Lab Manual

Course Name: Environmental Studies and Disaster Management

Course Code: CC-AGP323

School of Agriculture and Allied Sciences
The Neotia University

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CONTENT

Practical 1: **Field Work**

• Visit to a local area to document environmental assets.
• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
• Study of common plants, insects, birds.
• Study of simple ecosystems.

Objective: Learning from textbooks, lectures and other study material does not suffice for holistic learning. Practical, hands-on learning is essential for better understanding of work processes and functions. Field activities which would provide student a firsthand knowledge on various local environmental aspects. Field experience is one of the most effective learning tools for environmental concerns. This moves out of the scope of the text book mode of teaching into the realm of real learning in the field, where the student observes or discovers fundamental concepts in his/her own environment.

Benefits of field work for the students:

1. For students pursuing professional education course, field work help them gain hands-on experience of how practically operations are executed.
2. Field work bridges the gap between theoretical training and practical learning in a real-life environment.
3. Field work provides opportunity for active/interactive learning experiences in-class as well outside the classroom environment.
4. With field work, students are able to better identify their prospective areas of work in the overall organizational function.
5. Field work help enhance interpersonal skills and communication techniques.
6. Students become more aware of industry practices and regulations during visits.

Methodology or Guidelines for the Field work:

1. The class representatives or any two members (one boy & one girl) nominated by the students with the approval of faculty members act as tour coordinators.
2. The tour coordinators accompanying faculty members will be responsible for the conduct of study tour as per the approved travel plan by the Head of the Institute.
3. The accompanying faculty member must cut short the study tour at any point of time of the tour in case of occurrence of any inappropriate incidence (violation of travel plan, tour manual, misbehavior, disobedience, accident, etc) during the tour.
4. The Principal is the final authority for the approval and modification of the educational tour.

5. The bus journey has to start from college campus itself and return to the college campus within the stipulated time.
6. The college management will not be responsible for any consequences resulting from disobedience or misbehavior of the student during their entire duration of visit including the journey.
7. Disobedience of students towards accompanying faculty member must be reported and will be viewed seriously and dealt with accordingly as per Institute rules.
8. Students suffering from health problems will not be permitted to attend their tour/ visit.
9. In addition to the first aid kit in the vehicle, an additional medical kit with first aid facilities and medicines for common health problems should be compulsorily stocked by the students.
10. A banner of study tour which displays college name and address should be placed in front of the bus.
11. Parents' consent letter is compulsory for all the students who are attending the tour program.
12. Students undergoing Industrial visit/training should compulsorily carry college ID card.
13. Regular attendance is admissible for all students for the tour program which are accompanied with faculty members.
14. It is compulsory that all students must submit a detailed report on industrial visit within two weeks from the date of return.
15. Enclosures:
    i) Annexure I: General Information for study tour.
    ii) Annexure II: Parent /Guardian consent letter for study tour.
    iii) Annexure III: Particulars of students and parents.
    iv) Annexure IV: Questionnaire as per objectives of study tour.
    v) Annexure V: Certificate.

Practical 2: VISIT TO A LOCAL AREA TO DOCUMENT ENVIRONMENTAL ASSETS: RIVER/FOREST/GRASSLANDS/ HILL/MOUNTAIN

Objective:

To document the nature of an ecosystem which gives a deeper appreciation of its value to mankind and have multiple benefits at global, national and local levels.

Background:

Each ecosystem has something different to offer us. It may contain natural resources, different cultures and socio-economic groups that local people depend on, or provide important ecological functions for us all, or have tourist or recreational potential, or simply have a strong aesthetic appeal that is difficult to quantify in economic terms. A tribal from a wilderness setting, an agriculturalist from farmlands, a pastoralist from grasslands, or a fisherman looks on his or her environment very differently from an urban resident who is mainly focused on the management of the quality of air and water and the disposal of garbage. Tribal people who live by hunting and gathering have a deep understanding of nature and what it provides for them to survive. Farmers know about utilization of their land and water resources, and also appreciate what droughts and floods can do to their lives. A shepherd or livestock owner knows the grasslands intimately.

Guidelines for the study of environmental assets:

There are two parts to this study:

1. Documenting what you see.
2. Documenting the findings of what you ask local user groups

Methodology:

• Documenting the observed abiotic and biotic aspects of the ecosystem, asking questions to local user groups about their environment and finally the conservation.

• Describe the ecosystem as seen. Its structural nature, its quality and the differences one can perceive in its geographical features, and its plant and animal life. This takes time and patience for a careful scrutiny and critical study.

Key questions:

There are several key questions that one should attempt to answer in a study of any ecosystem's natural resources.

1. What are the ecosystem's natural resource assets?
2. Who uses these and how?
3. Is the ecosystem degraded? If so how?
4. How can it be conserved?

5. How does the ecosystem function? What are the linkages between different species with each other and with their habitat? Observe its food chains.
6. By interacting with local residents and multiple user groups, decide if this is sustainable or unsustainable utilization.
7. If it is undisturbed, why has it remained so?
8. If it is sustainably used, how is its use controlled?
9. If it is degraded, how did it get to this state and when?
10. If it is seriously degraded suggest measures to restore it and to what extent could it be used so that utilization would be sustainable?

All these questions may not be observed during a single visit. It may need multiple visits.
The help of an ecologist, botanist, zoologist, geologist, hydrologist or forester to get deeper insights may be needed. A historical background frequently helps to clarify many of these questions as landscapes are not static and always change over time.

Format for field work on documenting Environmental Assets of each ecosystem

A. Documenting general features during the field survey:

The field work should be recorded in your Journal as:

Step I: **Aims and objectives:**

Step II: **To identify and document:**

1. What are the ecosystems goods and services? (Checklist of resources)
2. Who uses them and how?
3. Is the utilization sustainable or unsustainable? (Signs of degradation)
4. How can the ecosystem be used sustainably?

Step III: **Observation of the ecosystem/ Methodology**

1. Questioning the local people on the use of resources and sustainability.

Step IV: **Discussion:**

1. Observations on levels of resource use found during the field work.

Step V: **Findings:**

1. Specific concerns relevant to the study site's sustainable utilization as discussed with local people.

Step VI: **Results and Conclusions**

B. Documenting the special resource features of individual ecosystems

Once the general features are documented, observations pertaining to the specific features of the ecosystem must be documented. The checklist on resource use of each ecosystem can help in creating an environmental profile of an area which includes its important assets. Often qualitative judgments are appreciated by comparing the resources available in the study area with many others.

FOLLOWING SOME EXAMPLES
PRACTICAL : 3: RIVER

A. Guidelines on what to look for on river resource use:

- Observe what local people use from the river, wetland or lake:

1. They collect drinking water and use it for other domestic needs.
2. They catch fish and crabs,
3. They graze their cattle and buffaloes in or near the water.
4. They lift water from the lake by pumps to irrigate their fields.

- Mapping land use in terms of its water resources:

1. Document the pattern of landuse around the aquatic ecosystem river, tank or lake.
2. Assess the importance of the water resources in the ecosystem.
3. Observe the animals both wild and domestic come to the water source,

- Field observations on a river front:

1. Observe a clean stretch of river in a wilderness area full of life.
2. In a rural area observe all the different ways in which people use the water from the river.
3. Observe a river in an urban area for comparative study.
4. Who has polluted it and how? This is a sign of unsustainable use of water.

- Possible Observations:

1. Along a river in a forest observe all the different animal tracks at the edge of the water.
2. Identify the different fish that local fishermen have caught. Ask if the fish catch has decreased, remained the same, or has increased during the last decade or two.
3. Resource use: Observe and document the different types of fish and other resources used by local people.
4. Is the resources used for consumptive or productive purposes.

- Report preparation

1. Compare and contrast an unpolluted and polluted body of water.
2. What do they use water for during the course of one day?
3. How much do they use?
4. How to stop wasting water by using it carefully?
5. How can they reduce the water use for bathing and other purposes?
6. Discuss how wastewater can be used in the garden.
7. How can water be recycled?

B. Observations on the site that should be recorded:

1. Type – i) Permanent flow/ seasonal flow.
ii) Slow moving/ rapid flow;
iii) deep/shallow.

2. Qualitative aspects – i) Describe its abiotic and biotic aspects.
ii) Is the flow natural or disturbed by a dam upstream?
3. Describe its aquatic plant and animal life.
4. What are the characteristic features of its components – banks, shallow areas, deep areas, midstream areas, islands?
5. How is the land used?

C. Findings on the site that should be recorded through interviews:

1. What is the water used for and in what proportion? – Domestic use/ Agriculture/ Industry.
2. What other resources are used – fish/ crustacea/ reeds/ sand, etc.
3. Is the water potable? If not what are the sources of pollution – domestic sewage/ agricultural runoff/ industrial effluents.
4. Extent of pollution – Severe/ high/ moderate/ low /nil. Explain why.
5. Test the water quality.
6. Does it flood? How frequently flood occurs?
7. How does flood affect people?
8. What preventive steps can be taken to prevent ill effects of floods?
9. How can you enhance public awareness on the need for keeping the river clean?
10. How are you dependent on the river ecosystem? How is it linked to your own life?

D. Results of the water analysis.

The following analysis of sample water should be done in the laboratory;

i) Hardness
ii) pH
iii) Salinity
iv) Alkalinity
v) Turbidity

PRACTICAL 4: FOREST

A. Guidelines on what to look for on forest resource use:

- Assessing forest use:

1. Ask local people, especially the women, what products they collect from the forest.
2. Document what they use for household use, those that are sold in the local marketplace and those that are taken out and sold to other areas.
3. Fruits, leaves, roots, nuts, fuel wood, timber, grass, honey, fiber, cane, gum, resins and medicinal products are all forest products of great value.
4. Observe the number of cattle tracks and cow dung piles, which tell where the local people graze their domestic animals or any sign of overgrazing.
5. The amount of branches of trees the people cut and shrubs for fuel wood.
6. Ask local women how far they must travel for fuel wood.
7. Document the level of forest loss.
8. Draw up a list of articles you use that could have originated from a forest ecosystem.

B. Observations on the site that should be recorded:

1. Identify the forest type – evergreen/ semi evergreen/ deciduous/ dry deciduous/ thorn forest.
2. Is it a natural forest or a plantation?
3. Observe its qualitative aspects – Undisturbed/ partially disturbed/ mildly degraded/ severely degraded.

C. Findings on the site that should be recorded through interviews:

1. List its natural resources – goods and services.
   Goods- food, fuel wood, fodder, non-wood forest products, water, etc.
   Services- water regime, climate control, oxygen, removal of carbon dioxide, nitrogen cycle, etc.
2. Who uses the ecosystem's natural resources and to what extent? Are these used for personal use, for marketing or for both?
3. What proportion of the income of local people comes from the sale of fruit, fodder, wood, non-wood forest products?
4. Make a map of the study area showing the different land uses and where resources are collected from.
5. Provide a historical profile of its utilization and changes in its environmental status by asking local people about their resource dependency.
6. Is it protected, if so how?
7. If it is to be restored, how can one make this possible?
8. What forest produce do you use in your day to day life?

PRACTICAL 5:

VISIT TO A LOCAL POLLUTED SITE

Step I: **Aims and objectives:**
Step II: **To identify and document:**
1**.** Identify the sources and affects of pollution on different aspects of our environment, our lives and health.
2. Select and identify the polluted sites - urban, rural, agricultural and industrial areas.
3. Identify the possible effects of pollution can affect:
• Air (smoke, gases),
• Water (urban sewage, industrial chemical effluents, agricultural pesticides and fertilizers),
• Soil (chemicals, solid waste from industry and urban areas),
• Biodiversity: effects on plant and animal life.
(Observations on pollution must include all the above aspects.)

STEP III: General observations:
The following aspects need to be observed and documented:
1. The type of land or water use in the polluted area, it's geographical characteristics, who uses or own the area.
2. Map the area to be studied.
3. Identifying what is being polluted – air, water, soil;
4. The cause(s) of pollution and the polluting agent(s).
5. Assess the extent of pollution – severe/moderate/slight/nil, to: air, water, soil, biodiversity.
6. Assess from literature, the health aspects associated with the pollutant.
7. Ask local residents about its effect on their lives.
8. Make a report of the above findings

STEP IV: Format for fieldwork
A. Aims and objectives: To study the cause and effects of pollution at the site.
B. Methodology: Certain key questions related to the polluted site are given below.
Explore the site to answer the questions about the area you have visited.
1. What is the site?
   Rural - agricultural area, polluted waterbody, polluted industrial area
   Urban - Solid waste management site, Polluted industrial area.
2. What do you observe at the polluted site?
   A solid waste- garbage dump, polluted water at a river or lake, gaseous effluents or smoke coming out of an industrial area, etc.

3. Explore the reasons for pollution.
4. Observe and document the components in the garbage/ the polluted waterbody/ industrial chimneys.
5. Observe the area and list the waste that is seen in the garbage dumping site.
6. Categorise the waste into the three types:

Degradable wastes, are those which are easily decomposed by micro organisms. These include food wastes, plant material, animal carcases, etc.

Non-degradable wastes are those which are not easily decomposed. Eg. plastic, glass.

Toxic wastes are those that are poisonous and cause long term effects. Eg. Several chemicals, paints, sprays, etc.

STEP V: Findings:

1. What are the effects of the pollutant?
2. What actions can you take to get the pollution reduced?

SOME EXAMPLES:
PRACTICAL 6: SOLID WASTE study site

A. Guidelines for the study of solid waste polluted sites:
Pollution caused due to solid waste can be seen at various places:

I. Garbage dumps: One of the urban or rural environmental problem sites that can be studied is a garbage-dumping area. This problem is basically due to increase in population, an over utilization of non-biodegradable disposable consumer goods and lack of awareness of the management of waste at the household level.
How much garbage is produced everyday is not given much thought. No one really thinks about where the garbage goes or what happens to all the things we throw away.
Garbage is a source of various diseases. Improper handling of organic waste leads to a large population of flies, cockroaches and rats that are responsible for the spread of diseases. Products like plastics are not degraded in nature and hence remain for a long time in the environment, thus adding to the need for more dumps. For many years waste has also been dumped into oceans, rivers or on land. These methods off disposing off waste contribute to contamination of soil, groundwater under the dumping site, foul up the air and aid the spread of diseases.

- **Interview of a ragpickers at a roadside disposal area or at a dump and understand their problems.**

  Prepare a survey sheet and ask them:
  1. What is the area covered in a day?
  2. How many hours are spent in collecting the waste?
  3. What are the types of waste collected?
  4. What are the problems faced while collecting waste?
  5. What do they prefer to collect and why?
  6. What is done with the waste collected?
  7. If it is sold, where?
  8. Would it be better to collect waste from homes rather than from roadside bins?
  9. Do they feel that segregation of waste would help them?
  10. Where the wastes are primarily dumped?

> **Study of a dump site**

1. The location of the site and where the garbage comes from.
2. How it is collected, by whom and with what frequency.
3. Understand how the waste is managed.
4. What are the different types of garbage?

5. What proportion is non-degradable and degradable?
6. What can we do to reduce the quantity of garbage?

II. Households: The garbage generated in our homes is termed domestic waste, while a community's waste is referred to as municipal waste.
1. Classify as kitchen waste, which is degradable, wet waste and non-biodegradable
2. Recyclable home waste which consists of plastic, glass and metal.
3. Observe and document what happens in homes of different economic groups.
4. What happens to your own household waste? Could it be managed better?

III. Agriculture: Agricultural waste consists of biomass including farm residues such as rice husk, straw, bagasse, etc.
1. How to utilize the biomass which could be effectively used for generating power or producing paper.
2. Waste material from fields includes fertilizers and pesticides that are a serious health hazard.

IV. Industries: Industrial solid waste includes material from various industries or mines. Industries produce solid wastes during manufacturing processes.
1. Identify the sources.
2. Identify the chemicals that have serious environmental ill effects, as they are toxic.
3. Visit an industry and ask what are the waste products
4. How they are disposed off.
5. Identify the generated waste during mining is non-biodegradable, it remains in the environment nearly indefinitely.
6. Identify the solid waste is also generated as a result of excavation and construction works.

V. Hospitals:
1. Identify the waste generated from hospitals contains cotton dressing and bandages
2. Blood or other tissue fluids and pus, all of which can contain pathogens like harmful bacteria, fungi and viruses.
3. Used needles, syringes, bottles, plastic bags, operation theatre waste, such as tissues, blood.
4. Plastic disposable equipment all need very careful disposal.
5. The hospital should have a waste separation system at source into biomedical waste, glass, plastics, etc.
6. The biomedical waste can be autoclaved or incinerated so that microorganisms are killed.

PRACTICAL 7: WATER POLLUTION site
Guidelines for study of polluted water sites:

1. Observe if the river/ lake/ tank can be considered unpolluted/ slightly polluted/ moderately polluted or severely polluted by looking at the water and by simple tests using a water monitoring kit.
2. Document the name of the river and the nearby urban or industrial site from where the pollution is generated.
3. Is there urban garbage dumped on the bank?
4. Are there industrial units near the site?
5. Do the industries discharge their wastewater into the site?
6. Is this treated or untreated?
7. What is its colour and odour?
8. Are there any sources of water contamination from the surface runoff from adjacent agricultural land on which fertilizers and pesticides are used?
9. Ask fishermen if this has affected their income.
10. Identify plants, birds and insects found on the banks.

PRACTICAL 8: AIR POLLUTION site

Guidelines for the study of polluted air sites:
Air pollution sites include cities due to traffic congestion in urban centers and industrial areas due to gaseous products released during manufacturing processes.
1. Ask people from the area the effects on their lives.
2. How can this be reduced?
3. How can you make more people aware of this issue?
4. Effects on their health?

PRACTICAL 9: STUDY OF COMMON PLANTS, INSECTS, BIRDS

Guidelines for the study:

To visit a National Park or Sanctuary to see mammals or reptiles, several plants, insects and birds can be seen around an urban or rural setting where there is some vegetation. One needs a little equipment – a note book, preferably a pair of binoculars, field guides to identify species. Field reference books:

1. The book of Indian Animals – S.H. Prater, BNHS
2. The book of Indian Birds – Salim Ali, BNHS
3. The book of Indian Reptiles – J.C. Daniel, BNHS
4. Field Guide to the Common Trees of India – P.V. Bole and Y Vaghani, BNHS
5. CD ROM on The Biodiversity of India – EK Bharucha, Mapin Publishing

A. Plants:

1. Identify and list common plant species at the study site (at least 20; 10 trees, 5 shrubs, 5 herbs).
2. Identify if there are rare species by using a field guide or asking a botanist.
3. Identify and list the types of plants – trees/shrubs/climbers/ground cover – herbs, grasses.
4. Observe their abundance levels.
5. Describe five plant species. Document the characteristic features that help in identification of the selected species: Specific characteristics of leaves/ flowers/ fruit/ seeds.
6. Describe the plant's role in the ecosystem.
7. How is it used and by whom?
8. Is it being collected sustainably or over harvested?
9. Is it common or rare? If rare, why?
10. Is it a keystone species? If so why.

B. Animals:

1. Identify and list all the species you see in the study site.
2. Observe and identify the major features of the common animals and birds in field.
3. Look for and document for each group; insects, birds (mammals if possible) at least 10 species.
4. Role of the species play in nature – producer, herbivore, carnivore, decomposer, pollinator, seed dispersal agent, pest, etc.
5. The level of abundance at the site – Classify as abundant/ common/ rare/ very rare.
6. Watch and document the area unobtrusively to observe all the linkages between the different species and between a species and its habitat.
7. What role does each species play in the food chain and energy pyramid?
8. Observe the habits of selected species such as feeding behaviour, nesting (for birds), and breeding, territorial behaviour, etc. whether abundant, common, uncommon, rare, and endangered.
9. Is it used by people? For what purpose?
10. How can it be protected?

PRACTICAL 10: STUDY OF SIMPLE ECOSYSTEMS

METHODOLOGY:

Field studies to be documented:

> Describe any two ecosystems in the same way - specific forest type, marine, coastal, mangrove delta, lake, cave, etc. that you have visited for documentation of an ecosystem.
> Discuss its abiotic and biotic aspects.
> Describe its common species and their habitats.
> Describe its food chains, food web, food pyramid.
> Discuss its biogeochemical cycles.
> Describe all its habitat characteristics.
> Describe its utilization.
> Discuss its conservation potential.

A. General guidelines on aspects that can be observed and documented during ecosystem field studies:

I. The major questions that must be addressed during a field visit to any ecosystem include:

1. What is the ecosystem called on the basis of its typical features?
2. What are its abiotic and biotic characteristics?
3. Are its goods and services being misused or overused?
4. What are the signs that can be observed of degradation of the ecosystem occurred in the area?
5. Deforestation, pollution of a waterbody, soil erosion, are signs of degraded ecosystems if occurs.
6. How can this degradation process be prevented by sustainable use of the ecosystem's goods and services by changing ones own habits, such as by saving water, electricity, paper etc?
7. How can we all care for our 'mother earth' in our own way?
8. Many small actions together reduce the adverse impacts of human activities on the ecosystems.

II. Observing the Water Cycle:

1. During a monsoon field trip observe the effect of the rain.
2. The type of vegetation is an indicator of the amount of rainfall.
3. Classify the ecosystem: forest / grassland/ semiarid/ desert type on the basis of rainfall.
4. Observe how rain percolates into the subsoil. This recharges ground water, which charges wells, streams and rivers.
5. Document if the rain is eroding the soil. This can be judged by observing if the water is brown in colour. The colour is an indicator of the extent of soil erosion and is darker wherever plant cover has been destroyed. It takes thousands of years for new soil to form.
6. Excessive silt eventually changes the course of the river and leads to flooding of surrounding land.

III. Observing the Carbon Cycle:

Since plants take up carbon dioxide, which we exhale, and split it into carbon and oxygen, which we breathe, we are dependent on the plant life on earth.

Carbon is a component of the food we eat in the form of carbohydrates, which come from plant material. Thus we need plants to give us oxygen and food, without which we cannot survive.

IV. Observing the Oxygen cycle:

While on the field trip focus attention on the amount of green material that plants contain. Without this there would not be enough oxygen for animals to breathe.

Sunlight is essential for plant growth in the water, including microscopic algae and underwater vegetation which is the food producer for all aquatic forms of animal life.

V. Observing the Nitrogen Cycle:

Observe the quantity of dried leaves on the ground in a forest, or the dried leaves of plants planted in the area that have collected as detritus. Ants, beetles and worms that feed on this dead material are breaking it up into small fragments. Microscopic bacteria and fungi are acting on this material to convert it into nutrients for plants to grow.

VI. Observing the Energy Cycle:

Look for the different types of insects and birds in the trees. Birds feed on fruit, insectivorous birds and spiders feed on insects. These form food chains. There are thousands of such food chains in an ecosystem. These inter-linked chains can be depicted in the form of a ‘web of life’.

Observe that in our surroundings there is a great amount of plant material. There is much less animal life in which there are a relatively larger number of herbivores than carnivores, which live on herbivorous animals. Estimate and document the differences in the number of plants, herbivores and carnivores in an area. This can be depicted as a food pyramid.

PRACTICAL 11: Specific ecosystem studies:

A. Objectives of a Field Visit to an Ecosystem:

1. Identify the local landscape pattern in the forest, grassland, desert, river, hills, etc. These are unmodified 'natural' ecosystems.
2. Identify the modified ecosystems such as farmland, grazing land, industrial land and urban land. Compare and contrast natural and intensively used areas.
3. The study site may have a mosaic of landscapes and aquatic ecosystems.
4. Use the observations to create a map of the area and its ecosystems.

B. Document the following:

1. Common plants you see (trees, shrubs, grasses, etc.).
2. Animals observed (mammals, birds, fish, insects, etc.).
3. The natural landscape is beautiful. Describe how you feel about it.
4. The plants and animals have several exciting features that can be 'discovered'.
5. Observe and document their abundance or rarity, their habitat, their behaviour and their links to other species.

Some examples of natural ecosystem: FOREST ECOSYSTEM

Field Visit to a Forest – Depicting the nature of the ecosystem:

1. Visit the nearest or most convenient Reserved Forest, National Park or Wildlife Sanctuary.
2. Meet the Forest Official to explain your study.
3. Check if there is an Interpretation Centre where there may be local information.
4. Ask for brochures or other material. Officials may agree to address a group of students.
5. Observe the forest type. Make notes on the ecosystem.
6. Classify the forest type:

Coniferous, deciduous, evergreen, thorn forest and mangrove are some examples.

7. Interpreting the connection between abiotic and biotic aspects of the ecosystem.
8. Observe differences in vegetation types during the field visit and relate this to abiotic features such as temperature, rainfall, soil and topographic patterns wherever possible.
9. Understanding food chains and food pyramids:
10. Observe the abundance of different species in the ecosystem.
11. Observe which plants are found commonly in the forest. Only a few species are very abundant but there are a large number of less common species of trees, shrubs and climbers and small ground plants that add to the diversity of plant life in any forest.
12. Observe and document the names of animals seen.

13. Classify them as mammals, birds, reptiles, amphibian or insects. Classify these into herbivores and carnivores.
14. Identify the structural levels in a forest:
15. Identify the layers of the forest. Draw profiles of the structure and label the levels.
Ground – trunk – branches – canopy.
16. Document the micro-habitat for species in different levels of the forest:
17. Observe which animal uses different parts of a forest habitat. Some live on the ground among the fallen leaves (worms and insects such as ants, termites and beetles), others live in the middle layer on branches and tree trunks (lizards and woodpeckers), many others live in the canopy of the tree tops, (such as fruit and nectar dependant birds
such as sunbirds, parakeets and mynas. There are insectivorous birds, (flycatchers, drongos and bee eaters) in the canopy. Several insects live under the ground. If one turns over dead leaves on the forest floor there are a large number of animals (millipedes, ants, beetles etc.).
18. Document what you have seen and estimate their abundance at different levels.
19. Observe food chains and interpret the food web.
Field Observation – examples of food chains that are easily seen:

Flower →	□butterflies →□	spiders
Flower →	□sunbirds →□	birds of prey
Fruit →	□parakeet →□	birds of prey
Seeds →	□rodents →□	birds of prey
Flowers →	□bees →□	bee eaters
Seeds →	□munias →□	small carnivorous mammals and birds of prey
Leaves →	□monkey →□	leopard
Grass →	□chital →□	tiger

20. Explaining the detritus cycle:
21. Observe the large number of ants and beetles in the dead leaves fallen on the forest floor. Together they constitute a very large mass of living animals. They thus breakdown an enormous amount of dead plant and animal waste material.
22. See what earthworms, millipedes, ants and beetles do without disturbing them. Insects and earthworms moving on the forest floor are breaking down the detritus so that microscopic fungi and bacteria can recycle this material into nutrients for the forest plants to grow.
23. Look for the larger fungi such as mushrooms and bracket fungi that also do this work. This shows how the cycle works.
24. Interpret the temperature and moisture control functions of the forest:
25. Observe temperature differences under a closed forest canopy and outside in the open.
26. Feel the moisture in the detritus and superficial layers of soil, which can be compared with the dry soil elsewhere.

27. Appreciate species diversity:
28. Make a rough estimate of the number of species of the trees, shrubs and the different plants that form the ground cover. One need not name them all. Appreciate the wide variety of plants in a forest as compared to a mono culture plantation.
29. Identify the most commonly observed trees.
30. Appreciate that there are some rare species of plants. These can become extinct if the forest is cut down.
31. Appreciate abundance of different animal species:
32. How do forests influence the water cycle?
The forest acts as a sponge: Feel the moisture and coolness of the forest air and compare this with the drier and warmer temperature outside the forest cover. A considerable amount of moisture is retained in the dead leaves (humus) of the forest floor.
Dig a small hole in the ground. It is moist and cool under the forest floor. This demonstrates how the forest acts as a sponge and releases water gradually into streams after the monsoon is over.
33. Document the linkages between food chains and processes such as pollination of plants in the forest:
Animals such as monkeys, squirrels and birds feed on leaves, fruits and seeds. Insects such as ants, butterflies and birds such as sunbirds and mynas use flower nectar for food. These flowers have bright colours to attract them. During this process the insects and birds pollinate the plants.
At night when most animals sleep, the bats and moths pollinate flowers. These flowers are usually white in colour so that they can be seen at night.
34. Look for the pollinators – butterflies, moths, beetles, ants and nectar feeding birds are easy to observe.
35. Look for birds that eat berries and fruit and disperse seeds. These include bulbuls, parakeets.
36. Look for birds of prey that complete the food chain.
37. Regeneration: Look for seeds and seedlings growing on the forest floor.
38. Observe that while there are plenty of small seedlings there are fewer saplings as a majority of seedlings die.

PRACTICAL 12: AQUATIC ECOSYSTEMS

Document the nature of aquatic ecosystems:
1. Visit an aquatic ecosystem such as a pond, lake, river or seacoast.
2. Observe if the water is clean or polluted. A simple kit can be used to study water quality.

A. Studies on the ecology of a pond:

1. Make observations on a seasonally active pond if possible on several occasions before, during and after the monsoon. 2. Document the seasonal changes in the plant and animal life.

Example: Guidelines for a write up on a POND ecosystem

A pond is a highly dynamic mini ecosystem. It changes rapidly during the year. To study a pond one should, as far as possible, cover all its phases. A monsoon phase, when the pond changes from a dry to a wet (aquatic) state. It's growing phase, when it is colonized by microflora and fauna and then other forms of macroscopic life. At the height of the monsoon, it is in a mature aquatic phase, which is full of life.

Once the rain stops, the pond begins to shrink. Its periphery becomes dry and is colonised by terrestrial plants

like grasses and herbs. As it shrinks, its aquatic flora and fauna dies, giving place to land flora and fauna. Eventually it may only remain in the form of a ditch or depression containing terrestrial forms and dormant aquatic invertebrates such as insects that must await the next monsoon. This process, when repeated year after year, leads to a silting up of the pond which eventually gets shallower and shallower and in the course of time, gives place to a grassland, scrubland and after many decades to a forest. This is the process of succession.

A. **Observe the pond**:

1. What seasonal stage is it in?
2. What do you expect to occur over the next 3 months, 6 months, 9 months, 12 months?
3. What are the vegetation zones in the pond?
4. What species use the pond as a habitat?
5. Take some water from the pond and examine it under a microscope. What do you see?
6. Describe the pond's periphery – its soil, vegetation, fauna.
7. Describe the pond's floor – its soil, vegetation, fauna.
8. Write a note on the food chains you observe.
9. Observe the vegetation zones at the water's edge:
10. Observe the different zones of vegetation - grasses on the periphery, emergent reeds, floating vegetation and underwater plants in the pond.

11. Seasonal field observations on a pond:
Early stage - soon after the pond fills with water in the monsoon:
12. Observe algae and microscopic animals. These can be observed under the microscope.
13. Fully active phase: Submerged and emergent vegetation – fish, frogs, snails, worms and aquatic insects.
14. Shrinking phase: Drying aquatic plant life with dead and dying plant material and terrestrial plants growing on the exposed mud of the pond.
15. Dry phase: Overgrown with grasses and shrubs with hidden dormant animals in the mud, which cannot be seen.

B. Laboratory exploration:

1. Observe water from the pond in a glass.
2. Document its colour and what it contains.
3. Observe water from a pond under the microscope. There are a large number of algae and zooplankton that form the basic food chains of the aquatic ecosystem.

C. Results and Discussion:

PRACTICAL 13. Observations at a wetland:

1. Visit a Wetland.
2. Observe the varied vegetation zones within the ecosystem.
3. Document and map its vegetation patterns – Underwater/ emergent/ floating/ none.
4. Describe if the water is clean or turbid. Describe the level of algal growth and weeds.
5. What is the nature of its bed – rocky/ sand/ silt/ mud/ mixed (in what proportion?).
6. Develop a map of the aquatic ecosystem vegetation and its relationship to species of aquatic birds.
7. Ask local fishermen to show you their fish catch.
8. Observe the ducks, waders and other birds. These are most abundant in the winter as most of them are migrants from across the Himalayas.

PRACTICAL 14. Observation on a field visit to a beach:

1. Beaches can be sandy, rocky, shell-covered or muddy.
2. On each of these different types, there are several specific species, which have evolved to occupy a separate niche.
3. Observe all the different crustacea such as crabs that make holes in the sand.
4. Observe how the various shore birds feed on their prey by probing into the sand.

PRACTICAL 15: CASE STUDY

CASE STUDY

Sardar Sarovar Project

The World Bank's withdrawal from the Sardar Sarovar Project in India in 1993 was a result of the demands of local people threatened with the loss of their livelihoods and homes in the submergence area. This dam in Gujarat on the Narmada has displaced thousands of tribal folk, whose lives and livelihoods were linked to the river, the forests and their agricultural lands. While they and the fishermen at the estuary have lost their homeland, rich farmers downstream will get water for agriculture. The question is why should the local tribal be made homeless, displaced and relocated to benefit other people? Why should the less fortunate be made to bear the costs of development for better off farmers? It is a question of social and economic equity as well as the enormous environmental losses, including loss of the biological diversity of the inundated forests in the Narmada valley.

CASE STUDY

Israel drip irrigation systems

Israel began using drip irrigation systems as it is short of water. With this technique, farmers have been able to improve the efficiency of irrigation by 95%. Over a 20-year period, Israel's food production doubled without an increase in the use of water for agriculture. In India, some traditional communities in urban and semi urban towns used to grow their own vegetables in backyards on wastewater from their own homes. Calcutta releases its waste water into surrounding lagoons in which fish are reared and the water is used for growing vegetables.

CASE STUDY

Narmada Project

The Narmada Bachao Andolan in India is an example of a movement against large dams. The gigantic Narmada River Project has affected the livelihoods of hundreds of extremely poor forest dwellers. The rich landholders downstream from the Sardar Sarovar dam will derive the maximum economic benefit, whereas the poor tribal people have lost their homes and traditional way of life. The dam will also destroy the livelihood of fishermen at the estuary. The disastrous impact that this project has on the lives of the poor, and the way in which they are being exploited. The controversy over the plan to build several dams on the Narmada River and its tributaries symbolizes the struggle for a just and equitable society in India. The construction of these dams displaces many poor and underprivileged communities, destroying their relatively self-sufficient environmentally sound economy and culture and reducing a proud people to the status of refugees or slum dwellers. The Narmada Bachao Andolan (Save the Narmada Movement) is one of the most dynamic people's movements fighting for the rights of these underprivileged people who are being robbed of their

homes, livelihoods and way of living in the name of 'national interest'. One such dam, the Sardar Sarovar Dam, when completed will drown 37,000 hectares of fertile land and displace 200,000 adivasis and cause incomprehensible loss to the ecology.

CASE STUDY

Selenium – Punjab

In 1981-82, farmers from Hoshirapur and Nawanshehar Districts approached scientists of the Punjab Agricultural University (PAU), Ludhiana, as wheat crops had turned white. Soil analysis indicated selenium (Se) levels in the area were above toxic limits. Se is a naturally occurring trace element, essential for animal and human health, but the gap between requirement and excess is narrow. Soils containing 0.5 microgrammes (ug) of Se per kg or more are injurious to health. In some areas of Punjab, Se levels ranges from 0.31 ug/kg to 4.55ug/kg. Rice cultivation requires the presence of standing water. Being highly soluble, Se dissolves and comes to the surface. The water then evaporates leaving the Se behind.

CASE STUDY

Threats to wetlands in Assam Almost 40% of all wetlands in Assam are under threat. A survey conducted by the Assam Remote Sensing Application Center (ARSAC), Guwahati, and the Space Research Center, Ahemadabad, has revealed that 1367 out of 3513 wetlands in Assam are under severe threat due to invasion of aquatic weeds and several developmental activities. The wetlands of Assam form the greatest potential source of income for the State in terms of fisheries and tourism. Though the wetlands of Assam have the capacity of producing 5,000 tones of fish per hectare per year, around 20,000 tones of fish have to be imported to meet local demands. This is primarily due to poor wetland management.

CASE STUDY

Kailadevi Wildlife Sanctuary – Sawai Madhopur, Rajashtan

While conservation efforts are associated with conflicts between villagers and Forest Officials in most Protected Areas across the country, the Kailadevi Wildlife Sanctuary in Rajasthan has involved local community initiatives for conservation and regeneration. The Sanctuary was initiated in 1983, over 674 sq km forming a part of the 1334 sq km Ranthambore Tiger Reserve. It is located within the Karauli and Sapotra blocks of Sawai Madhopur district. The primary occupation of the predominant Meena and Gujjar communities is pastoralism and subsistence agriculture. Pressures on the sanctuary included migrant grazers known as the Rabaris, who came from the Mewar region of Rajasthan with herds of over 150,000 sheep. Other pressures were from exploitation of timber and fuelwood and mining. The threat poised by the migrant grazers spurred the formation of the "Baragaon ki anchayat" in 1990, which in turn initiated a 'Bhed Bhagao Andolan'. The Forest Department supported the villagers in the formation of Forest Protection Committees and Van Suraksha Samitis.

The benefits of involving local people in protection of their resources were obvious. Illegal felling was checked. The use of forest resources for local use was monitored. The Forest Protection Committees (FPCs) were also successful in stopping the mining in the Sanctuary. Mining is now banned in the Sanctuary. The people not only protect their forests but also use their resources judiciously.

CASE STUDY:

Kokkare Bellure – Karnataka: Co-existence (Man and Wildlife)

The pelican, which is an endangered species breeds in large numbers at Kokkare Bellur which is one of the ten known breeding sites in India. Kokkare Bellure is a village in Karnataka in Southern India. In December every year, hundreds of spot billed pelicans, painted storks, ibis and other birds migrate to this area to establish colonies on the tall tamarind trees in the center of the village. The local people have protected the birds, believing that they bring good luck with regard to rain and crops. The villagers collect a rich supply of the natural fertilizer that collects below the nests – the guano. The droppings of fish-eating birds are rich in nitrates. The owners of the trees inhabited by the birds dig deep pits under the trees, into which the guano falls. Silt from nearby lakes and ponds is mixed with the guano which is used in their fields and sold as fertilizer. They have now planted trees around their homes to encourage nesting.

CASE STUDY

Orissa – Olive Ridley Turtles

Every year at Gahirmatha and two other sites on the Orissa coast, hundreds of thousands of Olive Ridley turtles congregate on the beach, between December and April, for mass nesting. This was the largest nesting site for the Olive Ridleys in the world. In 1999 by the end of March it was estimated that around 200,000 turtles had nested at the Gahirmatha beach. Marine biologists believe that only one out of every 1000 eggs actually matures into an adult. There are severe threats to these nesting sites. Shrinking nesting sites, construction of roads and buildings close to these rookeries, and other infrastructure development projects hamper nesting. Trawler fishing is another large threat to the turtles. After its ‘discovery’ in 1974, the beach was notified as a Sanctuary (the Bhitarkanaika Sanctuary) and was closed for hunting. Recognising the threats to turtles from fishing by large trawlers, the Orissa Marine Fisheries Regulation Act was passed in 1982. This Act prohibits trawling within 10 km of the coastline throughout the state and makes it mandatory for all trawlers to use Turtle Excluder Devices (TEDs). In 2001, the State Government of Orissa declared that a five month period between Januarys to May should constitute a no-fishing season for a distance of 20 km from the coastline. Apart from these initiatives; Operation Kachhapa is being coordinated by the Wildlife Protection Society of India, Delhi and Wildlife Society of Orissa with many local NGOs as partners. The Orissa Forest Department and the Coast Guard are also involved in the Project.

CASE STUDY

Beej Bachao Andolan (Save the Seeds Movement)

This movement began in the Himalayan foothills. 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. Many different varieties are being grown as an outcome of this program in local farmer's fields. This has also been supported by local women's groups who felt these varieties were better than those provided by the green revolution. In contrast, men who were interested in cash returns in a short time found it difficult to appreciate the benefits of growing indigenous varieties

CASE STUDY

Minamata-An important lesson about mercury

A case of human mercury poisoning which occurred about forty years ago in the Minamata bay in Japan taught the world an important lesson about the dangers of mercury poisoning. A large plastics plant located near the Minamata bay used a mercury containing compound in a reaction to produce vinyl chloride a common plastic material. The left over mercury was dumped into the Bay along with other wastes from the plant. Though the mercury was in its less toxic inorganic state when dumped 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 poisoning killing and affecting several people. Mothers who had eaten the contaminated fish gave birth to infants who showed signs of mercury poisoning. Mercury poisoning is thus called Minamata Disease.

CASE STUDY

Mewar, Rajasthan

The Mewar region of Rajasthan has a rich legacy of traditional water harvesting systems to share the available water for cultivation. There are various types of rainwater harvesting systems. Medhbandi: This is a stone embankment built on a hill slope to help create a level field for cultivation. It controls erosion and conserves moisture. Naada/bandha: These are stone check dams across streams or gullies that are constructed to capture runoff on a stretch of fertile land that is submerged in water during the monsoon. The land not only becomes more fertile after trapping silt, but also retains substantial quantities of water in the soil. These dams are constructed in phases over several years. The height is slowly increased up to the right height of the check dam which determines the size of the naada. Hembar: These are small temporary dams constructed with stones, twigs and mud over a seasonal stream when water flows in it is reduced to a point that it cannot be taken directly to the fields for irrigation. Chak: Chak is a big plot of land, usually a charnot or village pasture land, enclosed by a stone boundary wall called kot. Tree plantations, seeding of grass for fodder, contour bunds with trenches and loose stone check dams are developed in the chak. The chak is used for fodder and fuel

wood. It reduces soil erosion and enhances recharge of ground water. Talab: The Mewar region is well-known for its built reservoirs (talabs). Udaipur City is famous for its large number of talabs, and is called the lake city. A small reservoir of less than five bighas is called talai, a medium sized lake is called bandh or talab and a bigger lake is called sagar or samand. Saza kuva: This is an open dug well which has several owners. In Mewari language, saza means partner. This is an important method for irrigation in the ravalli hills. About 70,000 wells in the Udaipur District provide water for 80% of the area under irrigation and provide water for their owners. These are considered common property resources.

CASE STUDY

Pani Panchayat – Pune District, Maharashtra

Mahur village in Pune District of Maharashtra is situated in a drought prone area. People were not able to grow a good crop in most years. Clean drinking water was also scarce. Vilasrao Salunkhe initiated a movement known as Pani Panchayat, to conserve water in this drought prone area. Watershed development was initiated on a barren and uncultivated piece of land belonging to a temple. Conservation of soil and water harvesting through a omprehensive microwatershed management program gradually led to a surplus of water. Out of the 16 hectares of land in the village, 9.6 hectares were brought under irrigation, 2.4 hectares was afforested and 4 hectares was converted into percolation tanks. Wells and field bunds were built. While 200 quintals of grains were produced on 24 acres of Salunkhe's land, 40 acres in the same area yielded only 10 quintals. This made other villagers follow suit. The area rapidly turned green and productive.

CASE STUDY

Chipko movement

About 300 years ago, a ruler in Rajasthan decided to fell 'khejri' trees in his State to create lime. Local women led by a Bishnoi woman, Amrita Devi, clung to the trees to prevent the felling of the trees that formed the basis of the scarce resources on which they were dependent. The women were ruthlessly massacred. It is said that the ruler later realised his mistake. The story however has been remembered and was revived in the 1970s when severe tree felling for timber in the Himalayas prompted local women, supported by people such as Sunderlalji Bahuguna and Chandi Prasad Bhat, led a people's movement to prevent deforestation by timber contractors. They called their movement the 'Chipko' movement in memory of the event during which women had clung to their trees and given up their lives. The movement followed the path the 300 Bishnoi women had taken three centuries ago in Rajasthan. Chipko is a movement primarily begun and supported by local women in the hills of Uttarakhand and Garhwal, where the women have had to bear the brunt of deforestation. They have not only realised that their fuelwood and fodder resources have receded away from their 'resource use areas' around their settlements due to commercial timber extraction, but that this has led to serious floods and loss of precious soil. Chipko activists have made long padyatras across the

Himalayas protesting against deforestation. The movement has been highly successful and has been primarily supported by empowering local women's groups who are the most seriously affected segment of society by deforestation. The movement has proved to the world that the forests of the hills are the life support systems of local communities of immense value in terms of local produce that is essential for the survival of local people and that the forest has less quantifiable but even more important ecological services such as soil conservation and the maintenance of the natural water regime of the whole region. The ability of local women to band themselves together in the foothills of the Himalayas goes back to the pre Independence days when women such as Miraben, a disciple of Gandhiji, moved to this region and understood that it was the deforestation that led to floods and devastation of villages in the valleys and in the Gangetic plains below. They also appreciated that substitutions of oak and other broadleaved forests of the Himalayas by planting fast growing pine for timber and resin was an ecological and social disaster which reduced the forest resources used by traditional hill communities.

CASE STUDY

Silent Valley

The proposed Hydel project at Silent valley, a unique pocket of tropical biodiversity in South India, in the 1970s was stopped and the area declared a National Park in 1984. This was achieved by several dedicated individuals, groups and organisations lobbying to save the area from being submerged and protect its rich biodiversity.

CASE STUDY

Bhopal Gas Tragedy

The siting of industry and relatively poor regulatory controls leads to ill health in the urban centers. Accidents such as the Bhopal gas tragedy in 1984 where Union Carbide's plant accidentally released 30 tones of methyl isocyanate, used in the manufacture of pesticides, led to 3,330 deaths and 1.5 lakh injuries to people living in the area.

CASE STUDIES

Arsenic poisoning – Bangladesh

More than half the population of Bangladesh is threatened by high levels of arsenic found in drinking water. This could eventually lead to an epidemic of cancers and other fatal diseases. Rezaul Morol, a young Bangladeshi man, nearly died from arsenic poisoning caused by drinking arsenic-laden well-water for several years. The doctor advised Rezaul to stop drinking contaminated water and eat more protein-rich food such as fish. Since then Rezaul feels a lot better and is happy that his skin is healing.

CASE STUDY

Nuclear disasters and leakages

In 1986 the Nuclear Power Station at Chernobyl in USSR developed a problem that led to a fire and a number of explosions in its Nuclear Reactor. The radioactive dust spread over many kilometers and covered not only Europe but North America as well. Three people died in the explosion and 28 shortly after due to radiation exposure. Some 259 sick were hospitalized. As the area had to be evacuated 1,35,000 people had to be moved immediately and another 1.5 lac by 1991. As radioactive fall out continued even more people had to be moved. An estimated 6.5 lakh people may have been seriously affected. They may get cancer, thyroid tumours, and cataracts, and suffer from a lowered immune mechanism. As radioactivity passes from grass to herbivores, sheep in Scotland and Reindeer in Lapland were affected and were unfit for human consumption. Vegetable, fruit and milk were contaminated in Europe. A French Nuclear Waste Processing Center in Normandy may have affected the lives of children playing nearby. They may develop leukemia (blood cancer) in later life.

ANNEXURE I

REQUST FOR STUDY TOUR / INDUSTRIAL VISIT

1. Branch and Semester :

2. Nature of tour :

3. Places or Industries planned to visit :

4. Proposed dates of tour or visit :

5. Mode of journey :

6. Total number of students in class :

7. Total number of attending students :

(Attach students list as per Annexure III)

a. Number of Boys :

b. Number of Girls :

8. Details of accompanying Faculty members :

Sl. No.	Name	Designation	Department	Signature
1				
2				
3				

9. Details of Industry from which permission obtained: (Attach copy of permission letter)

i) Industry 1:

ii) Industry 2:

10. Total number of days :

Signature of Class Representatives/Tour coordinators

1. Name……. Signature……..

2. Name……..Signature……..

Place :
Date :

ANNEXURE II

PARENT /GUARDIAN CONSENT LETTER FOR STUDY TOUR / INDUSTRIAL VISIT

I, …… Parent/Guardian of…… do hereby give my consent to my son/daughter the for study tour/industrial visit to ……. from…..……to…..……(….days) along with faculty members. During journey, I assure you that he/she will abide the rules and regulations stipulated by the faculty members and college tour manual. I understand that the college authorities will not be held responsible for any untoward incidents may occur during the journey.

Name of Student :
Contact No. :
Signature :

Name of Parent / Guardian :
Contact No. :
Signature:

ANNEXURE III

PARTICULARS OF STUDENTS AND PARENTS

Sl. No.	UID. No.	Name of Student	Mob. no.	Name of Parent	Contact no.	Remarks
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

ANNEXURE IV

Questionnaire as per objectives of industrial visit (listed above)

ANNEXURE V

CERTIFICATE

TO WHOMSOEVER IT MAY CONCERN

This is to certify that …… of …… stream and …… semester is permitted to undergo the specified tour to …… from ….. ……to ……..….. (…….) days; as per the college/ university norms and college tour manual in order to meet mandate course curriculum requirements for the Bachelors' degree.

Place: PRINCIPAL
Date: (College seal)