitis.
4. Different types of untreated toxic effluents, heavy metals are discharged in water by industries.
5. Leaching and seeping of agrochemicals such as pesticides, synthetic organic chemicals and persistent organic pollutants (POPs) get released in surface and ground water affecting human health.

• Air and Health

Air is mixture of different gases. The composition of air is altered by primary and secondary pollutants. It changes quality of air and causes harm to health of organisms and human being. Air is a movable entity, it affects global health.

Particulate matter (sizes 2.5 μm - 10 μm) (soot and dust), toxic gases and agrochemicals are responsible for degradation of air quality. It results into unwanted and unexpected situations.

1. Two weeks of office and school work was stopped in Delhi in 2018 due to air pollution.
2. More than 3 million deaths occur in India due to air pollution.
3. Inhalation of particulate matter causes heart, respiratory and lung disorders, increased risk of cancer.
4. Global warming by green house gases increases communicable and skin disease.
5. Vehicular pollution soot, CO_2 , cause irritation of eye, nose and increased asthmatic condition and bronchitis.
6. Smog results in respiratory diseases, decreasing visibility and taking lives in accidents.
7. Congested overcrowded and unhygienic conditions increase microbial growth and air borne diseases such as T.B., pneumonia, polio, whooping cough etc in children.

The basic necessity of life is pure air. If its quality is degraded, it hits life of all organisms

Case study: Delhi pollution

It was in October 2016, Delhi faced one of its worst smog episodes. The Particulate Matter (PM) 2.5 levels rose to 750 micrograms/cubic mm; that is 12 times the permissible level. Very poor visibility, cancellation of flights, school closure were few of the features of this incidence. The smog is made up of particles and toxic chemicals. Merely breathing in this air was

like smoking 50 cigarettes in a day. Indian government declared this situation as an emergency.

As a part of the action plan, Delhi government planned to shift all petrol and diesel vehicles to clean fuels like compressed natural gas (CNG). It was the first time in India that CNG was introduced for public transport effectively. Delhi government also moved highly polluting industries out of Delhi region.

Burning of crop residues also intensified during the years between 2010 to 2019. Multiple new settlements and construction activities boomed. The population of Delhi and National Capital Region (NCR) increased from 16.6 million in 2001 to 46.1 million in 2011. The measures adopted to control air pollution mainly related to monitoring during this period were noteworthy.

Delhi government took steps to curb the number of private vehicles. The popular ‘Odd – Even’ measure of private vehicles having odd vehicle numbers on odd dates and even numbers on even dates; was intended to reduce vehicular emission and traffic congestion. This lead to city wide discussion on air pollution and its sources. There were further restrictions brought e.g. ban on diesel generator sets in Delhi, the closure of brick kilns, stone crushers across NCR, and shut down of Badarpur power plant in winter were some of the steps taken after 2016 smog. Presently medium to long term measures are planned for pollution control with a detailed timeline for its implementation.

• Soil and Health

Health is deteriorated due to contaminated food which results due to inappropriate agricultural practices.

Non-biodegradable compounds, chemicals, POPs are entering in food and food chain resulting their bio magnification. Consumption of such contaminated food disturbs the various systems of the body causing diseases such as cancer and infertility.

Biomedical wastes added to soil, affect soil flora and fauna. Radioactive products, heavy metals mixed by e-waste, chemical waste causes various diseases in plants, animals and humans.

• Radioactivity and Health

Nuclear tests, the warfare in countries and accidents in radioactive nuclear plants destroy environment in that area.

Uranium - 235, Strontium - 90, Iodine - 131, Cesium - 137 are major radioactive pollutants released in the environment due to different activities.

Accumulation of radionuclides in human tissues leads to cancer, gene mutation, which also results in birth of abnormal babies with malformed organs.

1.5 Right to live, human rights and value education

• Environmental ethics

It studies the relation of human beings with the environment. It believes that humans are part of the environment along with other living creatures. It is important to understand that the health of humans is closely linked to ecosystem health.

Guiding Principles of Environmental Ethics

1. All species have equal right to all resources and also have right to compete for equal opportunities and comfort.
2. The right of the environment should take precedence over the right of individual as it is linked to the welfare of entire life.

• Right to Live

The different types of pollution are deteriorating environment. Some species have become endangered and few have become extinct due to loss of aquatic and terrestrial habitats. They are struggling for proper environment. Do they have right to live on earth or Not? Man is not only harvester of natural environment, he is one of the species amongst millions of species. All the creatures of nature have equal right to live and cherish it for whole span of life. Humans must realize and admit that they can not live on earth alone. All other biodiversity is the support system for them. So we need to think about rights of nature. We must accept these rights i.e. all organisms have right to live in a peaceful, good and clean environment, compassion to life and with, equal right to natural resources. We must think about right to biodiversity, right to protect culture of the creature. This will help to sustain the environment.

• Human Rights and Environment

United Nation (UN) has linked Human Rights and Environment in 1994 draft. It described to accept the rights of everyone to secure healthy and ecologically sound environment.

1. Human rights to healthy, safe and secure environment. It must be free from pollution and degradation of air, water and other environmental resources.

2. Right to enjoy natural ecosystems and their rich biodiversity in just and equitable manner.
3. Right of humans to lead dignified life and legitimate needs.
4. Right to take environmental information, education, participation in environmental discussion and create awareness.
5. Right of future generations to fulfill their own needs.

Do you know?

United Nations (UN) also mentioned the duties of human beings to cherish proper human rights such as -

1. Protection of environment.
2. Preservation of good status of environment.
3. Prevention of environmental harm.
4. Accept thresholds / limits of use of nature and natural resources.

• Value Education

Ancient India had developed values in human being by family and Gurukul education. The value education is the process of learning life principles which decides virtues of a person in the family and the society.

The character of a person is developed by having values like environmental ethics, natural principles, truthfulness, honesty, peace, non-violence, integrity, righteousness, civic sense, respect to all nature's laws. The Indian constitution added more values as sovereignty, secularism, socialism, democracy, republican character, equal justice, unity, integrity of nation and dignity of all individuals.

Value education in reference to environment is expected to bring about a thinking for

sustainable lifestyle for everyone in the society . Environmental values need to be inculcated through a process of appreciating our environmental assets and act for conservation of these assets. We consider economic growth as most important and this mindset must change and everyone should think and act for sustainable development.

Every human being should have feelings and respect for different aspects of his or her surroundings. The values for the resources of nature should not be only utilitarian importance alone. The true environmental values go beyond valuing a river for its water, a forest for its timber and other resources , or the sea for its fish. Environmental values should have a feeling to bring about sensitivity for preserving nature as a whole. Our environmental values should have pro-conservation actions in day-to-day activities. Most of our actions have adverse environmental impacts unless we consciously avoid them.

Values lead to a process of decision making which leads to action. For value education in relation to the environment, this process is learned by an understanding and appreciation of nature's oneness and the importance of its conservation.

With the small human population in the past, throwing away a little household degradable garbage could not have been considered wrong. But with enormous numbers of people throwing away large quantities of non-degradable waste, it is indeed extremely damaging to the environment and our value system must prevent all this through a strong environmental value education system.

Appreciating the negative effects of our actions on the environment must become a part of our day-to-day thinking. While we do need economic development, our value system must change to one that makes people everywhere

support a sustainable form of development so that we do not have to bear the cost of environmental degradation.

Each action by an individual must be linked to its environmental consequences in his/her mind, so that a value is created that strengthens pro-environmental behaviour and prevents anti-environmental actions. This cannot happen unless new educational processes are created that provide value education right from an early age.

At the community level, this occurs only when a critical number of people become environmentally conscious so that they constitute a pro-environment lobbying force that makes governments and other people accept good environmental behaviour as an important part of development.

Environmental values are linked to varied environmental concerns. While we value resources that we use as food, water and other products, there are also environmental services that we must appreciate. These include nature's mechanisms in cleaning up air by removal of carbon dioxide and addition of oxygen by plant life, recycling water through the water cycle of nature and maintaining climate regimes.

However, there are other aesthetic, ethical values that are equally important aspects of our environment that we do not appreciate consciously. The tiger's magnificence, the whale and elephant's giant size, , the graceful flight of a flock of cranes, are all parts of nature that we admire. The lush evergreen forest, the great power of the ocean's waves, and the tranquility of the Himalayan mountains are things that each of us value even if we do not experience it ourselves. We value its being there on earth for us. This is called its 'existence value'.

Environmental values must also stress on the importance of preserving ancient structures. The characteristic architecture, sculpture, artworks and crafts of ancient cultures are invaluable environmental assets. Unless we learn to value these landscapes and preserve them , they will disappear and our heritage will be lost.

Apart from valuing the diversity of life itself, we must also learn to value and respect diverse human cultures. Many of the tribal cultures of our country are vanishing and along with them the traditional knowledge that they have.

The equitable use of resources is an essential aspect of human well-being and must become a part of all socially and environmentally conscious individuals. Our environment has a major component that does not belong to any one individual. There are several commonly owned resources that all of us use as a community. The rivers, lakes etc are common property resources and they need to be protected and conserved for the society.

Exercise for Journal Assignment

- 1) Explain various factors, responsible for migration of people.
- 2) Explain the importance of sacred groves.
- 3) Write down the eco friendly practices that you can follow in your day-to-day life.
- 4) How the population pyramid explains demography of a country?
- 5) What are different environmental factors, that affect human health?
- 6) Explain environmental ethics with the help of an example.
- 7) Suggest major improvements for sustainable future of human and environment.
- 8) Explain environmental problems of your locality.



2. Environmental Pollution

- 2.1 Air pollution**
- 2.2 Climate change**
- 2.3 Soil pollution**
- 2.4 Noise pollution**
- 2.5 Solid waste management**

Environmental pollution is one of the major threats to mankind. Population explosion, uncontrolled industrialization, urbanization and exploitation of natural resources lead to environmental pollution. The serious ecological imbalance is due to environmental pollution. The three basic amenities for all living organisms i.e. water, land and air become polluted because of various anthropogenic activities.

Pollution can be defined as, “An undesirable change in the physical, chemical or biological characteristics of air, water and soil that may harmfully affect life or create a potential health hazard for any living organism.”

Do you know?

A new report by the World Health Organization (WHO) reveals that 24% of global diseases and 23% of all deaths are caused by environmental exposures. Many of these can be prevented by better environmental management. Four diseases most influenced by poor environment are diarrhea, respiratory infections, unintentional injuries and malaria.

An agent which causes pollution is termed as pollutant. Pollutants can be

defined as, “Any solid, liquid or gaseous substance present in such concentration which may be or may tend to be injurious to the environment.”

2.1 Air pollution

Air pollution is the entry of unwanted particulate matter, biomolecules or other harmful materials into the Earth's atmosphere. It causes diseases, death to humans and damage to other living organisms.

According to The Air (Prevention and Control of Pollution) Act, 1981, “Air pollution is the presence of any solid, liquid, or gaseous substances in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.”

Air Pollutants

The major air pollutants are as follows :

- 1) **Particulate matter** - Soot, smoke, tar or dust and domestic wastes.
- 2) **Toxic Gases** - Carbon Monoxide (CO), Oxides of Nitrogen (NO_x) Oxides of Sulphur (SO_x), Halogens (chlorine, bromine and iodine) and volatile organic compounds.
- 3) **Metals** - Lead, zinc, iron and chromium.
- 4) **Industrial pollutants** - Benzene, ether, acetic acid etc. and cyanide compounds.
- 5) **Agricultural pollutants** - Pesticides, herbicides and fungicides, Chemical fertilizers.

6) Photochemical pollutants - Ozone, Oxides of Nitrogen (Nox), aldehydes, ethylene, photochemical smog and Peroxy Acetyl Nitrate (PAN) and Oxides of Sulphur (SOx).

7) Radiation pollutants - Radioactive substances and radioactive fall-outs of the nuclear test.

Sources of air pollution

The basic sources of air pollution are natural and anthropogenic/man-made.

Natural sources of pollution are those that are caused due to natural phenomena such as volcanic eruptions, forest fires, biological decay, pollen grains, marshes, radioactive materials etc.

Anthropogenic/man-made sources of pollution are those which are created by human activities. These include indoor air pollutants, vehicular emissions, fossil fuel burning, agricultural activities, industrial emissions and thermal power plants etc.

Effects of Air Pollution

Table 2.1: Some major pollutants and their effects

Pollutants	Effects on human health	Effects on environment
Sulphur oxides (SOx)	Respiratory problems, heart and lung disorders, visual impairment	Chlorosis, death of plant tissues
Nitrogen oxides (NOx)	Generates PAN, Pulmonary disorders, Respiratory infections, very toxic at high concentrations	Acid rain reduces crop yields.
Aerosols (Dust, smoke, smog)	Interferes with ability of lungs to exchange gases	Influence climate by scattering light
Particulate matter (PM) PM _{2.5} and PM ₁₀	Respiratory problems, asthma, bronchitis, reduced lung function, lung/liver fibrosis, heart stroke, bone problems, cancer, heavy metal poisoning	Adverse effect on biodiversity Accumulation of soot or black layer on the leaves.
Carbon monoxide (CO)	Reduces oxygen carrying capacity of blood, cardiovascular problems. Infants, pregnant women, and elderly people are at higher risk.	Global warming
Ozone (O ₃)	Tropospheric ozone causes respiratory problems such as throat irritation, asthma, bronchitis, chest pain, etc.	Adverse effects on plants. Assist in the formation of Peroxyacetyl nitrate (PAN), acts as green house gas.
Lead (Pb)	Affects blood, nervous system	Increase in atmospheric lead due to vehicular emissions
Ammonia (NH ₃)	Burning of eyes, nose, throat and respiratory track. Prolonged effects result in blindness, lung damage or death.	Affects aquatic organisms

Air Quality Index (AQI)

Air Quality Index is the index used to show level of air pollution in particular area. It is used by government to communicate to public about the quality of air. Public health risks increase as AQI rises.

Table 2.2 Air Quality Index (AQI)

Air Quality Index (AQI)	
AQI Values	Levels of health concern
0-50	Good
51-100	Satisfactory
101-200	Moderately-polluted
201-300	Poor
301-400	Very poor
401-500	Severe

Control Measures of Air Pollution

Following measures have been suggested to control air pollution -

- 1) Avoid burning of fire wood, charcoal and garbage.
- 2) Use renewable energy resources.
- 3) Strict implementation of pollution control laws.
- 4) Height of chimneys should be increased to the highest possible level to reduce pollution at the ground level.
- 5) Development of green belt by tree plantation. The trees absorb polluting gases and particulate matter which settles on the leaf surface.
- 6) Strengthen and use public transport system.

Do you know?

The Government has taken following steps to control air pollution :

- Establishment of Ambient Air Quality Monitoring throughout India.
- Notification of Ambient Air Quality Standards under Environment (Protection) Act.
- Notification of vehicular emission norms for year 1990-91, 1996, 1998, 2000, 2001.
- Improving fuel quality by phasing out lead from gasoline, reducing diesel Sulphur, reducing gasoline benzene etc. Blending of ethanol with petrol and diesel.
- Introduction of alternate fueled vehicles like electric, CNG/LPG and hybrid.
- Improvement in public transport system.
- Phasing out of grossly polluting commercial vehicles.
- Public awareness and campaigns.

The best method to control air pollution is 'Pollution Prevention', also known as 'source reduction,' is any practice which reduces, eliminates or prevents pollution at its source.

For every vehicle you must regularly obtain PUC (Pollution Under Control) certificate which is a Certification Mark issued to certify that motor vehicles in India meet emission and pollution control norms is necessary for every vehicle.

Do's

- Walk to work or ride a bicycle.
- Try to use public transportation whenever possible.
- Carpool - Two or four people can ride in one car.
- Get a valid pollution under control certificate (PUC) from authorized testing centre.
- Keep automobiles fuel filters clean and save the fuel.
- Maintain recommended tyre pressure.
- Use biofuels.

Don't

- Extensive use of private vehicles.
- Travel by congested road during rush hours.
- Keeping the engine running on for more than one minute at traffic signals.
- Use of clutch pedal as footrest.
- Use of leaded petrol.



Do you know

SAFAR

Govt. of India has introduced a major national initiative called "**System of Air Quality, Weather Forecasting and Research (SAFAR)**" in greater metropolitan cities of India to provide location specific information on air quality in near real time. It is installed in four cities Delhi, Pune, Ahmedabad and Mumbai. This system benefits the general population by increasing awareness on climate related events. Before the introduction of SAFAR there was no way to know the status of air quality.

The Air (Prevention and Control of Pollution) Act, 1981

The Air (Prevention and Control of Pollution) Act, 1981, was established to maintain the ambient air quality in the nation. The enactment regulates the emissions from the industries and factories so as to keep them below the harmful levels. The Air Act also has a provision under which Pollution Control Boards can earmark areas wherein no polluting industrial activity is allowed.

Violation of provisions of the Air (Prevention and Control of Pollution) Act, 1981 attracts criminal charges and such organisation or individuals have to face criminal trials for polluting air. The Act makes it mandatory for every occupier of the premises to furnish appropriate information, whenever asked for, to the pollution control board officials.

2.2 Climate change

Climate is the general average pattern of weather in a place over a period of years. Changes in environment are either natural or man-made. Man-made changes have greater and more serious impact on the climate. Human activities are leading to an unprecedented acceleration in climatic changes. It is predicted that by 2050, the world will be warmer by an average of 1.5 - 4.5°C. There are several reasons for these accelerated changes. The increase in some gases in the atmosphere, resulting from human activities such as burning of fossil fuels and deforestation are some of the reasons. As these emissions continue to rise, it is feared that they will lead to a substantial change in the climate.

Greenhouse effect

In the normal course of things, the earth

surface absorbs solar radiations and gets warmer, while some of the heat is radiated back into atmosphere. Naturally occurring gases, present in the atmosphere trap a part of this outgoing heat and prevent it from escaping back into space. This leads to warming of the earth's surface and a substantial rise in temperature of the troposphere.

This phenomenon keeps the earth sufficiently warm; and the life on the earth survives at this temperature.

Gases like Carbon dioxide (CO_2), Oxides of Sulphur (SO_x), Oxides of Nitrogen (NO_x), Methane (CH_4) etc. are called greenhouse gases (GHGs), because they act like the glass of a greenhouse. Due to which the heat absorbed by the surface of the earth is retained and it can not escape into the space. This trapping of heat in the troposphere is called Greenhouse effect.

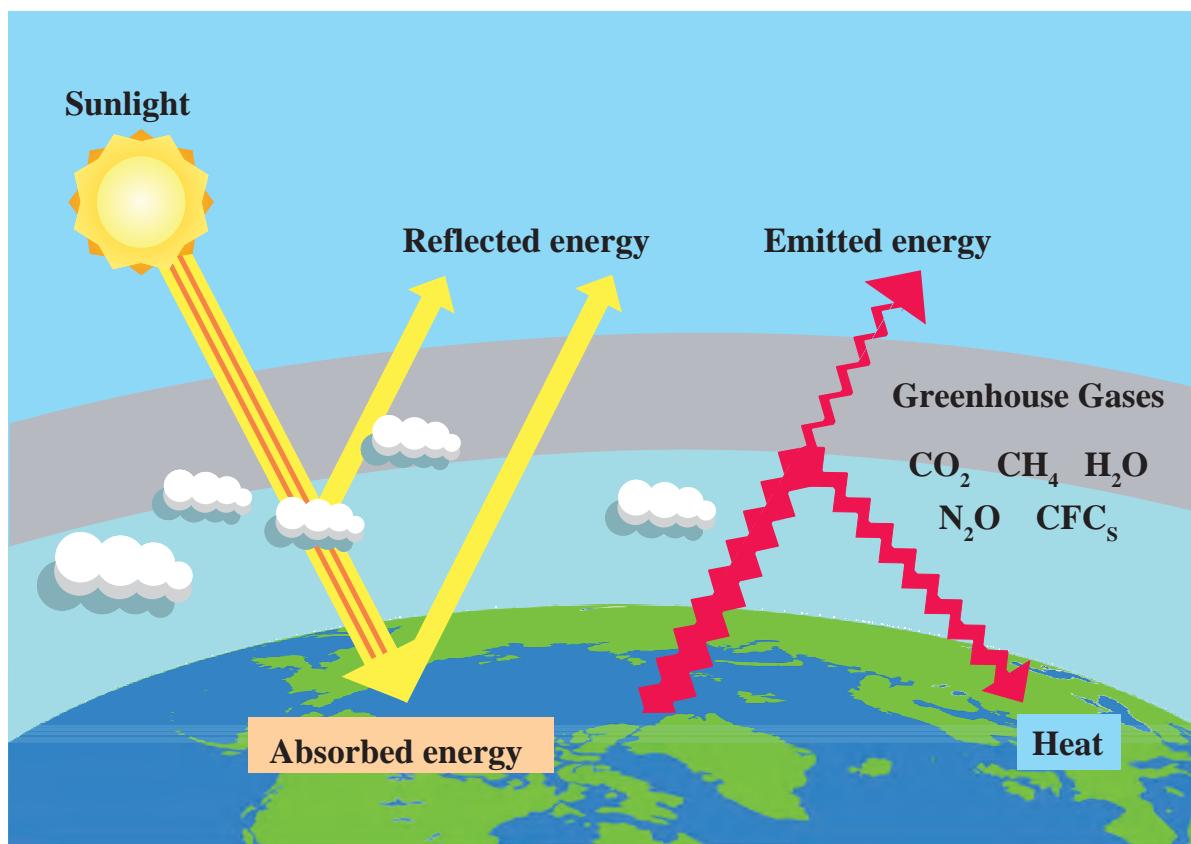


Figure 2.1 Greenhouse effect

Global Warming

Global climate is dependent on the concentrations of greenhouse gases present in earth's atmosphere. Today human activities leading to release of greenhouse gases are dramatically increasing. Vehicular and industrial pollution are adding gases like Carbon dioxide (CO_2), Sulpher dioxide (SO_x), (NO_x) and Carbon Monoxide (CO). Some new manmade gases such as CFC's are also responsible for increase in temperature. The gradual increase in the temperature of the earth atmosphere is referred to as Global Warming.

Table 2.3 : Activities responsible for climate change

Activity	Greenhouse gas
Industrial emissions	NO_x CO CO_2 SOx
Vehicular emission	CO CO_2 SOx
Fossil Fuel burning	CO CO_2
Cow dung, ruminant animals, paddy fields	CH_4
Sewage, Landfill	CH_4
Refrigeration, foams and aerosols	CFC's
Fertilizers	NOx

Impact of climate change

What will happen if the earth's temperature rises by a small amount? Is it something to worry about? Let us look at some of the impacts :

1. Temperature increase -

If input of greenhouse gases continues to

rise at the present rate; earth's mean temperature will rise by 1.5-4.5°C by 2050. This would disrupt crop growth and cause loss in agricultural production.

2. Rise in sea level

Over the last century, the global sea level has risen by 10-30 cm. due to melting of glaciers. If this situation continues, this would submerge small islands. The republic of Maldives is an example of a nation, which is very vulnerable to sea level rise. Delta regions are also at high risk.

3. Agricultural production

Changes in weather pattern would have far reaching effects on agriculture. Some places would get drier, some wetter, some get hotter and other cooler. This will affect the crop production and yield.

4. Loss of ecosystem and biodiversity

Due to large scale felling of trees and high level of dryness, large forests may catch fire. Indonesia and Brazil forests are the recent examples of forest fires. Large areas of forests would disappear, so animal species would be forced to migrate.

5. Adverse effects on human health

Deaths due to heat waves and other extremes of climatic conditions, water and air borne diseases like Malaria, Encephalitis and Dengue etc. would be more.

2.3 Soil pollution

Soil is like water and air, equally important for living organisms. It supports plants on which all other living organisms depend. The process of soil formation is so slow that the soil is considered as a non-renewable source. Therefore, the study and control of soil pollution is important.

Sources of soil pollution

There are several materials, which adversely affect physical, chemical and biological properties of the soil and thus reduce its quality. These are -

1. Pesticides and insecticides that are sprayed on crops.
2. Fertilizers and manures that are added to the soil to increase the crop yield.
3. Over irrigation.

Effects of soil pollution

- The productivity of soil is reduced due to the addition of harmful substances like chemicals, pesticides and herbicides.
- Chemicals and pesticides affect the structure and fertility of soil by killing the soil microorganisms.
- Faulty sanitation and unhygienic practices of the people add to the soil pollution.
- Pathogens present in wastes and excreta contaminate the soil and vegetable crops grown in that soil causes diseases in humans and domesticated animals.
- Increase in the concentration of soluble salts is called **salinization**. This adversely affects the quality and productivity of soil. It takes place due to accumulation of salts on soil surface and over irrigation. Saline soil becomes unfit for growth of vegetation.

Soil fertility ratings

Available nutrient status in the soils is generally classified as low, medium and high; which are followed at national level and are as follows :

Table 2.4 : Soil fertility

Sr. No	Soil Nutrients	Soil Fertility Ratings		
		Low	Medium	High
1	Organic carbon as a measure of available nitrogen (%)	< 0.5	0.5 - 0.75	> 0.75
2	Available nitrogen (kg/ha)	< 280	280 - 560	> 560
3	Available Phosphorus (P)(in alkaline soil) (kg/ha)	< 10	10 - 24.6	> 24.6
4	Available Potassium (K) (kg/ha)	< 108	108 - 280	> 280

Source : Ministry of Agriculture, Govt. of India

Control of soil pollution

Various measures to control soil pollution are

1. Use of chemical fertilizers should be reduced by using more of bio-fertilizers and green manures.
2. Use of pesticides can be reduced by adopting biological control of pests.
3. Use of cattle dung and agricultural wastes in biogas plants should be encouraged.
4. Plantation can check soil erosion to a great extent.

2.4 Noise pollution

The word noise is derived from a Latin word 'nausea' which means unwanted or unpleasant sound that causes discomfort. Noise can be defined as "wrong sound, in the wrong place at the wrong time."

When the sound becomes noise it adversely affects the auditory system of human beings, animals and birds. All over the world, in urban localities, noise pollution has been recognized as a major factor affecting public health and well-being.

Sound is measured in decibels (dB). Sound beyond 80dB becomes noise, as it harms auditory system. The World Health Organization (WHO) has fixed a limit of 45 dB as the safe noise level for a city. According to international standards a noise level up to 65 dB is considered tolerable.

Noise standards

According to the living style and standards, the different countries of the world have their own noise pollution standards. In India, the Bureau of Indian standards (BIS) has recommended noise level between 45 and 60 dB in an industrial area. The Threshold Limit Value (TLV) which is accepted everywhere under the occupational safety and health act is 90 dB for 9 hours, 95 dB for 4 hours, 100 dB for 2 hours and 115 dB for 15 minutes per day.

Do you know?

The Central Pollution Control Board (CPCB) India, has conducted noise pollution survey in eight major cities of India like Delhi, Chennai, Kolkata, Bangalore, Mumbai, Hyderabad, Kanpur, Jaipur and found that their noise pollution level is much higher than the prescribed limit. Similar situation is seen in almost every part of the world and is worsening day by day.

Table 2.5 : Intensity of some sound sources on Decibel Scale

Sr. no.	Source	Approximate Intensity (dB)
1	Breathing	10
2	Soft whisper	20 – 30
3	Library	30-35
4	Low volume radio	35 – 40
5	Normal conversation	35 – 60
6	Office noise	60 – 80
7	Traffic noise	50 – 90
8	Running motorcycle	115 – 120
9	Jet plane takeing off	140 – 150
10	Launching of space rocket	160 - 180

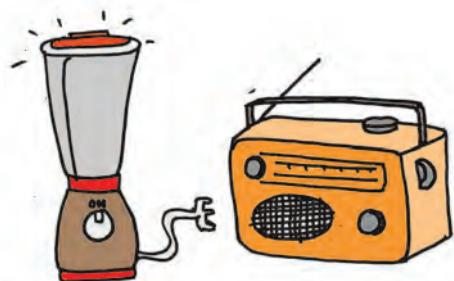
Source : cpcb.gov.in

Causes of noise pollution

- The ambient noise level in urban area is increasing mainly by man-made sources.
- The major disadvantage of technological development is noise pollution.
- The intensity of noise is high in densely populated area viz. metropolitan cities, industrial area, airports, railway stations and bus stations.



- House hold gadgets like television, radio, kitchen appliances, washing machine, mixer, grinders and fire crackers etc. are also responsible for noise pollution.



- In industrial areas, gigantic machinery running at high speed produces sounds of different intensities. These sounds add to noise pollution.
- Machinery used at construction sites, automobiles, blowing horns of vehicles are also responsible for noise pollution.

Effects of noise pollution :

- The disastrous effect of noise pollution on the health of people and animals is well reported. Constant noise affects a man physically and mentally.
- A child's physical and psychological health is hampered by noise. Noise pollution affects elderly persons by increase in blood pressure.
- Other physiological effects seen in humans due to noise pollution are loss of hearing, hypertension, stress diseases etc.
- Noise pollution is also responsible for pain, nausea, vomiting. Many behavioural changes are noticed in people working in factories that produces a huge noise are nervousness, irritation, headache, giddiness etc.

- Significant adverse effects of noise pollution also reported in animals.
- High intensity sound by industries, supersonic aircrafts when continued for a long period of time can permanently damage hearing.

Control measures of noise pollution :

- The noise pollution should be checked at the source only.
- Replacement of noisy devices / parts, effective cushioning to minimize vibrations, proper greasing and oiling to avoid frictions and using of proper silencers are effective ways to minimize noise pollution at source level.
- The noise of factories can be minimized by construction of proper sound-proof walls, doors, ceilings etc.
- The factory workers should be provided with proper ear plugs.
- Construction of residential complexes near railway station, bus station, airports and busy industrial areas should be avoided.
- Loud speakers should be regulated in public places. Periodic servicing and pollution tests of buses, trucks and cars should be mandatory to minimize noise from the engine.
- Stringent action should be taken against people who are violating rules of Environmental Protection Act.
- Proper development of green belts, plantation of specific species of trees helps to absorb excessive noise from industrial and other noisy areas.

Particular plant species used for green belt development are - *Azadirachta indica* (*Neem*), *Acacia auriculiformis*, *Mangifera indica* (*Mango*), *Pongamia pinata* (*Karanj*), *Dendrocalamus Spp* (*Bamboo*), *Ficus Spp* (*Banyan, Pimpal*), *Bauhinia Spp* etc.

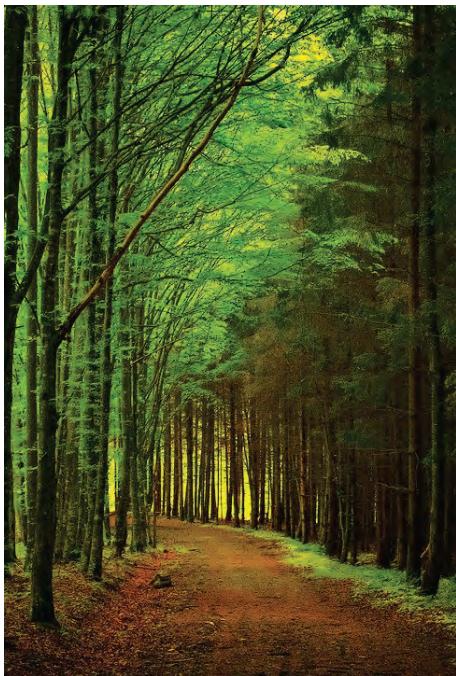


Figure 2.2 : Green belt development

The Noise Pollution Control Rules of 2017

The rules have established the parameters for maximum sound limits in various zones defined by the government. Under the amended rules, now the State Governments can notify the 100 meters area around hospitals, educational institutions and courts as a silent zone.

These rules are framed under the Air Act and noise pollution is considered as a type of air pollution.

Violation of these rules attracts punishments under the Air Act. The nodal agency to monitor noise pollution is respective police station.

Table 2.6 : Noise level standards in dB

Sr. no.	Category of Area/ Zone	Day time (6.00 am. - 10.00 p.m.)	Night time (10.00 pm. - 6.00 a.m.)
1	Industiral Area	75	70
2	Commercial Area	65	55
3	Residential Area	55	45
4	Silence Zone (Area around hospitals, educational institutes etc.)	50	40

Source : cpcb.gov.in

2.5 Solid waste management

Solid waste

Solid waste consists of household waste, commercial waste, institutional waste, construction and demolition debris, sanitation residue, e-waste, industrial waste etc.

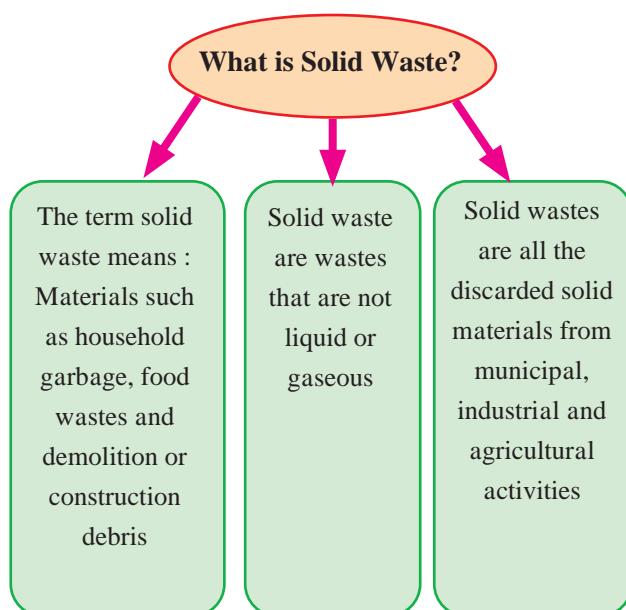


Figure 2.3 : What is solid waste?

KNOW YOUR WASTE - HOW LONG DOES IT TAKE TO DECOMPOSE?



Figure 2.4 : Know your waste

Types of solid wastes

- 1) Biodegradable waste
- 2) Non-biodegradable waste

1) Biodegradable waste - Biodegradable waste is a type of waste, typically originating from plant or animal sources, which are degraded by micro organisms along with other living organisms.

Biodegradable waste is commonly found in municipal solid waste as green waste, food waste, paper waste and garden waste etc. Other biodegradable wastes includes sewage sludge, slaughterhouse waste etc.

2) Non-biodegradable waste - Wastes which do not decompose naturally in the environment causes pollution and are also harmful to the living being and environment are called the non-biodegradable waste eg. plastic, rubber, glass, metals, thermocol, e-waste etc.

Solid waste is further clasified as -

- **Wet waste** - Wet waste is biodegradable waste which includes cooked and uncooked food, fruits, vegetable peels, garden waste and other organically decomposable waste. It is used to make compost and biogas.
- **Dry waste** - Items like aluminum foils, tetra packs, glass, paper, plastics, metals etc. come under the dry waste category. It is mostly used for recycling.

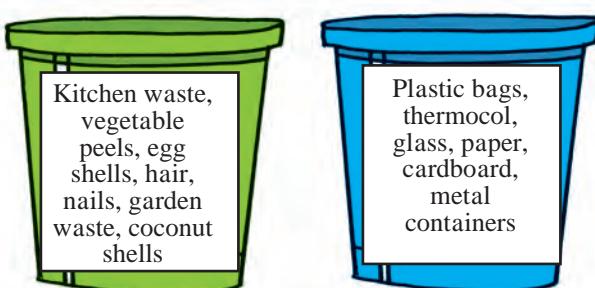


Figure 2.5 :- Wet waste and Dry waste

Remember it !

What can you do to segregate the waste at home?

- Keep separate containers for dry and wet waste.
- Keep a paper bag for throwing the sanitary waste.
- Food containers should be cleared and then should be dropped into dry waste bin.
- Use wet waste for making compost and give dry waste for recycling.

Sources of solid waste

1. **Domestic waste** – Waste from home includes organic matter like vegetable peels, spoiled food, glass products, packaging material like cardboard, plastic bags, foam, electronic waste and furniture etc.
2. **Agricultural waste** – Crop residue, waste from processing of crops, excreta of animals.
3. **Commercial waste** – This consists of packaging material, discarded office equipments, furniture, e-waste etc.
4. **Biomedical waste** – It comes from clinics, pathology labs and hospitals. It mainly consists of infectious waste, sharps like needles, knives, dressings, body parts and expired medicines etc.
5. **E-waste** - E-waste is generated from used electronic devices and household appliances. E-waste has been categorized into three main categories, viz. large household appliances, IT telecom and consumer equipments. Refrigerators and washing machines represent large household appliances. Personal computer, monitor and laptop represent IT and telecom, while television, mobile phones represents consumer equipments.
6. **Industrial waste** - It is produced by industrial activities. It includes material rendered useless during manufacturing processes.

Waste generation and its management is becoming a universal problem. Waste accumulation leads to spoilage of landscape

and creation of health hazards. It has adverse impacts on terrestrial and aquatic life. Lack of space for disposal of garbage leads to air pollution, water pollution, soil pollution, affecting life on earth.

Thus there is a need for more sustainable ways for management of waste to save the environment.

There are two ways to solve the problem -

1. To reduce generation of waste.
2. To extract maximum benefit from the waste generated or produced.

Do You Know

NIMBY stands for NOT IN MY BACKYARD. The NIMBY attitude prevents us from cooperating effectively to deal with the waste. It is the NIMBY attitude keeps our surroundings dirty. We could organise a separate bin for each type of waste and keep the garbage area clean. Scrap collectors could take away all the recyclable waste.

Remember it !

Reduce generation of waste

- Print if and only if utmost necessary. Print double sided copies, reuse envelopes.
- Carry a cloth bag when you shop.
- Prepare compost from grass clippings and kitchen waste.
- Buy products that are DURABLE and REUSABLE glass, plastic or aluminum bottles.
- Don't discard clothes or household items; donate to charities.
- Refuse to accept plastic bags in shops and markets.

The Waste Management Hierarchy

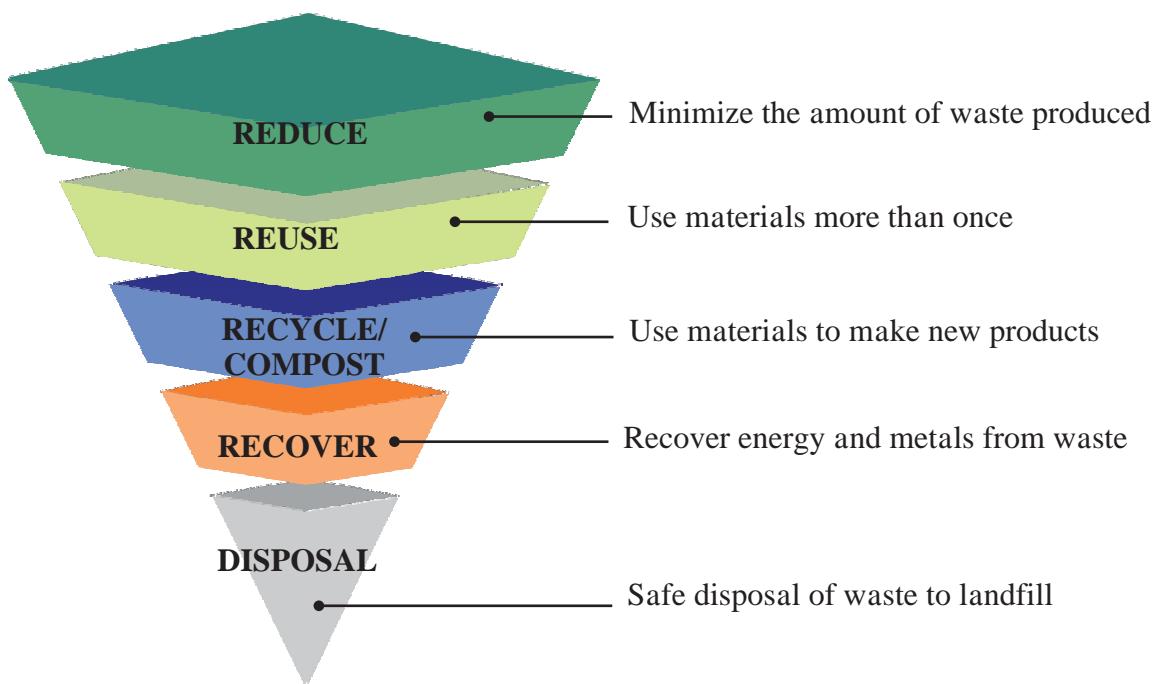


Figure 2.6 : Waste Management Hierarchy

Solid waste management

It is a purposeful and systematic control of waste from its generation to disposal. **Segregating the waste at the source is the basis of waste management.**

Solid waste management is based on 4 'R's principle - Reduce, Reuse, Recycle, Recover.

• Reducing the generation of waste

Waste generation is product of human activity, hence the quantity of waste produced can be controlled by people. If everyone buys only things which are needed and uses items for longer period, waste generation will also be less.

Source reduction is also known as **waste prevention**. It can be achieved through behavioural changes in all citizens. Waste

reduction cuts the municipal costs involved in waste collection and disposal.

• Reusing the waste

We should not throw away things that can still be used to the extent possible. We should repair and reuse things with little changes.

Activity 1

Find 10 reusable things at home. Make a list how it can be reused.

Sr. No	Name of reusable thing	How it can be reused
1	Old Plastic bucket	Used as dustbin
2		
3		

Activity 2

- Make new notebooks from unused pages of old notebooks.
- Use old pieces of cloth for making cushion covers and doormats etc. Use plastic bottles for gardening.



Plastic bottles used for gardening and used pieces of cloth for making bags and doormats.

• Recycling of waste

Recycling is the process of converting waste materials into new materials and other useful products. Recycling is the most widely recognized form of source reduction. It involves the process of segregation, collection, processing of a new product and marketing it effectively. It uses the material that would have otherwise been discarded or dumped.

It is the fundamental part of a modern waste management plan. It can divert a significant portion of a waste stream from disposal in landfill and combustion facilities. Recycling is possible only if the waste is segregated at source.

Commonly Recycled Materials

Paper

Paper recycling is the process of recovering waste paper and remaking it into new paper products. Paper and cardboard form the second largest component of domestic waste. Paper recycling is practiced extensively as it reduces the demand for wood and energy.

Activity 3

- Make a visit to handmade paper industry to understand process of paper recycling.

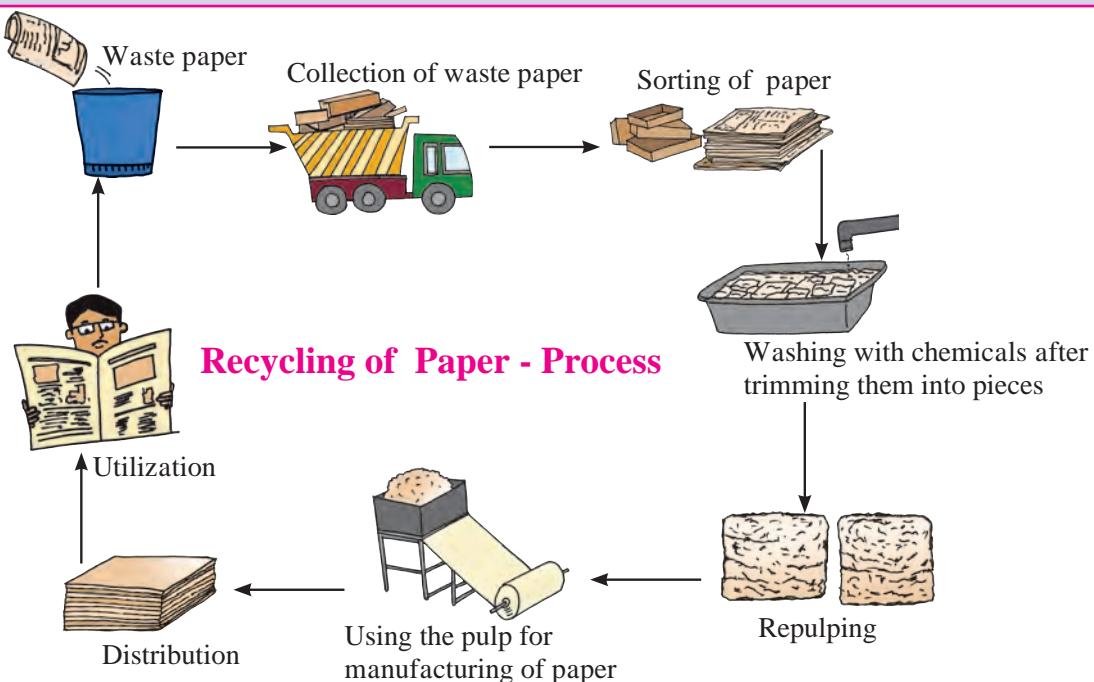


Figure 2.7 : Recycling of Paper

Glass

Glass is a commonly recycled material. Recycling of broken glass reduces the risk of hazard. Recycled glass has economic value only when it can be separated by colour.

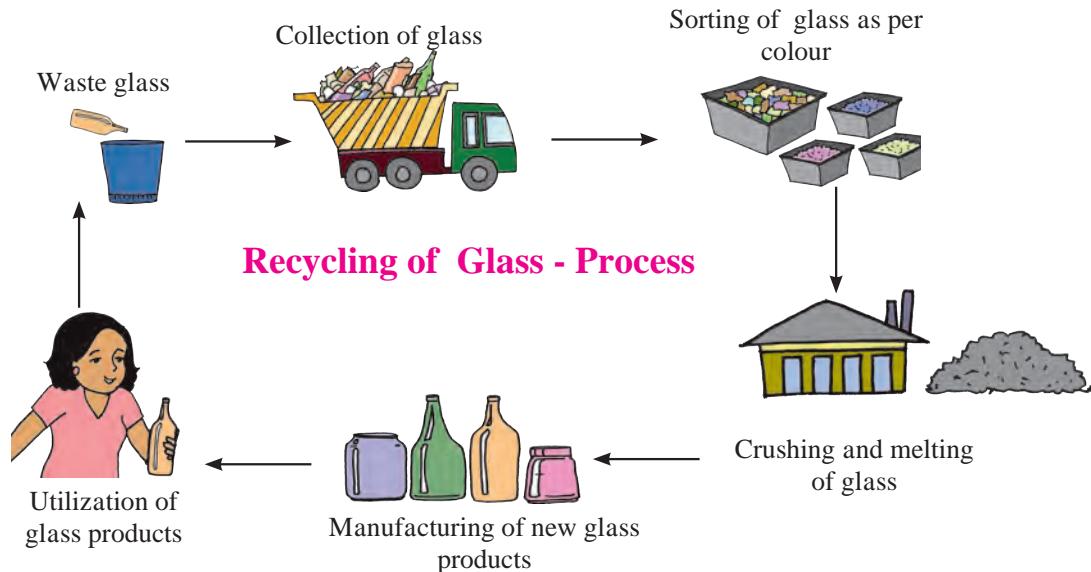


Figure 2.8 : Recycling of Glass

Metal

Metals can be used in several ways. Metals can be used for industrial purposes and domestic items as well. The good thing about metal recycling is that metal can be recycled over and over. The most common recyclable metals include aluminum and iron.

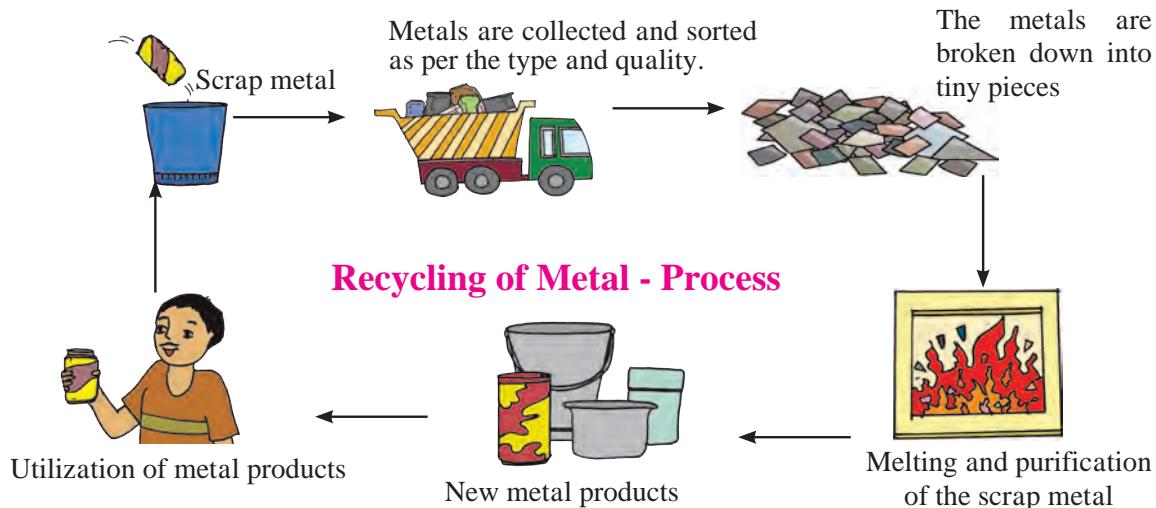


Figure 2.9 : Recycling of Metal

Plastic -

Plastic is among the most popular and important materials used in the modern world. However, its popularity is part of the huge problem and reason why plastics should be recycled. Instead of throwing them away and polluting the terrestrial and aquatic environment, plastics can be recycled and reused. Plastic recycling refers to the process of recovering plastic waste or scrap plastic and reprocessing it into useful product.

Activity 4

Examine every item of waste that is generated at your home. Find out where it came from and what is its fate.

Arrange interviews of kabadiwala, ragpicker and local recycler. Make a questionnaire for the interview based on points like type of waste collected, which type of waste is not accepted and why?

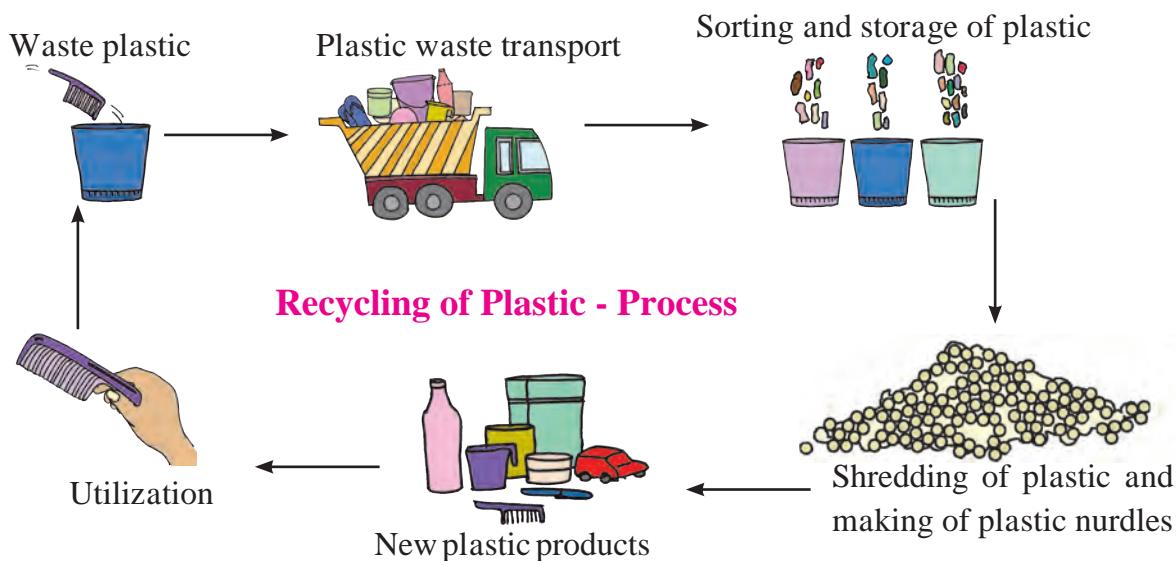


Figure 2.10 : Recycling of plastic

Activity 5

Examine your buying habits. Make a list of recycled products.

Composting -

Composting is an easy way of recycling organic waste. It is the biological decomposition of wet organic matter in the presence of oxygen. It converts everyday kitchen waste into manure.

Table 2.7 : Simple steps to turn your garbage into compost.

1	Segregate Waste	Container 1 - kitchen waste - vegetable peels, fruit peels, wasted cooked food, etc. Container 2 - dry organic waste like dried leaves, sawdust, newspaper chunks, packaging material etc.
2	Composting Spot	Kitchen, balcony, terrace or roof etc.
3	Construct Composting Bin	Take/ choose a bucket, normal dustbin or a garden pot. Drill around 4-5 holes around the container at different levels so as to let some air in easily. To avoid any spills place a newspaper or tray underneath the container.
4	Initiate the Composting Process	Make alternate levels of dry organic waste and wet waste in the bin to maintain the balance of moisture. To speed up the process, add compost culture available in the market.
5	Maintain the compost bin	If compost smells due to imbalance of waste in the bin increase the components of dry leaves or newspapers or add extra holes to the compost bin. Sprinkle some water if the compost turns too dry. After every 4-5 days, turn the waste upside down for aeration.

Vermicomposting

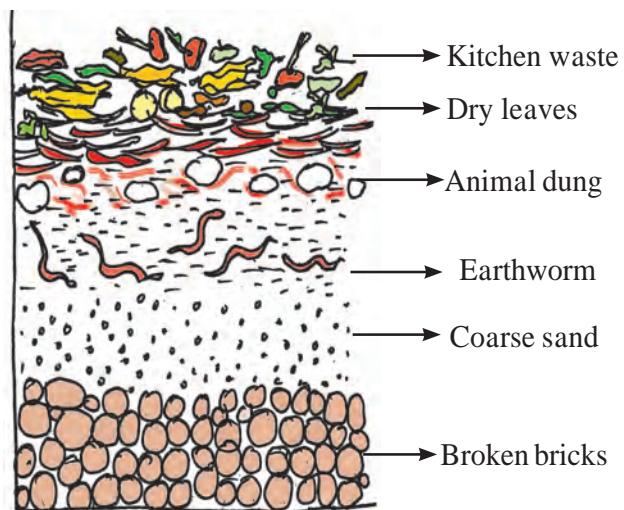


Figure 2.11 : Layers of Vermicomposting

It is the process of decomposition of organic waste and converting it into compost with the help of various species of earthworms. The excreta of earthworm makes the compost very rich in nutrients. The commonly used varieties of earthworms are *Eisenia fetida* and *Pheritima elongata*.

- **Recovering energy from waste**

Anaerobic Digestion

It is an anaerobic treatment in which organic waste is degraded and biogas is produced. The gas provides energy and thus economic benefits. Sludge from biogas plants is used as fertilizer.

Refused Derived Fuel (RDF)

When the solid waste contains large amount of combustibles it can be used as a fuel. Waste containing paper, plastic, leather etc. is suitable for making of RDF. Agrowaste can be used for making charcoal bricketts.

- **Incineration**

It is a waste treatment technology which includes the combustion of waste at high temperature. Incineration plants generate energy

from waste. This energy can be used to produce electricity. In the absence of effective pollution control measures, incineration plants produce wide variety of pollutants.

Landfill

Waste remaining after using 4 ‘R’s is disposed in landfill. Sanitary landfill is an engineered facility for the disposal of municipal solid waste. It is designed and operated to minimize public health hazards and environmental impacts. Solid waste is placed in a suitably selected and prepared i.e. lined landfill site in a carefully prescribed manner.

Journey of solid waste

For the better management of solid waste every citizen should understand the life cycle i.e journey of solid waste from its collection to disposal of waste. This helps in minimizing the impacts of waste on the environment, people and economy.

Ministry of Environment Forests and Climate Change (MoEF and CC). For better waste management in India, Municipal solid waste management Rules 2000 by MOEF and CC are the main guiding source. In 2016 the Environment Ministry has revised Solid Waste Management Rules.

Do You Know?

Ash from thermal power plants is used as cement substitute, for making roads and bricks.

Salient features of solid waste management rules 2016

1. No person should throw, burn or bury the solid waste generated by him on streets, open public spaces outside his premises, or in the drain or water bodies.

2. Generator will have to pay ‘User Fee’ to waste collector and ‘Spot Fine’ for littering and non-segregation.
3. All hotels and restaurants should segregate biodegradable waste and set up a system of collection or follow the system of collection set up by local body to ensure that such food waste is utilized for composting / biomethanation.
4. Every street vendor should keep suitable containers for storage of waste generated during the course of his activity such as disposable plates, cups, leftover food etc. and deposit such waste at waste storage depot or container or vehicle as notified by the local authority.

Activity 6

Read the following rules related to solid waste management from the website <http://cpcb.nic.in>

1. Plastic waste management
2. E-waste management
3. Construction and Demolition wastes management
4. Biomedical waste management

Maharashtra plastic ban

The Maharashtra government began enforcing a ban on single use plastic to beat plastic pollution from 23rd March 2018. Urban and rural civic bodies, forest officers, police authorities and Maharashtra Pollution Control Board officials have been empowered to implement the ban and take legal action. The penalty for violating the ban starts from ₹5,000 (first offence), ₹10,000 (second time) and ₹25,000 (third time) with three months in jail.

Items banned

- Plastic bags (less than 50 microns)
- Disposable plastic items like spoons, forks, cups, glasses etc.
- Disposable thermocol items like plates, glasses, bowls, containers, decoration articles etc.
- Plastic wrap used for packaging or storing products

Items Exempted

- PET bottles (> 500 ml)
- Packaging material for medicines, solid waste, agriculture sector
- Bags/Sheets used in plant nurseries
- Food grade virgin plastic bags over 50 microns
- Milk pouches over 50 microns



Do you Know?

(A waste management model for small towns)

Vengurla in Sindhudurg district of Maharashtra, is a town which generates revenue from its waste.

The state government conferred Vengurla the Vasundhra Award, 2017 for its green initiatives. It is a successful model for 100 per cent solid waste management

under the Swachh Bharat Abhiyaan.

Vengurla has achieved 95 per cent waste segregation at source.

It is one of the only towns in India to convert a landfill into a waste management park, called the Swachh Bharat Waste Park. The park now hosts a biogas plant, a briquette-making plant, a segregation yard and a plastic crusher unit. It also has fruit trees and an organic farm. The idea was to make waste management look hygienic and pristine.

Exercise for Journal Assignment

- 1) Write down the journey of dry waste from your house to the place where it goes.
- 2) Write down plastic recycling rules and e-waste recycling rules.
- 3) What are the sources of noise pollution? Explain the ways to reduce it.
- 4) What is global warming? What you can do to reduce it.
- 5) What are the sources of air pollution in metropolitan cities in India? Explain with examples.
- 6) Explain the impacts of climate change.
- 7) Explain the problems related to use of fossil fuels.
- 8) Explain impacts of fertilizers used in agriculture.



3. Sustainable Development

- 3.1 Need for sustainable development**
- 3.2 Sustainable Development Goals**
- 3.3 Challenges for sustainable development**
- 3.4 Sustainable Agriculture**
- 3.5 Role of individuals, community and government in sustainable development**

We enjoy nature! We visit forests, mountains, rivers, oceans, wildlife for our recreation. But what about our future generation? We should think that they also should be able to enjoy the nature. "**Sustainable development is the development that fulfils the needs of the present; without compromising the ability of future generations to meet their own needs.**" The aim of sustainable development is to balance our economic, environmental and social needs for now and future generations.

3.1 Need for sustainable development

Sustainability is improving quality of human life; while living within the carrying capacity of supporting ecosystems. If natural resources on the earth are conserved, maintained and enhanced, the ecological processes would work smoothly. The raw materials for the industry, food, water, fuel, fodder come from the environment. The environment also absorbs the waste created by our developmental activities. Thus it acts as a source and also a sink for us.

Sustainable development will lead to true economic growth. This will be reflected in equitable distribution of economic benefits; which in turn will help to bridge the gap between poor and rich people in the society.

If we look at the scenario around us, we can

see an increase in population followed by excessive use of natural resources. This is because of the increased demands and needs of growing population. As the economic conditions of the people in urban area started improving, their purchasing power increased. People started purchasing electronic goods, metal and plastic articles. This led to consumerism.

Advancement in technologies, globalization, rapid changes in lifestyle, access and desire to luxury goods and consumerism are the main causes of rapid depletion of natural resources and deterioration of the environment.

3.2 Sustainable Development Goals (SDG)

Sustainable development goals are a collection of seventeen global goals designed to be a "blue print to achieve a better and more sustainable future for all." The SDGs set in 2015 by United Nations (UN) General Assembly and intended to be achieved by 2030.



Goal 1

End poverty in all its forms everywhere



Goal 2

End hunger, achieve food security and improved nutrition and promote sustainable agriculture..



Goal 3

Ensure healthy lives and promote well-being for all, at all ages.



4 QUALITY EDUCATION

Goal 4

Ensure inclusive and equitable education and promote lifelong learning opportunities for all.



5 GENDER EQUALITY

Goal 5

Achieve gender equality and empower all women and girls.



6 CLEAN WATER AND SANITATION

Goal 6

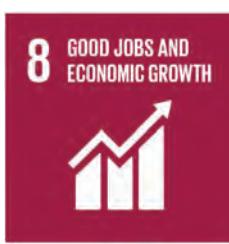
Ensure availability and sustainable management of water and sanitation for all.



7 RENEWABLE ENERGY

Goal 7

Ensure access to affordable, reliable, sustainable and modern energy for all.



8 GOOD JOBS AND ECONOMIC GROWTH

Goal 8

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.



9 INNOVATION AND INFRASTRUCTURE

Goal 9

Built resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.



10 REDUCED INEQUALITIES

Goal 10

Reduce inequality within and among the countries.



11 SUSTAINABLE CITIES AND COMMUNITIES

Goal 11

Make cities and human settlements inclusive, safe, resilient and sustainable.



12 RESPONSIBLE CONSUMPTION

Goal 12

Ensure sustainable consumption and production patterns.



13 CLIMATE ACTION

Goal 13

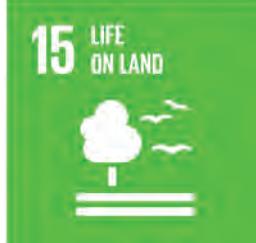
Take urgent action to combat climate change and its impacts.



14 LIFE BELOW WATER

Goal 14

Conserve and sustainably use the oceans, seas and all marine resources for sustainable development.



15 LIFE ON LAND

Goal 15

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss.

16 PEACE AND JUSTICE



Goal 16

Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

17 PARTNERSHIPS FOR THE GOALS



Goal 17

Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Activity 1

Write at least 2 steps to achieve the goals of sustainable development from 1 to 17.

3.3 Challenges for sustainable development

1) Population growth -

As the world population is growing there is a peer pressure on the available resources. Today world's population is approximately 7.7 billion and India's population is approximately 1.32 billion. The rate at which these resources are being exploited by such a large population, they would not last for longer time.

2) Exploitation of natural resources -

Exploitation of natural resources started to emerge on an industrial scale in 19th century. Timber, coal, metals, oil, natural gas, subsoil minerals, water and many more resources are being exploited for industrial and commercial uses. Progress and development of new technologies and equipments changes in life styles led to use of various appliances at work place, home, in industry and agriculture. This led to over

use of natural resources. To reduce the exploitation of these natural resources is a big challenge.



3) Poverty -

In underdeveloped and developing countries, poverty is a big challenge. Sustainable development must also look for the basic needs of poor and deprived people, as they also aspire for better life.

4) Unequal distribution of resources -

Consumption of resources per capita in developed countries like U.S is about 50 times greater than the consumption per capita in developing countries. U.S.A. alone with 4% of world population, consumes about 25% of the world's resources.

Even within the country, there is disparity in the use of resources like water. When large dams are constructed, huge tracts of forests and agricultural lands of affected people are utilized for the dam. These local people, whose livelihood are linked to this land are displaced to some other places.

5) Consumerism -

In growing economy, people have more purchasing power. This leads to more consumption of various goods for luxury. Production of a variety of electronic, plastic, metal goods are a major source of attraction/desire in the market.

To follow the path of sustainable development, people have to change their life style and do with less. In practice, people are reluctant to do so. This is one of the big challenges to sustainable development.



6) Education and unemployment -

Illiteracy is a major challenge for sustainable development. Poor people can't afford to educate their children. They are unable to get employment as they have no quality education. This vicious circle continues. Population increase in the country is also one of the reasons for the unemployment.

7) Awareness -

Common people are not at all aware about the fact that resources on this earth are limited and that non-renewable resources will not even get generated once they are used up. This is the reason that these resources should be used judiciously. People should realize what are their actual needs before purchasing.

8) Government Policy -

To achieve the goals of sustainable development, the government has to take certain hard decisions and implement different schemes. It should restructure the cost of all goods, considering the environmental cost of their

production. Similarly non-conventional energy sources like solar, wind energy, biogas based appliances should be subsidized. Rain water harvesting systems also should be given subsidies. Government should implement schemes to achieve sustainable goals.

3.4 Sustainable agriculture

Sustainable agriculture refers to the ability to produce food without causing irreversible damage to ecosystem and to human health. It has biophysical, socio-economic and environmental aspects.

- The impact of various agricultural practices should not affect crop productivity in the long term.
- Farmers should add the necessary inputs (use of bio fertilizers and bio pesticides etc.), manage the resources.
- In agricultural practices use natural resources such as water and land carefully.
- A way of moving towards that goal is to make a gradual shift from chemical agriculture to organic farming.

Organic Farming

Organic farming is a system which avoids use of chemical fertilizers, pesticides and animal feed additives etc.

It uses advance knowledge along with traditional methods such as crop rotation, mixed cropping, mixed farming, green manures, bio-fertilizers and bio-pesticides.

Organic farming is based on the following principles.

- Nature is the best role model for farming since it uses adequate natural resources.
- Soil is a living system and should not be used for dumping chemicals.

- Organic fertilizers in the soil are significant contributors to its fertility and must be protected and nurtured at any costs.

Elements of sustainable agriculture

- Cropping methods
 - 1) Mixed farming
 - 2) Mixed cropping
 - 3) Crop rotation
- Biofertilizers
- Biopesticides
- Integrated Pest Management

Cropping Methods

1) Mixed farming

Mixed farming is a system of farming crops, and raising livestock, poultry fish etc. together on a farm.

The advantages of mixed farming are :

- Greater stability of yield over different seasons.
- Better use of resources.
- Better control of weeds, pest and diseases.
- Suitable for small farmers.

2) Mixed cropping

In this method different crops are grown in the same field. Crops are mixed in such a way that they can benefit each other. For example, ‘Tur’ is planted in between the rows of cotton plants. Because of such practice atmospheric nitrogen is fixed in the soil by ‘Tur’ and used by both plants.

Advantages of mixed cropping are :

- Minimizing the risk of total crop failure
- Pest and disease control
- Weed control
- Protection of soil from erosion
- Improves soil fertility.

Activity 2

Conduct an interview of a farmer to collect information about mixed cropping along with the reasons.

3) Crop rotation

Monocotyledon crops repeatedly grown in the same place eventually depletes various nutrients. Crop rotation is the practice of growing a series of different crops sequentially in the same space.

Crop rotation gives the following benefits :

- Maintains the balance of nutrients.
- Improve soil structure and fertility.
- Reduces requirement of other fertilizers.
- Inhibits the growth of different pests.
- Keeps the land under continuous production.

• Bio-fertilizers

Bio-fertilizers are living organisms that enrich the nutrient quality of the soil. It refers to the use of microbes instead of chemicals to enhance the nutrition of the soil. Bio-fertilizers does not cause pollution thus they are eco friendly.

Advantages of bio-fertilizers

- Improves soil texture and increases yield of crops
- Do not allow pathogens to flourish
- Eco friendly and cost effective
- Do not cause environmental pollution

There are various bio fertilizers like Rhizobium, Azotobacter, Azospirillum, phosphate solubilizing bacteria and mycorrhiza, which are available in the market.

• Bio pesticides :

Bio pesticides are derived from natural material such as animals, plants, bacteria, and certain minerals.

In India, a range of neem products such as the extracts of neem kernel, seed and leaf are used as bio pesticides. Some farmers are using other pesticides made from herbs such as basil, mint, marigold and lemongrass etc.

Bio pesticides have the following advantages -

- They are less toxic than the chemical ones.
- They generally affect only the target pests and closely related organisms. While conventional pesticides affects organism like birds, insects and mammals.
- Bio pesticides are effective in very small quantities and decompose quickly. Further, the pollution problems are avoided.

Genetically modified crops (GM)

Genetically modified crops are made by using such technology which involves inserting a specific gene into the genome of plant species. This plant species is then grown by tissue culture. The new plants, having the specific gene in them, are useful as they are resistant to certain pests or diseases. Therefore use of chemical pesticides is considerably reduced. However, there are certain disadvantages of GM crops, which should also be considered while using them.

Do you know?

Cotton is one of the major fibre crops of global significance. In India, 162 species of insect pests attack different stages of cotton. Out of this bollworms are most damaging and loss inducing pests of cotton. The frequent and regular crop failures in the last 15 years have been attributed to bollworms. Although a wide variety of pesticides are used to minimize the pest damage, there were new serious problems such as resistance to pesticides, reoccurrence of secondary pests,

environmental contamination due to indiscriminate use and unspecific product. Bt cotton has proved useful in countries where it has been introduced earlier.

What is Bt cotton?

The Bt is a short form of soil bacterium *Bacillus thuringiensis*. This bacterium synthesizes proteins called 'endotoxins' which are highly toxic to certain insects. They kill the insect by acting on the epithelium tissues of midgut of caterpillars. When this gene is introduced in the cotton plant, it starts producing this toxin and destroying the pest.

This method is useful for protecting the crops without pesticides. The introduction of Bt cotton has provided growers with a new tool for managing bollworms in cotton. Reduced pesticide use, improved crop management effectiveness, improved yield and profitability and improvement opportunity to grow cotton in areas of severe pest infestation are some of the advantages of Bt cotton.

Integrated Pest Management

Integrated pest management (IPM) is a pest control strategy with following features :

- Focus on control and not eradication of pests. Attempts at total eradication are costly and environmentally destructive and may actually worsen the situation. It is better to decide on acceptable pest levels and take action when the levels are exceeded.
- Select the best suitable varieties for local conditions and use natural predators and parasites.
- Observe regularly and keep records of pest behaviour.
- Choose mechanical means such as hand picking insect barriers pheromone, traps, etc.

- Use minimum chemical insecticides as the last option.

IPM is an environment friendly approach that significantly reduces or eliminates the use of chemical pesticides.

Impact of chemical pesticides on environment and human health.

- Within 5-10 years, pest can develop immunity to pesticides through natural selection and pesticides become ineffective.
- Elimination of natural predators of pests.
- Generally less than 2% of the insecticide applied to crops reaches the target pests. The rest contaminates the air, water sources, soil and human food.
- The pesticide that used for the target species affects the non-target organisms like human beings and animals. Every year in the world, large number of farm workers and their children are affected due to careless handling of chemical pesticides.
- Pesticides remain in the harvest as residue and enter the food chain. Such residues persist for a long time. Most of the food items that we consume have been recorded for the presence of pesticides. Animals and birds are also seriously affected.

Activity 3

Visit agricultural service centre nearby. Prepare a table of commonly used pesticides and fertilizers along with their impacts on humans and environment.

Do you know?

Sikkim is 100% organic state!

In 2016, Sikkim became India's first organic state. Today all farming in Sikkim is carried out without the use of chemical fertilizers and pesticides. This makes agriculture more ecofriendly with healthy grain production.

1,90,000 acres of cultivable land in Sikkim is certified as organic. Thousands of composting pits are installed for making compost. Compulsory training on organic farming as part of capacity building is introduced. Due to this production and exports are growing. Biodiversity has flourished and tourism is also growing.

Water management

In sustainable agriculture, proper water management is essential. Sustainable water management techniques includes :

1. Drip irrigation

This technique delivers water directly to the plant root. It reduces the evaporation that happens with sprinkler system. In addition to this, timers can be scheduled for watering as per requirement. Drip irrigation can save up to 80% water as compared to conventional irrigation.

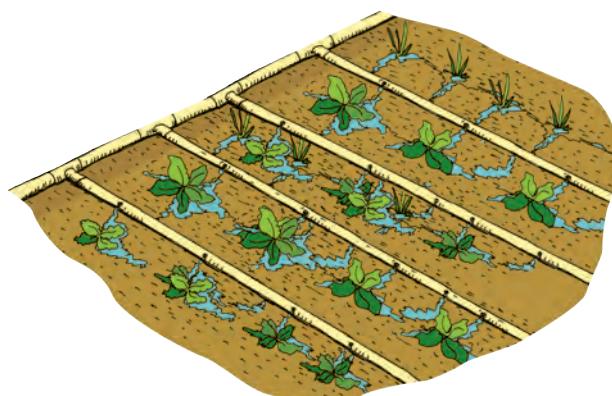


Figure 3.1 : Drip irrigation

2. Farm ponds

These are built in their own farm to harvest rainwater for use throughout the year.

drought-resistant. Increased soil organic matter and better forage cover are also water-saving benefits of rotational grazing.

3. Irrigation scheduling

Smart water management is careful monitoring of the weather forecast, as well as soil and plant moisture and accordingly schedule irrigation, avoiding overwatering to the crops.

4. Drought-tolerant crops

Growing crops that are appropriate to the regions climate. Selecting crop species that are native to arid regions and are naturally drought-tolerant.

5. Compost and mulching

Compost or decomposed organic matter used as fertilizers, has been found to improve soil quality also increase its water holding capacity.

Mulching is a material spread on the top of the soil to conserve moisture. It is made from organic and inorganic materials such as straw or wood chips that will breakdown into compost, further increasing the soil fertility and will retain water.

Activity 4

Make a visit to an organic farm in your area. Arrange an interview with the farmer to understand the ways and means of organic farming. Make a report of it.

Do you know?

Rotational grazing is a process in which livestock are moved between fields to help regrowth of pasture. Good grazing management increases the fields' water absorption capacity and decreases water runoff ultimately making pastures more

Activity 5

Arrange a poster competition on the theme 'wastage and conservation of natural resources' in your college/school.

3.5 Role of individual, community and government in sustainable development

Role of Individual

If we want to follow the path of sustainable development, we should use all kinds of resources like food, paper, water, energy, forest, land etc. very carefully at our individual level. This can be achieved by following simple steps and '4 R' principles - Reduce, Reuse, Recycle and Recover in our day-to-day life. Details of this topic are discussed in Chapter 2.

Role of Community

Any village or community can change the whole scenario of their village if they are inspired by a person or an incidence. Ralegan Siddhi is a very promising example of community participation, leading to sustainable development and prosperity.

Role of Government

Government of India is giving emphasis on achieving the goals of sustainable development. For this, government has defined certain policies and programmes. Some of them are as follows.



1) Swachh Bharat

Abhiyan - It was launched on 2nd October 2014 by

Prime Minister to make India clean. It is based on

Sustainable Development Goal number (SDG) 6. The aims of this project are to provide sanitation facilities to each and every family. It includes constructions of toilets and to form solid and liquid waste disposal systems. Another two aims of this project are to make villages clean, safe as well as adequate drinking water supply by 2019.



2) Beti Bachao, Beti Padhavo Yojana - This is a campaign of Government of India, launched on 22nd January 2015 by Prime Minister based on SDG goal number 4 and 5.

It aims to address the issue of declining child sex ratio (0-6 years). It initially focused on multisector action in hundred districts throughout the country where there was low child sex ratio.



3) Ujjwala Yojana - This project was launched on 1st May 2016 by Prime Minister. It is based on SDG 5.

In this nearly 50 million L.P.G. connections were distributed to women of below poverty line families. A budgetary provision of Rupees 800 billion was made available for this. The purpose of this scheme is to provide clean fuel to women for cooking. The women will be free from health hazards due to fire wood and cow-dung burning. These houses will be smoke free which benefits all including children.



4) Pradhan Mantri Awas Yojana - This is an initiative taken by Government

of India, in which affordable housing would be provided to poor people. This was launched by Prime Minister in 2015. This project targets to build 20 million affordable houses by 2022. It has two components urban and rural. This addresses sustainable goal no. 11.



5) Sarva Shiksha Abhiyan –

This is an

Indian Government Programme, aimed at universalization of elementary education in time bound manner. This programme was Pioneered by Primer minister to achive SDG goal 4. It aimed to educate all children between age 6 to 14 by 2010. However, the time limit has been pushed forward indefinitely.



6) Namami Gange Abhiyan -

This Abhiyan was launched by Prime Minister in June 2014 with a

budget out lay of Rupees 20 thousand crore to accomplish the twin objectives of effective abatement of pollution, conservation and rejuvenation of our national river, Ganga.

Do you know ?

Mangroves store 50 times more carbon in their soils by surface area compared to tropical forest; and 10 times more than temperate forest. That is why it is very important to conserve mangroves.

Activity 6

Find out more information on different Government schemes related to sustainable development.

Do you know ?

Gazi is a typical fishing community in Kenya. The people are poor and their children have no formal education. These people conserved their mangroves and established new mangrove forest in their region. In return, they received large amount of money by selling carbon credits. The villagers invested this money into childrens education and clean water. By conserving the mangroves these people achieved following goals of sustainable development.

Goal 1 (end poverty)

Goal 4 (quality education)

Goal 6 (clean water and sanitation)

Goal 13 (climate action)

Goal 14 (conserve marine resources)

Activity 7

Which of the following actions are sustainable and which are not? Why ?

1. A dozen of plastic bottles are purchased because there is a 'sale' going in a mall.
2. The newspapers, plastic and metal articles are separated from the waste and given to kabadiwala.
3. Shopping bags of old cloths are made and used for everyday shopping.
4. Tree plantation is conducted at public places.
5. People, staying in the same area go to office by making car pool.
6. A farmer sows 7-8 variety of crops on his farm.
7. Cattle, chicken rearing on the same farm is

done along with the crops.

8. A strong weedicide is sprayed on the farm to control the weeds.
9. Green manure are grown on the farm for obtaining N, P and K.
10. College/ School management committee decides to follow green audit for the college/school.

Exercise for Journal Assignment

- 1) What is difference between development and sustainable development? Explain with suitable examples.
- 2) Make a table of commonly used chemical pesticides and fertilizers. Write down their impacts on human health and environment.
- 3) Write success story of Ralegan Siddhi with respect to sustainable development Goals.
- 4) Explain the role of individuals and community for sustainable lifestyle.
- 5) Explain the any two elements of sustainable agriculture.
- 6) Write information about some Bt varieties being cultivated in India.
- 7) Explain the sustainable development schemes being implemented in India.
- 8) Enlist the sustainable development goals. Explain which and how the goals among these are being achieved in your locality.



4 . Practices for Environmental Protection

- 4.1 Consumer Education**
- 4.2 Eco-labelling**
- 4.3 Environment Impact Assessment**
- 4.4 Green Audit**
- 4.5 Ecotourism**
- 4.6 International Conventions and agreements**

4.1 Consumer education

Progress in science and technology has led to increase in consumerism globally. This has led to a dramatic rise in the purchasing power of many people. Although this development is welcome as it assures a decent standard of living for many people, there are also problems because of increased purchasing power. As a result substandard products and services are made available at a higher price.

People face several problems while purchasing the product. Are they getting a product which is worth the cost? Are the products free from toxic chemicals, pesticides and adulterants? Consumer education is the only solution to these doubts and issues.

Consumer education may be defined as imparting knowledge to a consumer regarding cost effectiveness, budgeting ability and developing awareness of purchase.

Need and importance of consumer education

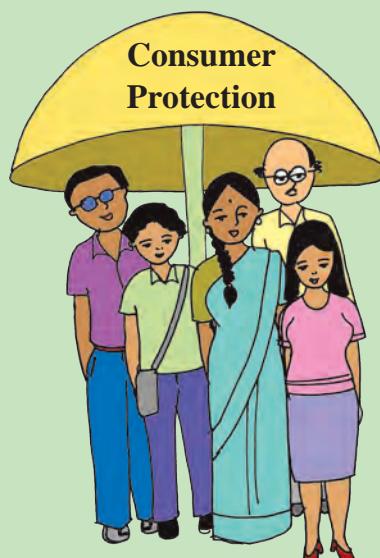
The economic status of a country and the welfare of its citizens are linked to each other. Both of these can be achieved only when the people of the country are able to make right choices in their purchases, so that they get value for their money. Consumer education is the only tool that can assure this protection to consumers for the following reasons :

- Provides necessary skills to select the right type of goods and services from a huge available range.
- Enables consumers to assess the market situation and make proper decisions.
- Reduces the number of complaints against cheating on the quantity and quality of products and services.
- Overcome poverty and promotes ethical values and human rights.
- Ensure sustainable consumption by using ecofriendly products.

Do you know?

Consumer Protection Act 1986

The Consumer Protection Act, which was passed by the Indian parliament in 1986, extends the following rights to consumers :



- Right to be protected from hazardous goods and services.
- Right to be informed about the quantity and performance of goods and services.
- Right to free choice of goods and service at competitive prices.
- Right to be heard in any decision-making process concerning consumer interest.

- Right to redressal if consumer rights are violated.
- Right to consumer education.

Efficient and Eco-friendly Practices

Eco-friendly products are those which ensure natural use of resources without harming the environment.

Eco-friendly products

Some examples of efficient and eco-friendly technologies from the Indian sub-continent

- **Janata refrigerator :** Earthen pot-in-pot units are used to keep vegetables fresh for a few days.
- **Treadle pumps :** Foot-operated pumps which are used to draw water from wells.
- **Sand filter :** Slow sand filters are used to filter water.
- Earthen cups and glasses are eco friendly.
- Plates made of green leaves replace styrofoam plates.
- Use of Compost - Manure made from organic waste.
- Use of Bio pesticides.

Construction Housing

Construction focus is on developing designs that optimize the use of solar energy to cut down the electricity bill. Fly ash bricks and plastic doors are becoming popular. These are made from recycled material instead of natural resources.

Do you know?

In India, a Bengaluru based firm, is using processed plastic waste mixture to lay roads. It substantially reduces the cracking of road surface due to rain or low temperatures and provides durability.

4.2 Eco-labelling

During the last few years, people have become aware of the deterioration of environment. There is growing demand for goods and services that cause less damage to the environment and health of human. Numerous initiatives have started from both private and public industries in order to define sustainability related information of products. This was achieved by introducing different kinds of symbols like labels and logos. The information that is provided on products can be used to influence or inform purchasing decisions. Now a days, there is increasing concern about purchasing of environment friendly products. It leads to conservation of natural resources and sustainable development.

Eco-labelling is the use of labels on products to show how environment friendly they are.

Eco-labelling is a method of environmental performance certification and labelling that is practised around the world.

International Organization for Standardization (ISO) has given different eco-labeling schemes and logos in operation around the world. It covers a different range of environmental criteria such as pollution and energy consumption during production.

Benefits of Eco-labelling

- An eco-label makes the customer more aware of the benefits of certain products, for example, recycled paper or toxic-free cleaning agents.
- It promotes energy efficiency and waste minimization.
- It helps in reducing environmental damage.
- It improves industry image and sale of product.

- It helps to increase consumer awareness, and encourage them to identify and purchase environment friendly products.
- Industries become more accountable for producing and marketing ecofriendly products.

Do you know?

Green building

Green building or sustainable design is the practice of using resources efficiently. It reduces impacts on environment and human health, right from selecting site, design, construction, operation and maintenance.

The design of green building includes five main elements as building material, energy water and health along with practicing 4 'R' principles (Reduce, Reuse and Recycle, Recover).

Indian Green Building Council (IGBC) 2001 is a leading green building movement in India for residential sector.

ECO Mark

The Government of India launched the eco-labelling scheme known as 'ECO Mark' in 1991 for easy identification of environment-friendly products. The aim of the scheme is to help the consumers to easily identify and encourage to purchase those products which are less harmful to the environment.

Criteria of ECO Mark

Any product that is made, used and disposed off in a manner that significantly reduces the harm to the environment, can be labelled with ECO Mark.

The criteria for awarding Eco-mark covers all stages of product. It is also called as cradle-to-grave approach. Main parameters include the source and type of raw materials used,

judicious use of natural resouces, energy efficient production, waste management and biodegradability of products.

The requirements for ECO Mark are as follows :

- Products to meet the relevant standards of Bureau of Indian Standards (BIS).
- The products to display the list of critical ingredient in descending order of quantity.
- The packaging to display the criteria, based on which the product has been labelled environment friendly with details information for proper use.
- The material used for packaging to be reusable / recyclable / biodegradable.

ECO Mark has been notified for 16 product categories by the eco mark technical committee. These are mainly soap and detergents, paper, food items, lubricating oils, packaging materials, paints, batteries, electronic goods, cosmetics, plastic products, leather etc.

Do you know?



An earthen pot has been chosen as the logo of ECO Mark 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.

ISO 14000 standards

ISO 14000 is a series of environmental management standards developed and published by the International Organization for Standardization (ISO) for organizations. The ISO 14000 standards provide a guideline or

framework for organizations that need to improve their environmental management efforts. It is a process for managing organizational activities that have an impact on the environment. Through ISO 14000, an organization matches its environmental practices against an internationally accepted standard. Certification under ISO 14000 means that the organization follows a management system that ensures eco-friendly practices.

ISO 14000 standards brings several benefits to organization like providing a system for pollution prevention and waste management. It also helps in saving money through conservation of raw materials and energy.

4.3 Environment Impact Assessment (EIA)

Environmental Impact Assessment is a systematic process to identify, predict and evaluate the environmental effects of proposed action and projects.

Objectives of EIA

- (i) To identify, predict and evaluate the economic, environmental and social impacts of developmental activities of an area.
- (ii) To provide information on the environmental consequences for decision making.
- (iii) Identification of appropriate alternatives and mitigation measures.
- (iv) To promote resource conservation, waste minimization and recovery from waste.
- (v) To promote sustainable development.

EIA in India

Whenever a new developmental project is planned which is likely to affect environmental quality, it is necessary to carry out EIA.

The Ministry of Environment Forests and

Climate Change of India (MoEF and CC) have taken efforts in Environmental Impact Assessment in India. The responsible body for this is Central Pollution Control Board.

EIA was started in India from 1994. Under the EIA notification of September 2006, EIA is statutory for 40 activities under specified sectors such as industries, mining, irrigation, power and transport etc.

It is the Government policy that any developmental project has to obtain prior environment clearance from the MoEF and CC

Importance of EIA

1. EIA is potentially a useful component of environmental management.
2. It focuses on problems, conflicts, natural resource constraints that could affect the viability of a project.
3. After predicting the problems, an EIA identifies measures to minimise the problems.
4. Outlines the ways to improve the project sustainability.
5. EIA is considered as an instrument for sustainable development

The EIA notification specifies two categories of project

Category A - These are large projects like the ports, highways, water and sanitation, urban transport, solid waste management sectors and those with greater potential for environmental impacts. Such proposals are handled by the central government through Expert Appraisal committee, (EAC).

Category B - These are smaller projects and those with less environmental impacts. These are considered at the state level by state expert appraisal committee (SEAC).

Environment Impact Assessment (EIA) process includes :

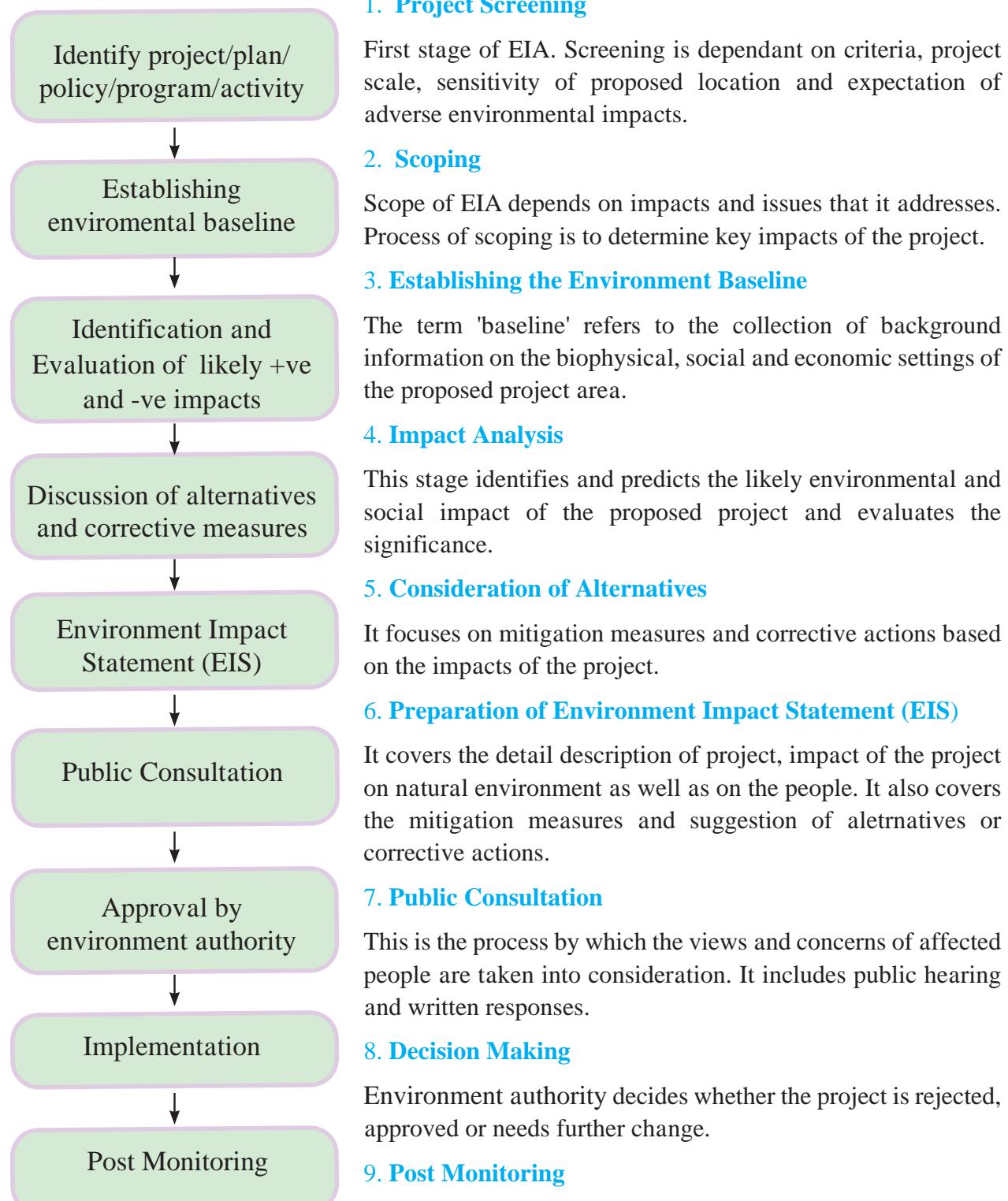


Figure 4.1 EIA process

4.4 Green audit

Rapid urbanization and economic development at local, regional and global level has led to several environmental and ecological crisis. On this background, it becomes essential to adopt the system of environmental audit for institutes, organizations etc. which will lead to sustainable development. As environmental sustainability is becoming an increasingly important issue for the nation, the role of organizations in relation to environmental sustainability is more important.

Green Auditing is a unique process that allows to know the uses of available resources i.e. Energy, Water quality, Builtup Space, Air quality in the organization. Green Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of various establishments.

It was initiated in 1970 with the motive of inspecting the work conducted within the organizations, which can cause risk to inhabitants and environment.

Green audit can be a useful tool for an organization to determine how and where they are using the more energy water or other resources; the organization can then consider how to implement changes for conservation.

Main objective of the audit is to upgrade the environment conditions in and around the organisation. It also aims to secure the environment thereby cutting down the threats posed to human health. It is used to analyse environmental practices within and outside the organisation, which will have an impact on the eco-friendly ambience.

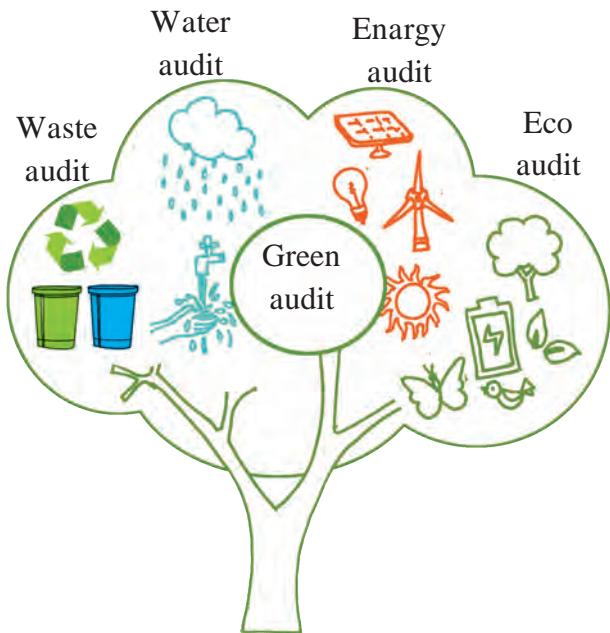


Figure 4.2 : Green audit

Green audit includes

Waste audit – It can be used to determine the type and volume of waste. It helps for a recycling project or to improve waste minimization plan. It guides to reduce the waste generation by segregating, reusing, recycling and composting. By checking waste collection and disposal system, it helps to understand what goes waste and how to make a 'zero waste' campus.

Water audit – It evaluates facilities of raw water intake and determines facilities for waste water treatment. It measures the total water requirement, amount of water harvested and recycled. Main objective of water audit is to balance the demand and supply of water along with harvesting it to use at the time of scarcity.

Energy audit – It deals with the energy conservation and methods to reduce its consumption and related pollution. It helps to target energy consuming practices and suggest the energy conservation techniques.

Ecological audit – It focuses on land use of organization to map green areas, to identify biodiversity and to understand the relationship with environment. It measures the percentage of green cover of organization, as green area has an important role in minimising air pollution and supports biodiversity. It also checks the use of pesticides and organization's initiative to maintain the ecology by using environment safer options.

Benefits of Green audit

- It empowers the organization to frame better environmental performance.
- It helps to prepare an inventory of the resources of an organization.
- It helps an organisation to develop and implement its own ways to conserve and manage the environment.
- To demonstrate that an organization is aware of its impacts upon the environment by providing feedback.
- Promotes environment friendly practices by efficient resource use.

Process of Energy audit

Energy audit refers to examination and verification of energy consumption in the form of electricity, gas and other forms of fuel energy used in households, industries, institutes, schools etc. It can be considered as the first step towards knowing how energy is being used in a given facility. It indicates the ways in which various forms of energy are being used and quantifies energy use according to different functions. It identifies the potential for improvement and thus where energy management efforts must be concentrated.

Energy audit of an institute is based on following criterias :

- 1) Types of energy used
- 2) Per day energy consumption
- 3) Efficient use and conservation of energy

Energy conservation means using energy more efficiently and less wastefully. Conservation of energy is an important energy resource because a unit of energy saved is as good as a unit of energy generated.

Steps of Energy audit

Step 1 - Prepare survey questionnaire taking into consideration construction, design features of the buildings of Institute, habits and practices of consumers and maintenance of the buildings. (Refer activity no. 1)

Step 2 - Identifies the quantity and cost of energy consumed by various devices used in the institute. (Refer activity no. 2)

Step 3 - Identifies energy consumption at department level. (Refer activity no. 3)

Step 4 - It calculates how much energy an institute consumes and energy wastage points are identified.

Step 5 - Recommends use of alternate energy sources as - renewable energy sources, like solar energy.

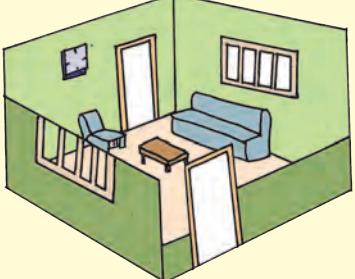
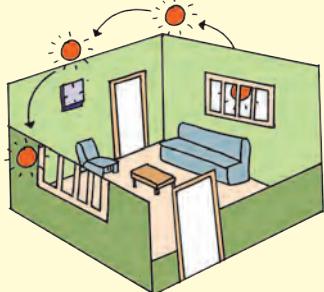
How to save energy?

- Use renewable energy sources like solar energy, wherever possible.
- Turn off lights, fans and other electronic equipments while leaving the room or classroom.
- Instead of lift, use the staircase while coming downstairs.
- Don't waste water.

Benefits of Energy audit

- Helps in understanding energy consumption pattern of the institute.
- By identifying energy wastage areas, saving energy and using renewable energy sources, the institute can become more energy efficient.
- Energy audit it is a small step towards preventing global warming.

Activity 1 (based on Energy audit step 1)

Sr. No.	Question	Yes	No	Corrective measures
1	Is the ground around the building generally covered with trees, shrubs and grass?			
2	Are the walls and ceilings of the rooms inside the building of a light colour to reflect light?			
3	Are there few windows on the east and west side of the building?			
4	Have provisions been made for natural lighting wherever possible?			
5	Are all appliances turned off when the work is completed?			
6	Are the water taps free from leakages?			

Activity 2 (based on Energy audit step 2 and 3)

- The energy audit team of students should have one member from administrative section and one teacher.
- Find the sources of energy in the institute.

(Specify number, nature and origin of electricity connection.)

Connection- Number of phases	Meter location	Source	Suggestions for safety measures if any
A			
B			
Generator			

Find how much institute pays for electricity – (Period of electricity bill, number of units consumed and total amount in Rupees.)

Bill. No.	Period of bill	Number of units consumed	Total amount in Rupees	Alternatives to cut down cost/ conservation
1				
2				
Total				

Activity 3 (based on Energy audit step 3)

Appliances	Total Number	Average Wattage (W/hr.)	Duration of per day usage (in hours)	Duration of per year usage (in hours)	Electricity used per year (in kWh)	Alternatives to cut down cost/ conservation
Tube lights		42				
Electric bulb (60W)		60				
Ceiling fan		50				

4.5 Ecotourism

Ecotourism, also called sustainable tourism, can be defined by a variety of travel practices. As an eco-tourist, you decide to travel in a way that shows respect to nature and does not

contribute to its degradation.

Ecotourism is a part of environmental conservation and understanding the needs of the local people to improve their quality of life.

It also involves preserving the historical landmarks.

Principles of Ecotourism

As per the International Ecotourism Society principles of ecotourism are given. People who implement and participate in ecotourism activities should adopt the following ecotourism principles :

- Minimize physical, social, behavioural, and psychological impacts on the environment.
- Build environmental and cultural awareness and respect.
- Provide positive and memorable experiences for both visitors and local people.
- Generate financial benefits for both local people and private industry.
- Design, construct and operate low-impact facilities having low impact on environment.

Do's

- Total silence and discipline is required to spot wild animals.
- Small groups are preferred.
- Early mornings and late afternoons are the ideal time to visit forests.
- Seek the assistance of a guide while going into the forests.
- Trekkers are advised to ensure their safety.
- Avoid smoking.
- Respect animals and their habitats.
- Ensure that waste is disposed only in bins.

- Dress code should be followed, modest dress is preferred.
- Keep noise to the minimum to avoid frightening of wildlife.
- Maintain a safe distance from entire wildlife.

Don'ts

- Do not collect any form of plants and animals from any locations.
- Do not disturb any animal by making noise, chasing or flashing lights.
- Do not hand-feed fish and animals.

4.6 International conventions and agreements

International conventions and agreements have contributed to the framing of laws and policies for the country. When a country is a signatory for that convention, means that it needs to take actions in the country to implement it.

The Constitution of India expects the Central Government to translate International Conventions to be implemented in our country. For example: Implementation principles of Convention on Biological Diversity in India is followed by enacting the Biological Diversity Act, 2002.

Ramsar Convention

It is one of the first ecosystem specific conventions to conserve the wetlands. It addressed not only conservation but the wise use of wetlands. This intergovernmental treaty adopted on February 2, 1971 in the Iranian city of Ramsar on the shore of the Caspian Sea. The convention gives following opportunities for a country.

- To make its voice heard in the intergovernmental forums on the

- conservation and wise use of wetlands.
- Brings increased publicity and prestige as these wetlands are of International importance.
 - Brings access to expert advise on national and site related problems.
 - Encourages international cooperation on wetland issues and brings up possibility to support wetland projects.

Convention on wetland came into force for India on February 1, 1982. India now has 27 sites designated as Ramsar sites of international importance. There are various criteria considered for declaration of a wetland as Ramsar site.

1. If the wetland is representative of rare or unique example.
2. If wetland supports vulnerable, endangered or critically endangered species.
3. If it regularly supports 20,000 or more water birds.
4. If it supports significant proportion of indigenous fish species, spawning ground or on migration path of fish stocks.

United Nations Conference on the Human Environment (Stockholm Conference), 1972

The United Nations Conference on Human Environment was held in Stockholm, Sweden from June 5-16, 1972, also known as the Stockholm conference. It was thought necessary to inspire and guide the people of the planet for preservation and conservation of Environment. It was the first major conference on international environmental problems and marked a turning point in development of international environmental policies. International guidelines for protecting the environment were laid down in this conference.

The conference conjointly created the 'Framework for Environmental Action,' an action plan, containing 109 specific recommendations related to human settlements, natural-resource management, pollution, educational and social aspects of the environment, development and international organizations.

India and Stockholm Conference

India had an important role in conference. India was also a signatory of conference. Environmental protection and conservation of natural resources emerged as key national priorities in India in the wake of the Stockholm Conference. The Prime Minister of India was present and at the conference she highlighted the issue of poverty and environment.

After the Stockholm Conference, Government of India brought the 42nd amendment in the Constitution and incorporated Article 48A and Article 51A (g). As per Article 48A the states are under the 'active obligation' to protect the environment; whereas as per Article 51A (g) every citizen has the duty to protect and improve the environment.

After 1972, India enacted the Water Act 1974, Air Act 1981, Environment Protection Act, 1986. India established Department of Environment under Ministry of Forests to look after the issues of environment.

United Nations Conference on Environment and Development (Rio de Janeiro 1992), 'The Earth Summit'

The United Nations Conference on Environment and Development is popularly known as 'The Earth Summit'. The Earth Summit was held twenty years after the first global environment conference held at Stockholm. The conference was held from 3-14th June 1992 at Rio de Janeiro, Brazil, with

Representatives from 172 nations. It sought to help governments to find ways to reduce the destruction of non-renewable natural resources and pollution of the planet. The goal was to establish a new and equitable global partnership through creation of new levels of co-operation among countries, key sectors of societies and people. It worked towards international agreements which would respect the interest of all and protect the integrity of global environmental and development system.

The earth summit also produced two international environmental treaties.

a) Convention on Biological Diversity

It was the first international treaty to address preservation of biological diversity. More than 180 countries have signed this convention. It has three primary goals :

- Conservation of biodiversity
- Sustainable use of the components of biodiversity.
- A fair and equitable sharing of the benefits arising from resources.

It balances traditional conservation efforts with economic use of natural resources.

b) The United Nations Framework Convention on Climate Change (UNFCCC)

It seeks to combat global climate change by reducing greenhouse gas emissions. More than 190 nations ratified UNFCCC.

The purpose of UNFCCC is to allow governments to perform various acts -

- Collect and share information on greenhouse gas emissions, national policies and effective practices.
- Launch national strategies for addressing greenhouse gas emissions.
- Cooperate in preparing for adaptation to the impacts of global climate change.

India and Earth Summit 1992

Between the Stockholm Conference and the Rio Earth Summit in June 1992, India developed an organizational structure and a legal and policy framework for the protection of environment and wildlife in the country.

United Nations Conference on Sustainable Development, (Rio+20)

The United Nations Conference on Sustainable Development or also known as Rio+20, was held at Rio de Janeiro, Brazil between 20 - 22nd June 2012. This conference was the 3rd conference on sustainable development. Many important decisions were taken for sustainable development. Rio+20 was a 20 year follow-up of 1992 United Nations Conference on Environment and Development which was held in same city with 192 UN member participant states.

Exercise for Journal Assignment

- 1) Explain the requirements of green building.
- 2) Write down the various impacts that industries can have on the environment.
- 3) What is eco-labelling? What are its advantages?
- 4) Explain the environmental clearance process in India.
- 5) Write the information on Paris Agreement.
- 6) Importance of Ramsar Sites for conservation of wetlands.
- 7) Explain the need and importance of consumer education.
- 8) Explain ecofriendly practices for ecotourism.



5. Water Security

- 5.1 Water resources**
- 5.2 Need and importance of water resources**
- 5.3 Water scarcity**
- 5.4 Water contamination**
- 5.5 Water conservation and management methods**

Activity 1

To observe World Water Day (WWD), you could organize meetings, discussion or an exhibition on water and its use. You can promote conservation of water in your school and your neighborhood.

Surface water sources

The major sources of fresh surface water are rivers, lakes, ponds and tanks. India is blessed with large number of major, medium and small size rivers. Rivers comprise the most important source of surface water. Ganga and Brahmaputra rivers have biggest catchment area in India.

In India due to topographical, hydrological and other constraints, only about 32 per cent of the available surface water can be utilized. You have studied in your 11th standard textbook, that precipitation in India has very high spatial variation and it is mainly concentrated in Monsoon season.

Groundwater sources

Groundwater is a part of rainwater that percolates in the ground. Though ground water represents one of the most important water source in India, its availability depends on various factors viz topography, subsurface geology and prevailing climate.

The level of groundwater utilisation is relatively high in the river basins lying in north-western region and parts of south India. The groundwater utilisation is very high in the states of Punjab, Haryana, Rajasthan, and Tamil Nadu. However, there are states like Chhattisgarh, Odisha, Kerala, etc., which utilize

Do you know?

United Nations World Water Day is held on 22nd March every year.

Events are organized on or around this day to increase the awareness about importance of water, environment, agriculture, health and trade in the society.

only a small proportion of their groundwater potentials. States like Gujarat, Uttar Pradesh, Bihar, Tripura and Maharashtra are utilizing their ground water resources at a moderate rate.

If the present trend continues, the demands for water would need the proper water management systems to be implemented. The Central Ground Water Authority (CGWA) regulates the industrial ground water usage in the country.

5.2 Need and importance of Water resources

Although 71% of the earth is covered with water, acute shortage of water is reported all over the world. India receives nearly 4% of global precipitation, still it suffers from water scarcity. It is mostly caused by over exploitation, excessive use and uneven distribution of water. Pollution of water by domestic and industrial sources, seepage of chemicals are also responsible for water scarcity, as they make water hazardous for use.

Increasing industrialization is exerting pressure on existing water resources. Rapid urbanization has also increased the pressure on groundwater sources like tube wells. An important source of water, Indian rivers like Ganga, Yamuna etc. are polluted due to rapid industrialization, modern agricultural practices and urbanization.

Although water is a renewable resource, the misuse and wastage of water, has resulted in depletion of water resource. Conserving water has become a major environmental issue. In order to save and conserve it, we must reduce wastage of water. Reducing per capita consumption of water and preventing wastage are effective ways of water conservation.

Importance of Water

Water is an essential element and plays a

key role in the human body. We can survive up to several weeks without food, but only a few days without water. Every system in the body, from cells and tissues, to vital organs requires water to function.

Do you know?

Water carries nutrients to all cells in all organisms.

Water allows the body to absorb and assimilate minerals, vitamins, amino acids, glucose and other substances. Water flushes out toxins and waste.

Water helps to regulate body temperature.

Water makes up an average 60% of an adult's body weight and the body cannot store water. Every day we constantly lose water through breathing, sweating and through urine and faeces. Ensuring that lost fluids are replenished in a timely manner is essential for good health.

Activity 2

Class teachers should organise a discussion on reuse and recycle of water.

5.3 Water scarcity

Water is vital requirement of life. By 2025 more than 50 countries including India will face water scarcity problem.

Water is available through uneven monsoon rains in India. Average rainfall is 117 cm in India and 101 cm in Maharashtra. Availability of water is more than 300 cm in Konkan while very less i.e. 50 cm in eastern parts of districts like Sangli, Satara, Solapur, Marathwada districts etc. There is highest rainfall in Amboli and Gadchiroli in monsoon but there is scarcity of water in summer. The surface run-off is more due to slope of mountains and non-availability of storage.

Do you know?

Day Zero (Cape Town)

Cape town is a tourist city in South Africa. City water requirements are met by the supply of water from the nearby dams. Dam water levels had been declining since 2015. The Cape Town water crisis peaked during mid-2017 to mid-2018, when there was no water in the city for use. The City of Cape Town has introduced the idea of 'Day Zero' to focus everyone's attention on managing water consumption. Day Zero is when most of the city's taps will be switched off.

Think and Act

Do you want your area to face the same problem like Cape Town in future?

Suggest your preventive measures to avoid a crisis like this.

Conflict of water

It is predicted that in future, water may be the main reason of wars. Water demand is increasing day-by-day for domestic, agricultural and industrial sectors. Within the country too, there are conflicts over water among the states.

International Water Conflicts

Middle east countries are having less availability of water. The world's longest river Nile feeds approximately 86% countries on the bank. Sudan is diverting water which will reduce water supply to Egypt. Also other countries like Ethiopia are claiming their right over Nile water. River Jordan basin, will face shortage of water by 2025. Syria has planned to build a large dam on it, which will reduce water supply to Israel.

National Water Conflicts

Krishna River Dispute

There are multipurpose projects of irrigation and hydroelectric power, constructed across the rivers Krishna and Godavari.

More than 6 dams are constructed on river Krishna. It flows through Maharashtra, Karnataka and Andhra Pradesh. There are disputes among these three states, over the distribution of water, since 1956. To resolve this, Government of India constituted a common tribunal in 1969.

Godavari River Dispute

Godavari is one of the largest rivers in India. It originates at Nasik in Maharashtra and flows through the states of Andhra, Odisha, Chhattisgarh, Telangana. The multi purpose projects constructed on this river provide a number of advantages to people. The disputes arising among the states are for sharing water resource and other advantages obtained from the dams. To resolve this, Government of India had to constitute a tribunal for this dispute.

5.4 Water Contamination

Deterioration of Water Quality

Water quality refers to purity of water or water without unwanted substances. Water gets polluted by unwanted matter such as micro-organisms, chemicals, industrial and other wastes. Such matter, deteriorates the quality of water and renders it unfit for human use. When toxic substances enter lakes, streams, rivers, ocean and other water bodies, they get dissolved or remain suspended in water. This results in pollution of water affecting aquatic ecosystems. Sometimes, these pollutants also seep down and pollute groundwater.

Water is undoubtedly the most precious natural resource existing on our planet. It is required to meet our basic needs in day-to-day life. It is also required for irrigation, day-to-day activities, generating electricity in power plants, manufacturing process and disposal of waste.

In the process of urbanization, industrialization and agricultural practices, we knowingly or unknowingly pollute our rivers, lakes and oceans. Subsequently, we slowly but surely harm our planet. One of the consequences of this is that many species of flora and fauna are diminishing at an alarming rate.

Water pollution can be defined as change in physical, chemical and biological characteristics of water in any way which interferes its use.

Generally water is mixed with gases and salts along with suspended matter. Since, these remain in a very scanty amount, the water remains potable. But when these impurities cross permissible limit or the water becomes turbid, having foul smell and contaminated with various germs, it is considered as unfit for human consumption.

Sources of water pollution : The major sources (causes) of water pollution are -

1. Domestic wastes (sewage)

This primarily includes excreta of humans and animals along with papers, food waste, detergents etc. Various discarded materials ultimately gets accumulated in nearby water bodies like lakes, ponds and rivers.



Figure 5.1 : Domestic waste (sewage)

2. Industrial wastes

Huge amount of water is needed for manufacturing process in steel and paper industries. Hence such industries are situated on the banks of rivers. Many other industries like textile, rubber, leather, medicine etc. are responsible for water pollution. All these industries produce huge amount of effluents, which if discharged untreated into water bodies, can cause severe water pollution. Wastes like heavy metals are carcinogenic in nature and toxic compounds like phenol, cyanide and ammonia are the major contaminants of chemical industries. Most of these pollutants are non-degradable in nature.



Figure 5.2 : Industrial waste water

3. Agricultural wastes

Chemical fertilizers are applied in fields to increase the crop yield. They have harmful effects on human beings, animals and environment too.



Figure 5.3 : Pollution due to chemical spraying

The excess of fertilizers are leached into ground and pollute the ground water. Excess pesticides, insecticides and herbicides are also used in the fields to protect the crops, but all these find their ways into nearby water bodies through surface run-off and are responsible for severe water pollution.

4. Thermal Pollution

In thermal power stations and nuclear power plants, huge quantity of water is used for cooling purpose and such water becomes hot. When such heated water enters into nearby lake or river, it causes thermal pollution. Such type of pollution has harmful effects on aquatic ecosystem.



Figure 5.4 : Thermal Pollution

Do you know?

Sea turtles are one of the most ancient creatures of the planet earth existing till date. They travel thousands of miles throughout their life. Turtles lay eggs in the sand. female turtle visits the sandy beaches for nesting and laying eggs. The eggs are laid into the holes dug in the sand on the beaches by the female turtles. It is the temperature of the surrounding environment which determines the sex of the turtles. The hatchlings or young ones do not have sex chromosomes. The temperature ranging between 28-29 degree Celsius is suitable for hatching. At these temperatures embryos

within the nests develop into mix of males and females. However the temperature above this range produces only females and temperature below this range produces all males. This standard temperature of 28- 29 degree Celsius changes slightly for each species.

Now increasing thermal pollution and climate change may disrupt the sex ratio of turtles by producing all females thus leading them to extinction.

Table: 5.1 Rivers and their sources of pollution

Sr. No.	Name of River	Place	Sources of water pollution
1	Mula	Pune	Industrial effluent and Sewage of Pune city
2	Panchaganga	Kolhapur	Sugar industries and sewage from city
3	Krishna	Nagpur	Sewage from city
4	Savitri	Raigarh	Chemical industries
5	Ulhas	Ulhas Nagar (Mumbai)	Chemical industries, dye units
6	Godavari	Nasik	Fertilizer industry, sewage
7	Ganga	Kanpur	Chemical industry, leather industry
8	Kaveri	Tamilnadu	Fly ash from thermal power station, steel industry

Activity 3

Find out and write down which are the major towns/cities located on the banks of the Ganga and Yamuna rivers and which are major industries in these cities.

Effects of Water Pollution

1) Harmful effects of domestic waste (sewage)

- a) Domestic sewage is nutrient rich and when such sewage is added in water bodies it consumes the available dissolved oxygen and adversely affects water quality. Addition of sewage also imparts foul smell and changes coloration of water bodies.
- b) Discharge of effluents, sewage and domestic waste causes various human health problems.
- c) Pathogenic bacteria, viruses, protozoa flourish well in sewage and are responsible for serious diseases like cholera, typhoid, and dysentery in human beings.
- d) Large amount of nitrates and phosphates dissolved in water cause eutrophication. It accelerates growth of algae and aquatic weeds. They cover the water body and reduce oxygen content in the water resulting in death of aquatic organisms like fishes. Such water becomes unfit for drinking purpose.

2) Harmful effects of Industrial waste

- a) Untreated industrial effluents may become responsible for imparting odour, color and turbidity to receiving water bodies.
- b) Effluents from chemical industries, textiles, tanneries etc. release heavy metals like

lead, mercury, cadmium, chromium etc., which causes pollution of water bodies and makes water unpotable.

- c) Hardness of water increases with the addition of calcium and magnesium salts, which makes water unsuitable for domestic consumption.
- d) Soaps, detergents and alkalies result in foam formation affecting the water quality.
- e) Many such contaminants enter in organisms through food chain and cause adverse effect on plants and animals.

3) Harmful effects of Agricultural waste

- a) Fertilizers and pesticides used in crop fields are washed off through rain and over irrigation and it percolates in the soil, which leads to ground water pollution.
- b) Useful soil micro flora and animals like earthworms are adversely affected by insecticides and pesticides making soil unproductive in nature.

Do you know?

According to World Development Report (WDR), each year about 40,000 persons die because of toxic effects of pesticides and 1 – 2 million peoples are affected by different types of pesticides.

Most harmful pesticides are BHC, DDT, Chlordrin, Aldrin, Endosulphan, round-up etc.

4) Harmful effects of Thermal Pollution

- a) Physico-chemical properties of water bodies are altered.
- b) Reduction in Dissolved Oxygen (D.O.).

- c) Increase in Biochemical Oxygen Demand (B.O.D.).
- d) Premature hatching of fish eggs.
- e) Bacterial multiplication increases.
- f) Migration of aquatic fauna.

Do you know?

Minamata Disease

Forty years ago Minamata bay in Japan taught the world an important lesson about the dangers of mercury poisoning. A large plastic plant located near the Minamata bay used a mercury containing compound in a reaction to produce vinyl chloride, a common plastic material. Left over mercury containing compound was dumped into the bay along with other wastes from the plant. Though the mercury was in its less toxic inorganic state when dumped, the microorganisms at the bottom of the bay converted the mercury into its organic form. This organic mercury then entered into the tissues of fish, which were in turn consumed by the people living in the area. The contaminated fish thus caused an outbreak of mercury poisoning, killing and affecting central nervous system of the people. People suffered from the following symptoms - numbness in hands and feet, loss of peripheral vision, damage to hearing and speech etc.

Control of water pollution

- 1) Restrictions must be imposed on the source of water pollution and stringent rules are to be applied.
- 2) Industrial effluents must be treated properly before it gets discharged into surrounding environment.
- 3) Heavy penalties must be charged to the industries for violating the rules.

- 4) Municipal corporations and other civic societies should properly handle the solid and liquid waste.
- 5) Ban on immersion of idols and used flowers (Nirmalya) in lakes and rivers, helps to minimize the water pollution.
- 6) Ecorestoration technologies like Artificial Floating Island (AFI), Floating fountains, Floating Gardens should be developed and maintained in lakes to minimize water pollution. It also increases the aesthetic value of surrounding area.
- 7) Creating awareness among the people and by formulating and implementing stringent laws, the pollution may be checked at the source level.

Do you know?

Highlights of India's National Water Policy, 2002

The objective of the policy is to provide surplus water to the deficit areas. It aims to reduce water pollution and improves water quality of rivers.

- ◆ Irrigation and multi-purpose projects should invariably include drinking water component. (wherever there is no alternative source of drinking water.)
- ◆ Providing drinking water to all human beings and animals.
- ◆ Measures should be taken to limit and regulate the exploitation of groundwater.
- ◆ Both surface and groundwater should be regularly monitored for quality. A regular programme should be undertaken for improving water quality.
- ◆ The efficiency of utilization in all the diverse uses of water should be improved.

- ♦ Awareness of water as a scarce resource should be fostered.
- ♦ Conservation consciousness should be promoted through early stage of education, regulation, incentives and disincentives.

5.5 Water conservation and management methods

We have to use both traditional and modern methods for conserving and managing water.

- ♦ Renewing traditional water harvesting structures.
- ♦ Renovating old ponds and lakes.
- ♦ Building check dams.
- ♦ Keeping control of water resources to the community.
- ♦ Rainwater harvesting in urban areas.
- ♦ Recharging groundwater through percolation pits.
- ♦ Adopting Integrated Watershed Management (IWM).
- ♦ Reducing demand through increased efficiency of water use.

Since there is a declining availability of fresh water and increasing demand, there is a need to conserve and effectively manage this precious resource for sustainable development. India has to take quick steps and make effective policies and laws and adopt effective measures for its conservation. Besides developing water saving technologies and methods, attempts are also to be made to prevent the pollution. There is a need to encourage watershed development, rainwater harvesting, water recycling and reuse, and conjunctive use of water for sustaining water supply in the long run.

Traditional water harvesting techniques used in different states :

In India, water harvesting is an ancient tradition. Many states are using the following traditional methods even today :

Table 5.2: Traditional water harvesting techniques in India

Sr No	Traditional water harvesting system	Description	States
1	Johads	Earthen dams	Rajasthan
2	Kunds	Covered underground tanks	Rajasthan
3	Khadin	A long earthen embankment to store runoff water	Gujarat
4	Cheruva	Reservoir water	Andhra Pradesh
5	Dongs	Ponds used by Bodo tribals	Assam
6	Kere	Percolation Tanks	Karnataka
7	Pukuar, Bil and Khal	Ponds	West Bengal
8	Kund	Temple tank	Maharashtra

Bamboo Irrigation System

It is 200 years old system of tapping stream water by using bamboo pipes. It is mainly practiced in north east part of India, especially Meghalaya. It does not need any fuel or power. It works on the principal of gradient of a terrain. It can be implemented in regions where bamboo is available for free or at very low cost.



Figure 5.5 : Bamboo Irrigation System

Normally, rainwater is good enough to drink. However one should avoid using water from the first rain of the monsoon. Rainwater harvesting systems usually incorporate first rain separators. As long as the storage is completely closed, the water remains good for a long period.

Rooftop rainwater can also be used to recharge groundwater. Water from the roof is directly let into the percolation chamber around the house pits. It percolates into the soil and recharges the groundwater, if the soil is porous. After a while, the water levels in the area will go up and the wells will have enough water.

Activity 4

Learn more about Rainwater :

How much can you harvest in Pune/your city?

Suppose you live in the city of Pune. Your house has a terrace area of 100 sq m. How much of rainwater can you collect in one year?

Average annual rainfall in Pune = 760 mm

Amount of rain falling on 100 sq m area

$$\begin{aligned}
 &= \text{Roof area} \times \text{rainfall} \\
 &= 100 \text{ sq m area} \times 0.76 \text{ m} \\
 &= 76 \text{ cu m} \\
 &= 76,000 \text{ liter}
 \end{aligned}$$

For a family of five, consuming 750 litres a day, this rainwater will last for 100 days or one third of the year.

Calculate how much rain water you can have in your house/college/school.

Watershed Management

Watershed management basically refers to efficient management and conservation of surface and groundwater resources. It involves prevention of run-off, storage and recharge of groundwater through various methods like percolation tanks, recharge wells, etc. However, in broader sense, watershed management includes conservation, regeneration and judicious use of all resources like land, water, plants and animals.

Watershed management aims at bringing about balance between natural resources on one hand and society on the other. The success of watershed development largely depends upon community participation.

Some watershed management techniques

- **Contour trenches**

These are trenches dug along a hillside in away that they follow a contour line and run perpendicular to flow of water. It helps to capture and hold rainfall.

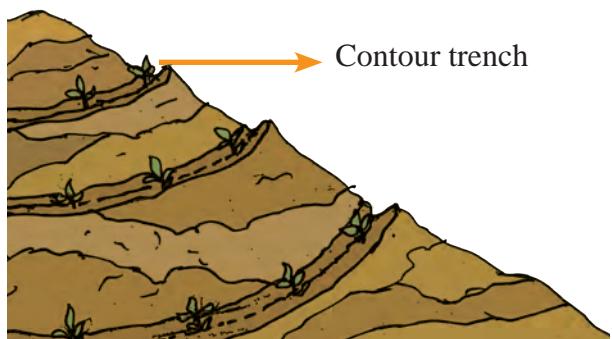


Figure 5.6 : Contour trenches

• Loose boulder structure

Loose boulder structure is a small barrier constructed of rock, gravels, sand bags placed across stream or any water channel. This reduces velocity of flowing water and allows sediments to settle down. It helps in reducing soil erosion.

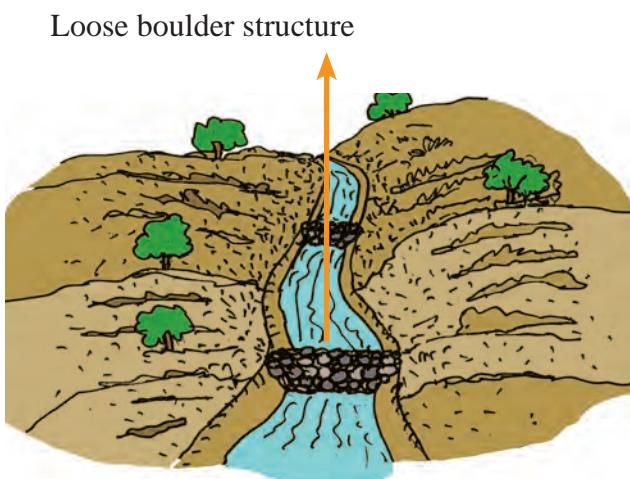


Figure 5.7 : Loose boulder structure

• Gabion structure

It is a box like structure filled with rocks / sand and soil covered with chain link mesh. It helps in percolation of water alongwith reduction in soil erosion.

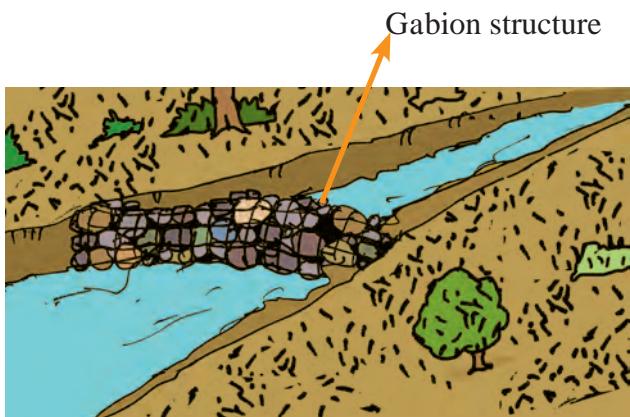


Figure 5.8 : Gabion structure

• Check dams

It is small dam constructed across a waterway to reduce velocity of water flow and helps in increase in water percolation in the

ground. It can be built from stone, sandbags or branches of trees etc.

Check dam

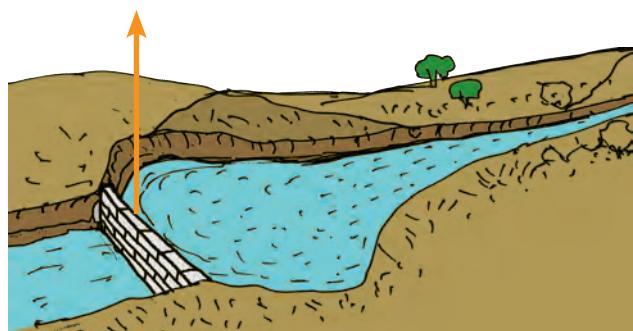


Figure 5.9 : Check dams

• Farm ponds

These are small tanks dug in farms for storing water. Water is later used for the crops, support aquaculture and provide water for livestock in summer.

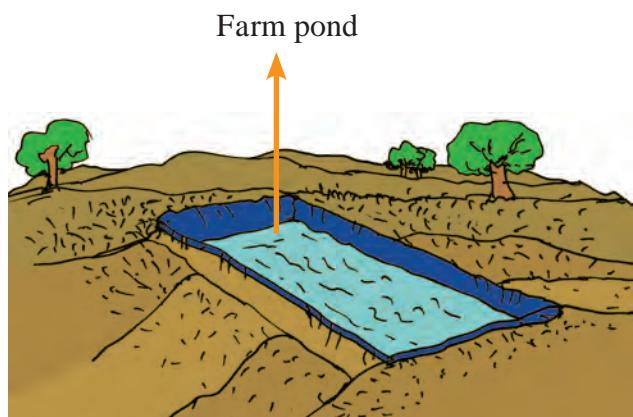


Figure 5.10 : Farm ponds

Water conservation programs in India

The Central and State Governments have initiated many watershed development and management programmes in the country. Some of these are being implemented by non-governmental organisation. Haryali is a organisation sponsored by the Central Government which aims at enabling the rural population to conserve water for drinking, irrigation, fisheries and afforestation.

The Project is being executed by Gram Panchayats with people's participation.

Neeru-Meetu (Water and You) programme in Andhra Pradesh and Arvayi Pani Sansad in Alwar, Rajasthan have taken up constructions of various water-harvesting structures such as percolation tanks, dug out ponds (Johad), check dams, etc. through people's participation.

Watershed development projects in some areas have been successful in rejuvenating environment and economy. There is a need to generate awareness regarding benefits of watershed development and management among people in the country. Through this integrated water resource management approach, water availability can be ensured on sustainable basis.

Do's

- Reuse of water whenever possible. Kitchen water can be used for watering the plants.
- Plan your kitchen activity to avoid wastage of fuel and water.
- Fix leaks promptly. A dripping joint can waste more than 76 liters of water a day.
- Use only one bucket of water for bathing. Showers use less water, if you limit them to five minutes. Install low-flow showerheads. Avoid the use of bathtubs as far as possible.
- Use sprinkler for irrigation.
- Run your dishwasher, washing machine and dryer, only when you have full loads.

Don'ts

- Don't keep on the tap running while having bath, brushing teeth, shaving or washing dishes; it wastes about 2 liters of water every minute.

- Don't hose down your lawn or corridor to clean it. Sweep it off.
- Don't wash the clothes and kitchen utensils in the water bodies.
- Avoid throwing flowers, sweets, puja materials into a river. It will degrade the quality of water.
- Avoid throwing dead bodies and ash in river.
- Avoid use of weedicides.

Do you know?

Paani Foundation - People's movement to fight drought!

Paani foundation is an organization founded in 2016, with the aim of making Maharashtra drought free by people's participation.

Water scarcity is largely a man-made condition and only people's efforts can solve this crisis. Thus, the movement is based on the thought that only people's movement can eradicate drought.

Paani foundation provides training of scientific watershed management, leadership and community building to the villagers. It is working in around 90% of drought hit villages in Maharashtra. Through training films and manuals, the teams of Paani foundation are working across the state. To incentivize the program, it conducts a competition called "Satyamev Jayate Water Cup" every year. This competition helps villages to compete for the best watershed management work. Started with 116 villages in 2016, more than 4,000 villages have participated in 2019 and around 23,000 crores liters of water storage capacity is built up till now.

This shows that it is not just a competition but an inspiration to make drought free Maharashtra.

Activity 5

Visit any village which has participated in water cup in your area, write down the techniques used for watershed management.

Samagra Shiksha - Jal Suraksha Drive August 9, 2019

Union Ministry of Human Resource Development (MHRD) launched Samagra Shiksha - Jal Suraksha drive to create awareness about water conservation among all school students in the country. It seeks to make students competent and committed water citizens of nation. This can be achieved by making water conservation essential for students, so that they can understand the importance of water. It also enables them to carry out water conservation activities in their day-to-day lives.

Do you know?

The Water (Prevention and Control of Pollution) Act, 1974

The objective of this enactment is to prevent pollution of water bodies and to protect the wholesomeness of water. The Act established Central and State Pollution Boards to regulate the sanctions and permissions required by the industries before coming into operation.

This enactment prohibits release of any polluted water with prescribed treatment in any stream or water-body. Whoever pollutes water becomes accused, liable to be punished with fine and imprisonment under

this Act. The Pollution Control Boards are the nodal agencies to govern permissions, sanctions and are entrusted with a function to keep the water-bodies free of pollution.

Remember it !

If one student – one day - saves one litre water,

Then one student – one year - will save 365 litres water,

And one student - 10 years - will save 3,650 litres water.

Activity 6

Write down the ways to save atleast 1 lit. water per day at home.

Exercise for Journal Assignment

- 1) Explain the causes and effects of flooding. Suggest the corrective measures to avoid flooding situation.
- 2) Write down a script for a street play on water conservation and its importance.
- 3) What precautions you should take to reduce the impact on environment while visiting a tourist place.
- 4) Explain water scarcity in India.
- 5) Explain importance of watershed management.
- 6) Explain river water pollution in India.
- 7) Study causes of water pollution in your locality and suggest the corrective measures for it.
- 8) Explain the measures required for water security in your locality.



Glossary

- **Adulterants** – The substance, which when added in food or drink, makes it weaker or lowers its quality.
- **Agro-biodiversity** – It includes all components of biological diversity related to food and agriculture ecosystems.
- **Anaerobic** – Organisms or processes which do not need oxygen in order to function or survive.
- **Animal husbandry** – The branch of agriculture, concerned with the production and care of domesticated animals.
- **Anthropogenic** – Man-made.
- **Ambient** – Immediate surrounding.
- **Expert Appraisal Committee – (EAC)**
Exists at the Union as well as state levels, (State expert appraisal committee or SEAC) to advise the government on environmental clearance of development projects. The role of EAC is integral to the process of granting environment clearance to developmental projects.
- **Audit** – Inspection of an organization by an independent body.
- **Biological oxygen demand** – The amount of dissolved oxygen needed by anaerobic decomposers to break down the organic materials in a given volume of water at a certain temperature over a specified time period.
- **Bio-magnification** – The process by which certain chemicals in the environment become concentrated as they move from one organism to another in the food chain.
- **Bio-methanation** – The process by which organic material is microbiologically converted under anaerobic conditions to biogas.
- **Biological decay** – The breaking down or rotting of organic matter through the action of bacteria, fungi or other organisms by decomposition.
- **Bt cotton** – Bt is a family of proteins, originating from strains of the bacterium *Bacillus thuringiensis*. Bt cotton is a genetically modified, pest resistant cotton variety.
- **CFC (Chlorofluorocarbon)** – Organic compounds, made up of atoms – carbon, chlorine and fluorine. An example of CFC is Freon – 12, used in refrigerators and Air conditioners.
- **Christian Era** – Also called common Era. It is one of the notation systems for the world's most widely used calendar era.
- **CH₄ (Methane)** – It is a colourless, odourless, flammable gas; which is the main constituent of biogas and considered as one of the green house gases.
- **CNG (Compressed Natural Gas)** – It is methane stored at high pressure and can be used as a fuel in place of diesel, gasoline.
- **Desertification** – The conversion of arid and semi-arid land into deserts by inappropriate farming practices or overgrazing.
- **Eco-restoration** – It is the redevelopment of degraded ecosystems including its biotic and abiotic components.

- **Effluent** – Liquid industrial waste.
- **Exponential** – Growing or increasing very rapidly.
- **Fibrosis** – Formation of an abnormal amount of fibrous tissue in an organ or part as a result of inflammation and irritation. Pulmonary fibrosis is a lung disease that occurs when lung tissues are damaged.
- **Fly-ash** – It is a coal combustion product composed of fine particles, that are driven out with the flue gases.
- **Food additives** – Substances, add to food to preserve flavour or enhance its taste, appearance and other qualities.
- **Gene mutation** – Permanent alteration in the DNA sequence, that makes up a gene.
- **Genetically Modified Organism (GM)** – An organism whose material has been altered in a way that does not occur naturally. It allows selected individual into another genes to be transferred from one organism.
- **Inventory** – A complete list of items, such as goods and materials.
- **Logging** – A process of cutting and processing trees to produce timber.
- **Landraces** – It is a domesticated, locally adapted, traditional variety of plant or animal species, that has developed over time.
- **Leachate** – It is a liquid that seeps through solid wastes or other medium and has extracts of dissolved or suspended material from it.
- **Mangroves** – It is a shrub or small tree, that grows in coastal saline or brackish water. It has numerous tangled roots, that grow above ground and form dense thicket.
- **Monocotyledon** - A group of plants whose seeds have only one cotyledon. These seeds can not be divided into two parts. The examples are maize, wheat, rice.
- **Non-conventional energy sources** – Natural resources like wind, tides, solar, biomass etc. which generate energy are known as non conventional energy sources.
- **Perennial** – Lasting or existing for a long time.
- **Protozoa** – Single celled organism, existing as free living organisms or parasites.
- **Persistent Organic Pollutant (POP)** – These are organic compounds that are resistant to degradation through chemical and biological processes. These are of global concern due to persistence in the environment, ability to bio accumulate in ecosystems and their negative effects on human health and the environment.
- **Peroxy Acetyl Nitrate** – Peroxy acetyl nitrate (PAN) is an important constituent of photo chemical smog. It is very stable at cold temperatures and easily decomposes to release NO_x at warm temperatures. PANs have many adverse effects on human body, such as reduced respiratory function and eye irritation.

- **Poly Ethylene Terephthalate (PET) –**
PET is a clear, strong and light weight plastic, that is widely used for packaging foods and beverages. It is typically called ‘polyester’ when used for fibres or fabrics and ‘PET Resin’ when used for bottles, jars, containers and packaging application.
- **Radionuclides –** They are atoms, that has excess nuclear energy making it unstable. They occur naturally or are artificially produced in nuclear reactors, cyclotrons etc.
- **Radioactive fall-out –** It is the radioactive material propelled into upper atmosphere following nuclear blast. It is so called because it falls out of the sky after the explosion. It is harmful for all living organisms.
- **Soil erosion –** It is one form of soil degradation. It is the displacement of upper layer of soil, caused naturally by water, snow, air, animals.
- **Surface run-off –** It is water from rain, snow melt that flows over the land surface. (If the run-off is heavy. There is less infiltration of water into the soil and if it is less, more water infiltrates into the soil.)
- **Sewage –** It is waste water and excrement conveyed in sewers.
- **Sludge –** Thick, soft, wet mud or a similar viscous mixture of liquid and solid components, especially the product of an industrial or refining process.
- **Styrofoam –** A kind of expanded polystyrene used especially for making food containers.
- **Spatial pattern –** Arrangement of a feature on land as it is shown distributed through earth space.
- **Topography –** The arrangement of high and low elevation in the landscape.
- **Turbidity –** A measure of fine, suspended matter on liquids.
- **Threshold –** The level or point at which something starts to happen or change.
- **Wetland –** Land that is cover all or part of the time with salt water or fresh water, excluding streams, lakes and the open oceans. The soil is basically undrained, giving rise to swamps, bogs and marshes. Wetland includes estuaries, deltas, mangroves and water logged paddy fields.
- **Watershed –** Area in a natural basin having a single outlet of water.



List of Projects

1. Visit any farmer who practices organic farming and make a report on type of compost/ bio fertilizers used, cost of fertilizer with respect to chemical fertilizer. Also get the information on bio pesticides used and the content of these bio pesticides.
2. Find out your 'carbon footprint' by using footprint calculator from the internet. After calculating the footprint list down steps that you can do to reduce carbon footprint. Calculate the foot print after taking necessary steps and make a report on it.
3. Conduct a project in your locality to find out solid waste disposal in your locality. Make a poster to reduce the waste and improve the waste management in the community.
4. Carry out energy audit of your house based on guidelines given in the book and write steps to reduce the use of energy. Study your electricity bill before and after taking steps. That is the conclusion of your project.
5. Visit the nearest hospital/ doctor in your locality. Prepare a questionnaire to talk to the doctor on the increase or decrease in the patients and the types of diseases reported. Write the report on what are the causes of diseases and preventive measures which can be taken. Make a report of the same.
6. Study population status of your village/ town/ city for past twenty years (since census is conducted every ten years) available on the Indian National Government website (<http://censusindia.gov.in>). Make a graphical representation of the changes seen and discuss the change in your classroom.
7. Study the local community traditions in your locality by talking to elderly people in your house or neighborhood and highlight the points which favour environmental protection.
8. Visit the local grocery shop/ mall and list down all the products that are available which have eco marks. List why are they registered as ecofriendly. Make a table listing the product name, product and the company names. They can also be organic products.
9. Visit any nature tourism site and make a report on why it is visited? How many people visit the site every year? Make a list of environmental impacts observed due to tourism and suggest preventive measures.
10. Carry out 'Green Audit' of your college/ school campus as per the guidelines given in the book.
11. Visit the solid waste dumping site of your locality. Prepare the report on volume generated per day, how dumping affects the surrounding. Take the interviews of local people staying in the surrounding area on how they are affected. Prepare a poster suggesting measures to reduce the waste.
12. Report the weather changes experienced by you and other people in your area in the previous year. Make a report on how it is affecting your own local environment.

13. Survey the local water resources in your area and its quality of water. (use guidelines from the book) Write on causes of pollution and suggest preventive measures to be taken.
14. Study the water quality of tube wells in your area. Prepare a table showing location, causes of pollution, since when water quality of bore well changed? Is there water available whole year or it is seasonal? Get the information from elderly people from the area. Write down suggestions for its improvement.
15. Visit a local industry and study the environmental impacts of it in the surrounding area. Carry out interviews of the local people about their views on the industry.
16. Survey the local rainwater harvesting installations if any in your locality. List down how it has benefitted the area.
17. Visit few farms in your area and study the agricultural loss due to insects or pests in the agricultural practices in recent years. Make a table documenting the name of crop, type of disease, monetary losses incurred, causes of problem according to the farmer.
18. Study mixed farming practices in the locality with respect to sequence of crops, advantages of it, types of varieties grown, benefits of each crop to the farmer with respect to economics, yield quality and quantity.
19. Visit your area to get the information on the various weeds present in the locality. Prepare a map showing the area occupied by the weed. Ask the local farmers how it has affected the agriculture and document it in tabular form. Write down control measures to reduce the same.
20. Survey the various water conservation practices in the locality. Write about the benefits of the project to the people. It can be drip irrigation, roof top harvesting in urban area or watershed development in rural area.
21. Study the drinking water supply system in your area. What is the source of drinking water, where water is purified and how it gets distributed in the locality. Study what happens to the waste water drainage.
22. Study the local or nearby dam and write down the environmental issues concerning the dam and the locality.
23. Study air pollution in the area using the AQI app. Do the monitoring for one month every week. Write conclusions based on your observations.
24. Use sound level app to study the sound pollution in the area. Measure the noise levels at market place, school, hospital, traffic signal. Prepare a detail report on it. Prepare a poster suggesting measures to reduce noise levels and its harmful effects.
25. Survey the biodiversity of your school/ college campus. Prepare a eco audit report.
26. Write down the environmental issues in your village/ city / area on the basis of the following points: a) Population growth b) Solid waste problem c) Pollution d) Documentation of biodiversity.

27. Visit the nearest historic area (eg. fort) and write down number of the visitors, purpose of visit by people, historical importance of the place and write about the environmental issues there.
28. Write down the information about environmental protection organizations in your area, the work that they have done in last few years.
29. Prepare statewise list of tribal communities in India. Explain the special characteristics of each. Describe the traditions of environmental conservation practices in the tribal community.
30. Participate in watershed management activity in nearby area. Prepare a report on water shed management techniques used in that area. Explain the importance of these techniques.
31. Visit a local distributor of chemical pesticides and make a detail list of commonly used pesticides in the area and used for which crops. Write about their impacts on human health and environment.



Some International environmental activity days

Sr. No	Name of the activity day	Date
1.	World Wetlands Day	February 2 nd
2.	World Wildlife Day	March 3 rd
3.	International Day of Action for Rivers	March 14 th
4.	World Consumer Rights Day	March 15 th
5.	Global Recycling Day	March 18 th
6.	World Sparrow Day	March 20 th
7.	International Day of Forests	March 21 st
8.	World Planting Day	March 21 st
9.	World Water Day	March 22 nd
10.	Earth Day	April 22 nd
11.	World Biodiversity Day	May 22 nd
12.	Bike-to-Work Day	3 rd Friday of May
13.	World Environment Day	June 5 th
14.	World Population Day	July 11 th
15.	International Tiger Day	July 29 th
16.	International Ozone Layer Preservation day	September 16 th
17.	World Animal Day	October 4 th
18.	Energy Efficiency Day	October 5 th
19.	International Day of Climate Action	October 24 th
20.	World Soil Day	December 5 th

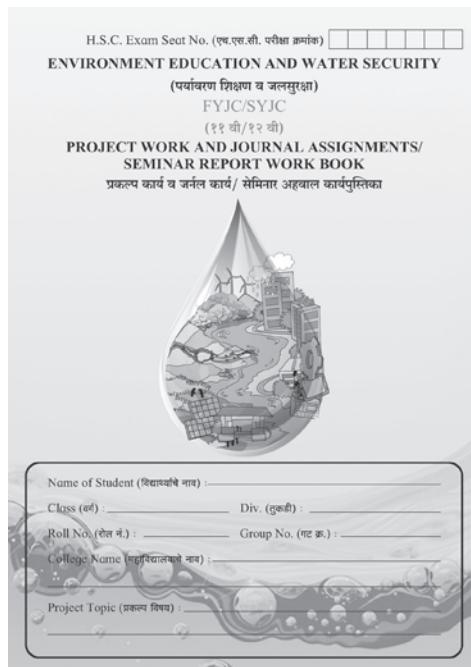
इयत्ता ९९ वी व ९२ वी प्रकल्प कार्य व जन्मल कार्य/सेमिनार अहवाल कार्यपुस्तिका

Environmental education and water security

दोन्ही
इयत्तांसाठी
उपयुक्त

मराठी व इंग्रजी
दोन्ही
माध्यमांसाठी
एकच पुस्तिका

मूल्य
३० रूपये



इयत्ता ९९ वी व ९२ वी प्रकल्प कार्य व जन्मल कार्य/सेमिनार अहवाल कार्यपुस्तिका नोंदवण्या पाठ्यपुस्तक मंडळाच्या विभागीय भांडारांमध्ये विक्रीसाठी उपलब्ध आहेत.

- (१) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, सेनापती बापट मार्ग, पुणे ४११००४, ☎ २५६५१४६५ (२) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, पी - ४९, औद्योगिक वसाहत, मुंबई-बंगलोर महामार्गावर, सकाळ कार्यालयासमोर, कोलाहपूर ४१६१२२ ☎ २४६८५७६ (३) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, ९० उद्योग नगर, एस. व्ही. रोड, गोरेगाव, पश्चिम मुंबई ४०० ०६२ ☎ २८७७९८४२ (४) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, सिडको प्लॉट नं. ९४, डब्ल्यू सेक्टर १२, वांजा रोड, न्यू पनवेल, जि. रायगड, पनवेल ४१० २०६ ☎ २७४६२६४६५ (५) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, लेखानगर जवळ, प्लॉट नं. २४, 'माघ' सेक्टर, सिडको, नवीन मुंबई-आग्रा रोड, नाशिक ४२२००९ ☎ २३१९५९९ (६) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, एम आय डी सी शेड क्रमांक २ व ३, रेल्वे स्टेशनजवळ, औरंगाबाद ४३९ ००९ ☎ २३३२९७९ (७) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, रवींद्रनाथ टागोर सायन्स कॉलेजसमोर, महाराजा बाग रोड, नागपूर ४४० ००९ ☎ २५४७७९६/२५२३०७८ (८) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, प्लॉट नं, एफ १९, एम आय डी सी, लातूर ४१३५३९ ☎ २२०९३० (९) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, शांकुतल कॉलनी, व्ही. एम. व्ही. कॉलेजमार्ग, अमरावती ४४४ ६०४ ☎ २५३०१६५



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