# 5. Water Security



## 5.1 Water resources

One of the major challenges we face is to provide safe drinking water and basic sanitation for all. At present, close to 1 billion people lack access to clean water sources and over 2.6 billion people lack access to basic sanitation. Nearly all of these people live in cities in developing countries.

Cities all over the world are facing a range of problems, from climate change and population growth, to deterioration of urban infrastructure. Cities of the future will have a hard time providing sufficient sanitation and efficiently managing with less reliable water.

New approaches for urban water management will need to address these issues. New strategies to be developed to build resilient urban water systems. Rural settlements and cities in developing countries require to take special efforts for water management.

**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.

**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

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 though 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 is 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 requirments 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 meatures 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, agricultured 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 worlds 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 constitued a common tribunal in 1969.

### Godavari River Dispute

Godavari is the one of the largest rivers in India. It originates at Nasik in Maharashtra and flows through the states of Andhra, Odisa, Chattisgarh, 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 dimimishing 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

= Roof area × rainfall

= 100 sq m area × 0.76 m

= 76 cu m

= 76,000 liter

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.

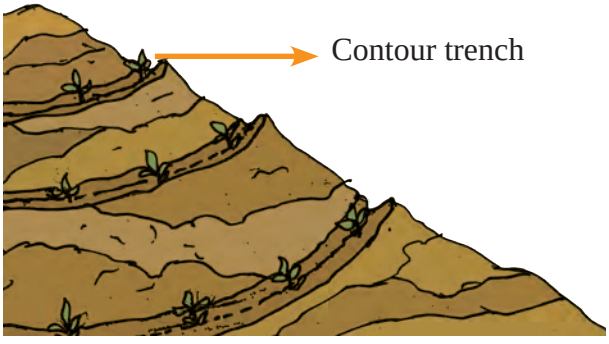



**Figure 5.6 : Contour trenches**

### • 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.

Loose boulder structure

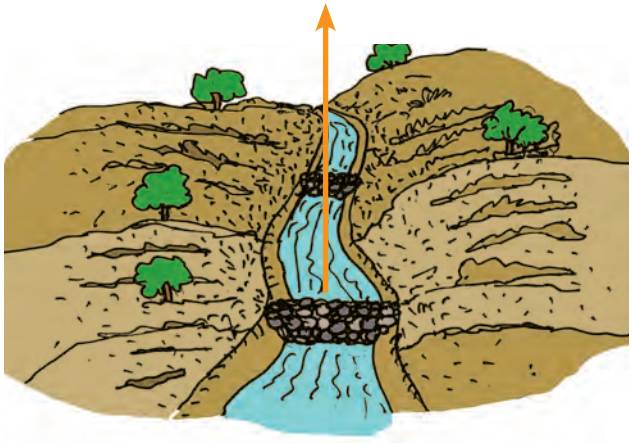


**Figure 5.7 : Loose boulder structure**

### • 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.

Gabion structure

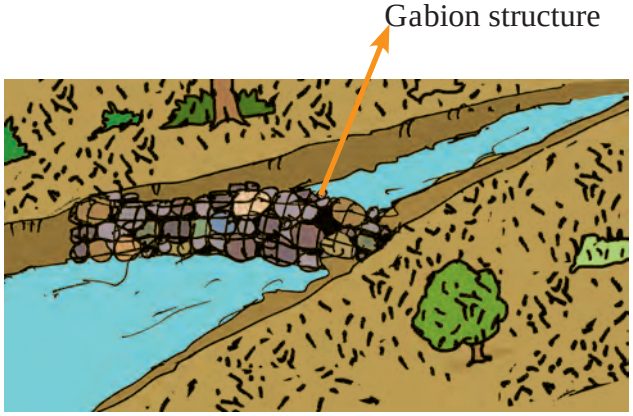


**Figure 5.8 : Gabion structure**

### • 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

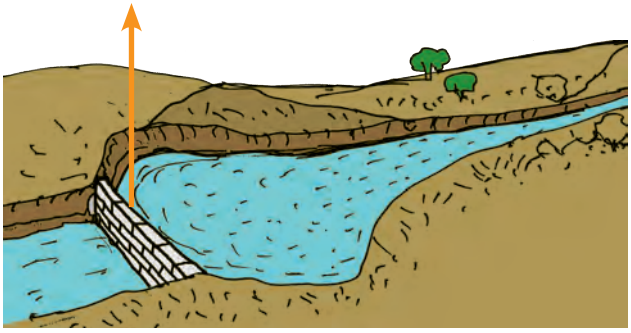


**Figure 5.9 : Check dams**

### • 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.

Farm pond

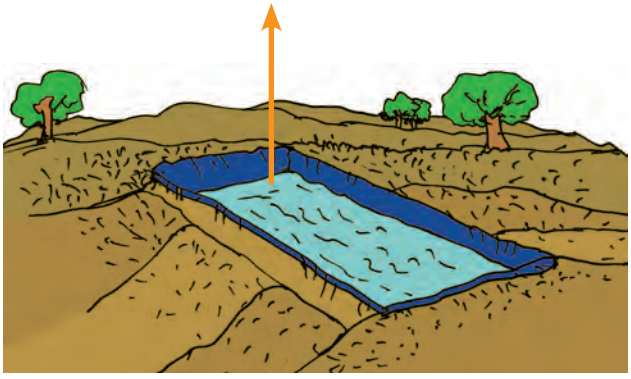


**Figure 5.10 : Farm ponds**

## 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 organisations 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-Meeru (Water and You) programme in Andhra Pradesh and Arvary 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 shower-heads. 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) Expalin 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, post resistant cotton variety.
- **CFC (Chlorofluorocarbon) –** Organic compounds, made up of atoms – carbon, chorine 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 calender era.
- **$CH_4$ (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 componants.

- **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.
- **Genectically 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 transfered 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 n costal 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, monitory 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 distributer 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 2nd |
| 2. | World Wildlife Day | March 3rd |
| 3. | International Day of Action for Rivers | March 14th |
| 4. | World Consumer Rights Day | March 15th |
| 5. | Global Recycling Day | March 18th |
| 6. | World Sparrow Day | March 20th |
| 7. | International Day of Forests | March 21st |
| 8. | World Planting Day | March 21st |
| 9. | World Water Day | March 22nd |
| 10. | Earth Day | April 22nd |
| 11. | World Biodiversity Day | May 22nd |
| 12. | Bike-to-Work Day | 3rd Friday of May |
| 13. | World Environment Day | June 5th |
| 14. | World Population Day | July 11th |
| 15. | International Tiger Day | July 29th |
| 16. | International Ozone Layer Preservation day | September 16th |
| 17. | World Animal Day | October 4th |
| 18. | Energy Efficiency Day | October 5th |
| 19. | International Day of Climate Action | October 24th |
| 20. | World Soil Day | December 5th |

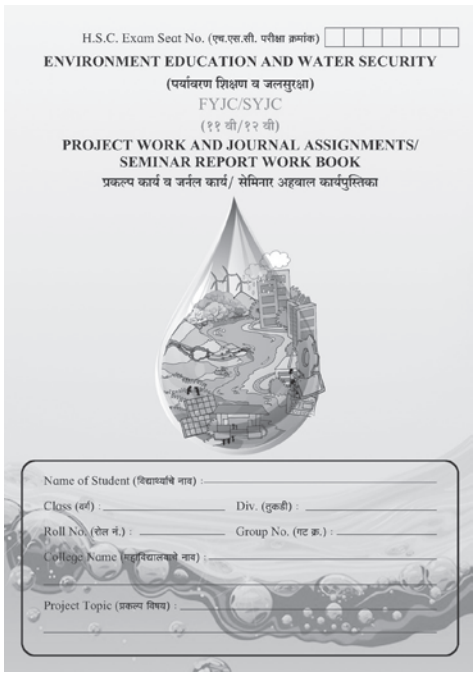
## *इयत्ता ११ वी व १२ वी प्रकल्प कार्य व जर्नल कार्य/सेमिनार अहवाल कार्यपुस्तिका*

## *Environmental education and water security*

दोन्ही इयत्तांसाठी उपयुक्त

मराठी व इंग्रजी दोन्ही माध्यमांसाठी एकच पुस्तिका

मूल्य ३० रूपये




- शासनमान्य अभ्यासक्रम व पाठ्यपुस्तकावर आधारित.
- मूल्यमापन योजनेनुसार सर्व पाठांवर आधारित.
- विद्यार्थ्यांसाठी महत्त्वाच्या सूचना.
- प्रकल्प निवडीसाठी मार्गदर्शन.
- विविध कौशल्य वापराची मार्गदर्शिका
- गुणविभागणी तक्ता.

## *इयत्ता ११ वी व १२ वी प्रकल्प कार्य व जर्नल कार्य/सेमिनार अहवाल कार्यपुस्तिका नोंदवह्या पाठ्यपुस्तक मंडळाच्या विभागीय भांडारांमध्ये विक्रीसाठी उपलब्ध आहेत.*

(१) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, सेनापती बापट मार्ग, पुणे ४११००४, ☎ २५६५९४६५ (२) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, पी - ४१, औद्योगिक वसाहत, मुंबई-बंगलोर महामार्गावर, सकाळ कार्यालयासमोर, कोल्हापूर ४१६१२२ ☎ २४६८५७६ (३) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, १० उद्योग नगर, एस. व्ही. रोड, गोरेगाव, पश्चिम मुंबई ४०० ०६२ ☎ २८७७१८४२ (४) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, सिडको प्लॉट नं. १४, डब्ल्यू सेक्टर १२, वावंजा 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 ☎ २३९१५११ (६) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, एम आय डी सी शेड क्रमांक २ व ३, रेल्वे स्टेशनजवळ, औरंगाबाद ४३१ ००१ ☎ २३३२१७१ (७) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, रवींद्रनाथ टागोर सायन्स कॉलेजसमोर, महाराजा बाग रोड, नागपूर ४४० ००१ ☎ २५४७७१६/२५२३०७८ (८) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, प्लॉट नं, एफ ९१, एम आय डी सी, लातूर ४१३५३१ ☎ २२०९३० (९) महाराष्ट्र राज्य पाठ्यपुस्तक भांडार व वितरण केंद्र, शांकुतल कॉलनी, व्ही. एम. व्ही. कॉलेजमागे, अमरावती ४४४ ६०४ ☎ २५३०९६५

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