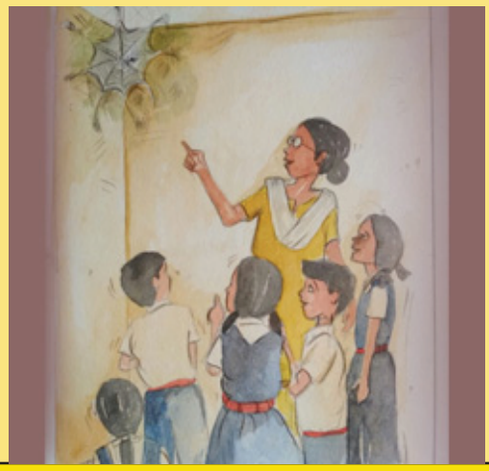
Science

ECOSYSTEM

Student Handbook



CONNECTED LEARNING INITIATIVE

An initiative seeded by

TATA TRUSTS

RE-IMAGINING FUTURES
भविष्य की पुनर्कल्पना
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The **Connected Learning Initiative (CLIx)** is a technology enabled initiative at scale for high school students. The initiative was seeded by Tata Trusts, Mumbai and is led by Tata Institute of Social Sciences, Mumbai and Massachusetts Institute of Technology, Cambridge, MA USA. CLIx offers a scalable and sustainable model of open education, to meet the educational needs of students and teachers. The initiative has won UNESCO's prestigious 2017 King Hamad Bin Isa Al-Khalifa Prize, for the Use of Information and Communication Technology (ICT) in the field of Education.

CLIx incorporates thoughtful pedagogical design and leverages contemporary technology and online capabilities. Resources for students are in the areas of Mathematics, Sciences, Communicative English and Digital Literacy, designed to be interactive, foster collaboration and integrate values and 21st century skills. These are being offered to students of government secondary schools in Chhattisgarh, Mizoram, Rajasthan and Telangana in their regional languages and also released as Open Educational Resources (OERs).

Teacher Professional Development is available through professional communities of practice and the blended Post Graduate Certificate in Reflective Teaching with ICT. Through research and collaborations, CLIx seeks to nurture a vibrant ecosystem of partnerships and innovation to improve schooling for underserved communities.

Collaborators:
Centre for Education Research & Practice – Jaipur, Department of Education, Mizoram University – Aizawl, Eklavya – Bhopal, Homi Bhabha Centre for Science Education, TIFR – Mumbai, National Institute of Advanced Studies – Bengaluru, State Council of Educational Research and Training (SCERT) of Telangana – Hyderabad, Tata Class Edge – Mumbai, Inter-University Centre for Astronomy and Astrophysics – Pune, Govt. of Chhattisgarh, Govt. of Mizoram, Govt. of Rajasthan and Govt. of Telangana.

Any questions, suggestions or queries may be sent to us at:
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ECOSYSTEM

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CLIx/Eklavya Team
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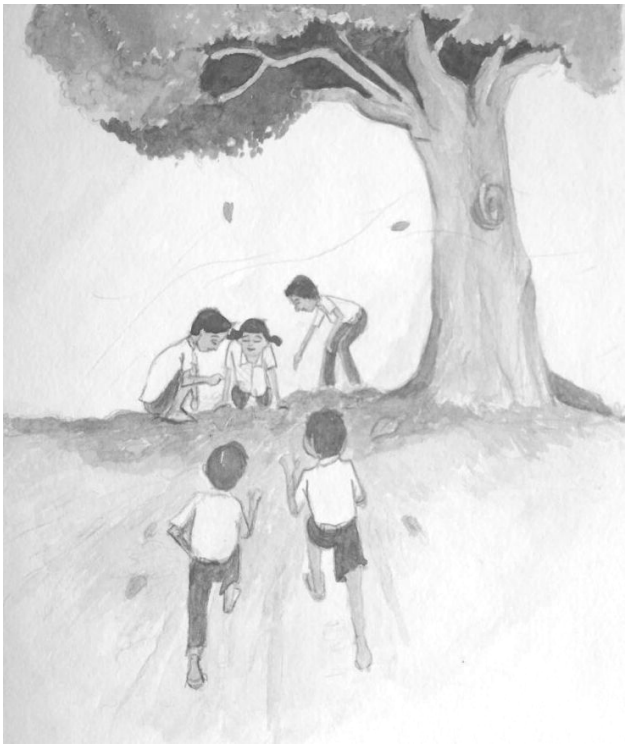
Content

Exploration of an ecosystem

1.1 Exploration of an ecosystem



While walking in your school complex, you may have noticed that all corners/areas do not look the same. Some areas have grass, bushes and weeds, while some are rocky and without any vegetation. During the rainy season, there may be new plants growing on concrete walls. An area that is moist may have mosquitoes and insects in abundance.

If you look closely, you may be surprised to find out that not only do the places and corners look different, they are home to different kinds of vegetation, insects and animals.

Are the living and non-living things you find on your school campus different from those that you will find, say, in a pond? Which system has more diversity?(diversity = a range of different things)

Does there appear to be a relationship between the non-living things and living things of any specific area?

Field Trip/Walk - a walk around the field

Let us go for an excursion around the school to discover Diversity (both living and non-living) and the interrelationship among things in nature. Excursion, here, means observing the world outside your classroom, gathering information about non-living and living things. Then coming back to class and organizing the information collected.

The room you are in, the walls, ground/field, roof, lawns, observe everything during your walk.

Precautions:

1. Do not touch any insect or other organisms. Observe them from a distance under the

supervision of your teacher.

2. Do not venture alone towards the pond, lake or river.

3. Do not play with any water collected outside. Mosquitoes may be present near the water bodies. So make sure you are fully covered - wear full-sleeved clothes, pants, salwar-kurta, etc.

Observation

Whatever you observe outside, should be noted in your table (see the table given below).

For example, if you see a spider - is it on the wall or in its web?

- Are there any insects stuck in that web? What are they?
- From where could these insects have come?
- According to you, why did the spider choose a corner for making its web?

Similarly, look at the soil, the stones -

- Are there any insects in the soil?
- What kinds of plants are growing in the soil?
- What are the kind of stones and pebbles you see there?
- Can you also see rotten or dry leaves, grass etc in the soil?
- What do you think is the use of these dry and rotten leaves?

If you can see water around	**If you see a honeybee**	**If you see trees**
Is the water clean or dirty?	Where was it seen?	What is the soil around it be like?What will
Which insects/germsdo it have?	where does it stop and rest?	Are there any birds living in the trees? Which ones?
Why are they breeding and flourishing there? If you see a honeybee	Why does it rest there?	Are there also insects on the tree?
	Where is its hive?	Is the tree also getting something from the air and soil?
	Does it get some kind of help from the tree? If you see trees	

Perhaps you will also see some organisms that live under the surface layer of the soil; write about them too in the table.

The information above is only to help you make the observations. You have to collect more information.

This table will help you organize the information you have collected during the Field Walk./ excursion.

Serial number	**Where it is found**	**Living or non-living**	**If living**
where/ from what does it get food			
Ants			
Pieces of rock			
Grass			
Plastic			

Wherever you stand, if you observe carefully, you will find an entire ecosystem that has living and non-living things depending on each other. There is an interrelationship between them. You can find this connection at the global level or just a single tree is enough to understand it. If you wish, you can take the pond or lake as a system and look for interrelationships within it.

Each of these ecosystems, a pond or a tree, may appear to be different and far away from each other. The organisms living in it may be different from each other but these systems are connected to each other as well. In these systems, there is an interaction between the living and the non-living. There is an interdependence between them. A change in one system can impact/ affect another system as well. For example, if the pond dries up, not only will the life within it die, the plants around it will also dry up.

In any ecosystem, there can be two types of living things - one

(e.g. birds, insects, animals) and second microorganisms which cannot be seen with naked eyes (e.g. bacteria, virus etc.).

In one square centimeter soil, there can be thousands of microorganisms. In the category of non-living, we have sunlight, air, soil etc.

In an Ecosystem, we see the interrelationship and interdependency between the living and non-living components.

1.2. Activity

Once you complete the exploration segregate your observation as given below

Serial number	Living	Non-living

While exploring the surroundings did you notice any linkage between living and non-living things?

1. Are trees and grass taking anything from the soil?

2. Do plants get anything from the soil?

3. Are dry leaves contributing anything to the environment?

4. Are grass and insects connected together?

5. Are human beings connected with soil and tree?

6 Can you draw a diagram connecting soil, water, plants and insects ?

Understanding an ecosystem

2.1. Understanding an ecosystem

The other day, we had explored our schoolyard and found biotic and abiotic components.

Just to help you revise - Biotic components mean all components that have life and Abiotic components are non-living in characteristics. All plants, animals and microorganism existing in a specific area and the non-living

things such as soil, air, water etc. present in their environment together form an ecosystem.

In an ecosystem, biotic and abiotic components are involved in interaction with each other. For e.g. plants utilize sunlight, minerals and water from their environment to survive and grow. Meanwhile, animals get their food, nutrition and energy by eating plants or animals. Plants, animals and microorganism need water and air for maintaining their life; they take it from their environment.

We, humans, are also a part of the ecosystem. Like other animals, we also get our nutrition from biotic and abiotic components.

The ecosystem could be very large such as ocean or forest, while a hole in a tree or a discarded pot filled with rain water. The study of the ecosystems is called ecology and the scientists who conduct such studies are called ecologists.

Now we know that although different regions of our planet look different, they are actually connected with each other. Any disturbance happening in one part of the world is not restricted to that region. The air from one continent travels to another continent. The pollution in one ocean can reach other oceans over time and influence the organisms living there. The forest fire from one country can create a haze in another country.

Yet we have found that many areas of our environment have a unique identity as far as the biotic and abiotic factors are concerned and function as distinct ecosystems.

2.2 Aquatic ecosystems

Aqua means water. Water bodies - big ones like oceans, rivers, lakes and small ones like ponds and your own fish aquarium, come under this category. Many aquatic ecosystems are surrounded by land and the water that they hold is stagnant in nature (e.g. pond). Meanwhile, the water present in the ecosystems such as streams and rivers keeps flowing. The stagnant ones are called Lentic ecosystems and the flowing ones the Lotic ecosystems.

The water present in rivers, streams, inland ponds, dugout wells etc. generally contain very less salt (known as Freshwater ecosystems) compared to the largest aquatic ecosystem - the oceans (Marine Ecosystem)

2.3. Terrestrial ecosystems

Forest, grassland, desert etc. come under this category. The ground on which your school is located is also a part of the terrestrial ecosystem. They exist only on the landmass.

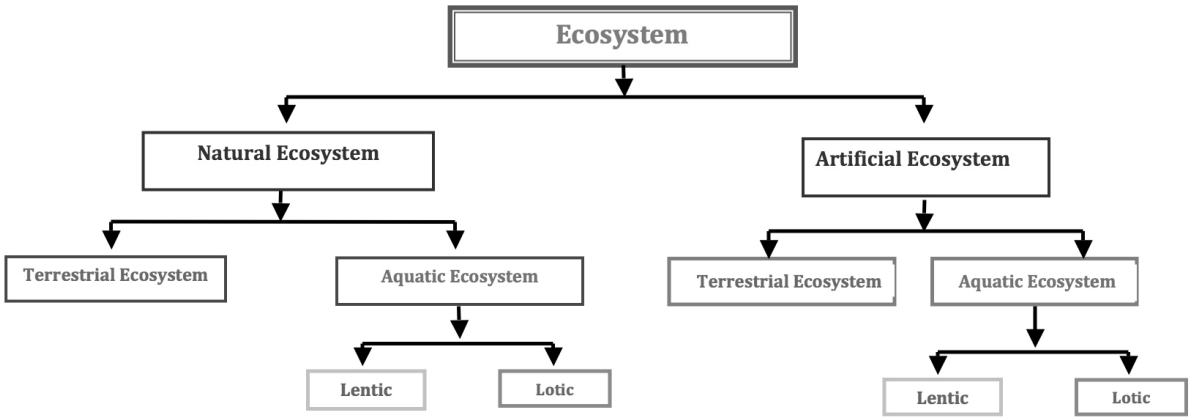
2.4. Man-made ecosystems

Many items constructed by human beings also attain the status of an ecosystem in due course of time. If we have to call any man-made item as an ecosystem, it should contain biotic and abiotic components and exhibit interaction between them. The major difference between the man-made and natural ecosystems (such as forest, ocean etc) is that the artificial ecosystems disintegrate once humans stop taking care of it.

Some man-made ecosystems are crop fields (such as paddy field), aquarium etc. The cities and towns are also man-made ecosystems.

2.5. Activity

Let's make a list of ecosystems that you all know. Give your reasons to call it an ecosystem and write biotic and abiotic components of the systems?



Name of the ecosystems	Type of the Ecosystem	Reason to term it as an ecosystem	Biotic components of the ecosystems	Abiotic components of the ecosystem
Wheat field	Terrestrial			

Let's make an ecosystem

3.1. Let's make an ecosystem

The next hour and so we will spend on setting up a small aquarium. It will slowly turn it into an artificial aquatic ecosystem.

This activity will be done in a group. Your teacher will help you break into groups.

Material for set up

Transparent plastic bottle : *one per group (empty water or cold drink bottles can be used for this purpose)*

Scissors or a thick cutter : (to cut the plastic bottle)

Measuring cups : *you can collect small measuring cups that come with children's medicine and syrup.*

Artificial Manure : *solutions will be provided to your school.*

Important : *make sure that every team uses the bottle of the same volume.*

Most important : *to avoid any accidents, your teacher will cut the bottle for you.*

Steps

1. Wash the bottle properly so that no dirt or any material remains. Measure the bottle 17 cm from the bottom and make a circular mark around the bottle at this point.
2. Take the help of your teacher to cut the bottle at this mark.

Preparing your aquatic ecosystem

Please fill the bottle up to 12 cm with tap water.

As you already know, you need biotic and abiotic components in an ecosystem. You already have an abiotic component in your bottle. What is that?

Which is that?

Get a cup of water from pond, stream or puddle. Measure just 50 ml using measuring cups and pour it into your bottle.

Why have we got this water?

Team A	This team will use paper (you can also use newspaper, black chart paper etc.) to cover your bottle from outside so that no sunlight reaches the water.
Team B	Will add a pinch of artificial manure or urea solution to the water.
Team C	Will not add any manure to the water or cover the bottle with paper.

Water from the natural water bodies such as pond, stream or puddle will contain many biotic components such as different kinds of micro organism and help in setting up of our system.

Once you have done that please mark the name of your team on the bottle.

Please keep your ecosystem near a window where there is enough sunlight. Now you need to go for long-term observation.

What to observe

As you know in order to call your bottle an ecosystem it needs to have both abiotic and biotic factors. You already have abiotic factors - Water, Sunlight, Air, Urea or Manure. You need to wait till biotic factors appear in it. Make observation as given in activity 3.1

Discussion

Could you call this an ecosystem? If so Why?

Will you call it a man-made ecosystem or a natural ecosystem?

3.2. Activity

Days	Observation
Day 1	Water is clear, no organism found….
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	
Day 7	
Day 8	

Day 9	
Day 10	
Day 11	
Day 12	
Day 13	
Day 14	
Day 15	

Watch out for the following changes in your ecosystem and record it in your notebook

Make the table given below in your notebook and record your observations daily

Please find out

Date on which the water of your ecosystem became pale green in color - due to the growth of algae.

When did you notice the presence of the zooplanktons in your ecosystem - they may be visible as tiny white or brown dots moving in the water of your ecosystem.

Date on which the insect larvae, such as mosquito larva, was seen in your ecosystem.

Time is taken by your ecosystem to become greenish in color – this means that the number of algae has increased.

Any other changes or organisms you noticed in your ecosystem.

Discussion

Every third day you should compare your observations with other groups.

Did all the teams get the same observation?

Unit 4- Measuring an abiotic factor: Oxygen

Measuring an abiotic factor: Oxygen

Oxygen is an abiotic factor essential for all organisms (except some bacteria) for their survival. Terrestrial organisms get oxygen from the air that they breathe. Although oxygen is a gas, it dissolves in water and aquatic organisms such as fishes utilize this dissolved oxygen.

We all know that if the content of oxygen reduces in the environment the organisms will suffocate and die. In an aquarium, the pump producing air bubbles helps to maintain the level of oxygen and saves fish from suffocation. (Please watch the video of the aquarium given in the lesson 2.1)

Generally, this kind of an experiment requires a sophisticated laboratory. However, we simplified it for you so that you can conduct this experiment in your classroom. The method we are using to measure the oxygen dissolved in the water is called “Winkler’s method”.

Material required

In order to conduct this activity, you need the following Items

Chemicals: Solutions of the following chemicals

Manganese sulphate

Alkaline potassium iodide

Phosphoric acid

Starch

Sodium thiosulphate

Water

2 liter of water collected from any natural water body

2 liter of water cooled after boiling for 15 minutes

Group Exercise

The whole class will be divided into a group of 6 students. Each team will choose the name A or B

Team A will choose the water collected from natural water body

Team B will choose the water cooled after boiling for 15 minutes

This way half of the total number of groups will use the water collected from a natural water body and the other half will choose the water that was cooled after boiling for at least 15 minutes.

Steps for water testing

Step 1	*Fill BOD bottle with water sample by dipping the bottle slowly into the water. Please make sure that no air bubble is trapped in the water sample. Presence of air bubbles can cause error. So put the lid on the bottle while it is still under the water.*
Step 2	*Open the lid carefully and add 4 drops of manganese sulphate solution.*
Step 3	*Then add 4 drops of alkaline potassium iodide solution*
Step 4	*Close the lid tightly and shake the water very well. You might have noticed that water in the BOD bottle is full of brown colored material, allow it to settle down.*
Step 5	*Now add 10 drops of phosphoric acid. Close the lid tightly and shake the bottle. Make sure that all the brown materials are dissolved.*
Step 6	*Using your 5 ml syringe, transfer the 5 ml of this solution from the BOD bottle into the test tube.*
Step 7	*Add 2 drops of starch solution to the test tube. Now your solution will become blue.*
Step 8	*Take 1 ml of sodium thiosulphate solution in 1 ml syringe.*
Step 9	*Slowly add the sodium thiosulphate solution drop by drop into the test tube till the blue color just disappears. Then note the amount of sodium thiosulphate solution used for making the solution in test-tube colorless.*
Step 10	*Put back the sodium thiosulphate solution remaining in the syringe after the experiment.*
Step 11	*Please watch the videos given below carefully to understand the method*

The whole class will be divided into groups of 6 students. Each team will choose the name A or B.

Team A will choose the water collected from natural water body.

Team B will choose the water cooled after boiling for 15 minutes.

This way half of the total number of groups will use the water collected from a natural water body and the other half will choose the water that was cooled after boiling for at least 15 minutes.

Calculation

of water litre = ……milligram oxygen per

Oxygen dissolved per one liter of water = Volume of sodium thiosulphate solution used (in ml) X 20.

Please use the formula given below to calculate the oxygen present in the water

Now calculate how much oxygen will be present in the water (400 ml) of your ecosystem.

4.2 Can oxygen dissolve in water?

You are familiar with the fact that oxygen could dissolve in the water. But if somebody asks you to prove that oxygen can dissolve in water, how will you do that?

Let us do this experiment and see whether you could add more oxygen to the water

Step 1	*Fill one plastic bottle (60%) with water from the same source from which you collected water for testing oxygen.*
Step 2	*Close the lid tightly and shake it well for 6 minutes vigorously*
Step 3	*Measure the amount of oxygen present in this water sample following Winkler's method*
Step 4	*Now add the value of oxygen you got in the first and second experiments (before and after shaking the water) into a spreadsheet and make a graph and compare.*

Steps for water testing

Calculation

of water litre = ……milligram oxygen per

Please use the formula given below to calculate the oxygen present in the water

Oxygen dissolved per one liter of water = Volume of sodium thiosulphate solution used (in ml) X 20.

now calculate how much oxygen will be present in the water (400 ml) of your ecosystem.

From where organisms get energy and nutrients: Producers

5.1. From where organisms get energy and nutrients: Producers

It is a well-known fact that every organism (microbes, plants theand animals) requires energy and nutrients to survive. Sun is main source energy for biotic factors living in any ecosystem. Plants and algae use sunlight as a source of energy with the help of chlorophyll present in their body through the process of photosynthesis. They use abiotic factors such as carbon dioxide, water and minerals absorbed from the environment for building their body parts. During photosynthesis, they absorb the carbon dioxide present in the atmosphere (produced by other organisms during respiration) and release another essential abiotic factor oxygen in return.

Since plants and algae utilize abiotic factors directly for getting energy and nutrients they are known as Autotrophs (auto = self, troph = nourishment; meaning self-nourishment). So green plants and algae are the biotic factors, which produce the energy and food themselves. They are also called producers.

5.2. From where organisms get energy and nutrients: Consumers

Many bacteria, animals and human beings eat various kinds of plants or animals to get energy and nutrients. They are called consumers since they consume the body or body part of other organisms.

Consumers cannot use abiotic factors directly as food. All organisms that depend on other living organisms for getting energy and nourishment are known as Heterotrophs (hetero = others, troph = nourishment). Some of them use only plants as the food materials (Herbivores) while others eat other animals (Carnivore). In many ecosystems, you could see animals, which consume both plant materials as well as animals (Omnivores).

5.3. From where organisms get energy and nutrients: Decomposers

The biotic factors that use dead bodies of other organisms or waste materials produced by them for the energy and nutrients are called decomposers. Mainly fungus and bacteria work as the decomposers in every ecosystem and their activity is essential to avoid the degeneration of the ecosystem. They break down the dead materials into the abiotic factors and make it available to the producers.

5.4. Activity

Now take the list of biotic components present in the surroundings of your school, prepared during your field trip.

Are they getting energy from the same source?

Are they using same nutrients for survival and growth?

Divide them into autotrophs (producers) and heterotrophs (consumers)?

Please discuss how producers, consumers and decomposers are interconnected with each other.

No.	***Producers***	***Consumers***			***Decomposers***
		Herbivores	*Carnivore*	*Omnivore*	

Human and ecosystems

6.1. Human and ecosystems

We human beings are dependent up on various biotic and abiotic factors available in different ecosystems for our day-to-day needs. Such useful materials, which we take from ecosystems for direct use (e.g. water) or making materials are called natural resources. Some of them are abiotic in origin while others are obtained from living beings.

Water, sunlight, oxygen, metals etc. are called abiotic natural resources. A normal person requires around 11000 liters of air (550 liters of oxygen) and at least 2 liters of water per day to keep her/ him alive. We extract various minerals and metals also from the ecosystems for making various materials required for our day-to-day needs.

We need the support of various biotic factors (known as biotic natural resources) also to survive on the earth. Various kinds of crop plants (food grains, vegetables) and livestock (goat, sheep, cow, pig) provide us with the food materials. Bees pollinate our crops and help the flowers to develop into fruits.

We also get various medicine (e.g. medicinal plants, antibiotics obtained from fungus), clothing material (sourced from cotton plants, wool) etc. also from different organisms. Although coal and petroleum, which is used for generating energy, required for various needs of humans are abiotic in nature, they come under the category biotic resources. This is because these fuels are formed from the plants and animal materials deposited under the soil millions of years ago.

Renewable and non-renewable natural resources

Some of the natural resources such as water are replaced naturally. A natural resource that could be replenished is known as renewable resources. However, the recovery of certain renewable resource also may take long years (e.g. forest). Although trees are renewable resource they take many years to grow.

However, non-renewable resources such as minerals, petroleum coal etc. cannot be replaced once we use them. Non-renewable resources are those resources, which either do not form naturally or take very long time to form.

We need to keep the balance between various biotic factors and abiotic factors present in our environment; if it is changed we human beings also will be affected. Hence the judicious use of natural resources is essential to make sure that they are available to us in future also.

Discussion

Could we humans live without any ecosystem?

Are we a part of it or do we control it?

Where will you put humans - as producers or consumers ? why?

6.2. Activity-1

Let us check how many types of biotic and abiotic resources we need to prepare our meals



Pick up the meal plate of your region. Identify the food item given in the plate and fill up the table given below

No	***Food item name***	***Source***	***Abiotic factor used to prepare this food item***
1	*Rice grains*	*Plants (paddy plant)*	*Water, gas, wood,*

6.3. Activity-2

Ecosystem services

We get various kinds of natural resources from different ecosystems. For instance, a forest ecosystem provides us timber, medicinal plants etc. while we get the major share of our fisheries and many minerals from marine ecosystems. Along with providing the natural resources (called provisional service) any ecosystem silently gives other services also. It regulates the abiotic and biotic factor to make life possible in a specific area. Maintenance of the temperature and production of oxygen by the plants, removal of waste materials by microbes through the process of decomposition etc. are the examples of regulatory services provided by the ecosystem. Additionally, we use certain ecosystems for recreation, religious purposes etc. Such service given by ecosystems is called cultural service. The recreational benefits given by the mountains, beaches, usage of river banks for conducting religious rituals etc. are some examples of cultural service we get from different ecosystems. Here we may not be taking any resource from the ecosystems but the activities conducted in the ecosystems are essential to make humans happy and peaceful.

L*ist out the resources and services we are drawing from this kind of ecosystem.*

Ecosystem	***Natural resource***	***Service***
River	*Water, fish*	*Transportation, irrigation, water sports*

Agriculture and ecosystems

7.1. Agriculture and ecosystems

Human beings have learned the art and science of cultivating plants and animals over several thousands of years.

In agriculture, we are applying the knowledge of ecosystem, i.e. the relationship between the biotic and abiotic factors as well as the interaction between biotic factors.

However, differing from a natural ecosystem where various types of organisms live and grow naturally, in agriculture fields, one or a few selected plant(s) may be grown.

For any given crop, farmers maintain favorable conditions in the ecosystems made by them (crop field) for a period of time during which seeds are sown, plants grow, pollination takes place, fruit or grains appear and then the crop matures.

In a paddy field, only paddy is allowed to grow and all other plants that may be present are removed. A crop field is an ecosystem where the plants such as rice, wheat, vegetables etc. are cultivated. Farmers exploit the relationship between the abiotic factors and producers. For instance, when they add manure to their farm they increase the abiotic factors (nutrients) required for the growth of their plants. Similarly, when they remove pests, insects, etc. they are eliminating the consumers that will eat the plants (producers) and reduce waste/loss. Cropland ecosystem like all other artificial ecosystems requires constant intervention by humans. Otherwise, it will degenerate and will result in loss of crops.

7.2. Activity-1

Let's talk about a fish farm.

There are fish farms, which grow those varieties of fish that eat algae. For instance, a fish known as tilapia. It consumes a good amount of algae along with the artificial food given in the farm ponds.

Farmers introduce cow dung, guano etc. to the pond. Decomposers break down these materials into abiotic components and release nutrients. With the help of these abiotic components and light, algae grow in the pond.

Eating these algae, tilapia fish will grow and increase in number.

If the fish are hungrier, they will consume more algae. When the number of fish increases in the pond they will need more algae to eat, which in turn will reduce the number of algae present in the pond. Lack of availability of food will lead to the starvation of fish and even their death.

In order to avoid such a disaster, farmers constantly check their pond and make sure that enough food is available for the fish they grow. They learn to maintain the delicate balance between algae and fish in the pond. Producers and consumers exist in natural water bodies also. For instance, in a stream or pond ecosystems number of fish, that eats algae, increases with the escalation in algal population. If the number of fish that eats algae increases uncontrollably, the availability of the algae would come down and these fishes will die due to starvation in due course of time. However, the consumers, the carnivorous fish that eat other fish would control the population of the former. Such cycle of interaction between abiotic factors, producers and consumers maintain the balance in any ecosystem.

7.3. Activity 2: Earthworms and agricultural ecosystems

Earthworms play a very important role in the agricultural ecosystems. They eat decaying plant and animal materials and helps in decomposing it.

Their burrowing activity enhances the aeration of the soil and brings minerals and other nutrients from the deeper levels of the soil to the surface that the plants could use. Their excretion, called earthworm casts, contains a good amount of phosphorus and nitrogen, which are essential for plant growth.It is a well-known fact that if the soil has a good population of earthworms, the productivity of the crop increases greatly. People culture earthworm to produce worm casts, which is used as manure for plants in the garden and crop fields. Cultivation of earthworms is called vermiculture.

Please talk to a gardener/ farmer or people who prepare vermi compost and collect the following information.

How do they prepare the compost?

Why are earthworms not seen in dry soil?

Will adding organic manure (e.g. cow dung) increase the growth of earthworms?

Will the addition of artificial manure (e.g. urea) affect the earthworms negatively or positively?

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