

UNIT



Exemplar Projects

Environmental awareness is best acquired by reading the book of nature, through live contact with the world around us. Science has developed an effective methodology for deciphering this book, for asking ever more meaningful questions, for acquiring deeper and deeper understanding of nature. What constitutes such scientific activity? Moore (1993) provides a succinct description:

1. A science must be based on data collected in the field or laboratory by observation or experiment, without invoking supernatural factors.
2. Data must be collected to answer questions, and observations must be made to strengthen or refute conjectures.
3. Objective methods must be employed in order to minimise any possible bias.
4. Hypotheses must be consistent with the observations and be compatible with the general conceptual framework.
5. All hypotheses must be tested, and, if possible, competing hypotheses must be developed, and their degree of validity (problem-solving capacity) must be compared.
6. Generalisations must be universally valid within the domain of the particular science. Unique events must be explicable without invoking supernatural factors.
7. In order to eliminate the possibility of an error, a fact or discovery must be fully accepted only if (repeatedly) confirmed by other investigators.

8. Science is characterised by the steady improvement of scientific theories, by the replacement of faulty or incomplete theories, and by the solution of previously puzzling problems.

Thus at the core of all scientific activity is the “hypothetico-deductive” method. Science progresses by setting up testable hypotheses. In other words, every scientific hypothesis must be accompanied by a statement of how to make observations that would lead to either its acceptance or rejection. If accepted, it strengthens our belief in the validity of the underlying model of the working of the world on which the hypothesis is based. If rejected, it suggests that we must make some appropriate changes in the underlying model. In either case, of acceptance, or rejection, we can come up with further, newer hypotheses to be tested. It is this cycle of generating testable hypotheses on the basis of our understanding of how nature works, of adding to this understanding as any hypothesis is either accepted or rejected, and then coming up with further testable hypotheses, which is at the heart of science. It is science’s insistence that

- (a) all hypotheses must be testable,
- (b) that the tests should be performed with due care,
- (c) that the results of the test feed back into deepening our understanding of underlying processes, and
- (d) help generate further testable hypotheses, that is responsible for the remarkable success of science in augmenting the stock of human knowledge.

Testing any scientific hypothesis requires observations under a variety of conditions. Such variation may be created through human manipulation – this is the experimental method, or by taking advantage of natural variation – this is the comparative method. Hypotheses dealing with simpler systems can often be tested experimentally. Such a simple hypothesis may be that a growing seedling bends towards light. The hypothesis can be tested by growing several seedlings and exposing them to light coming from different directions and recording how they grow. Much of physics, chemistry, and physiology progresses by such use of experimental methods.

In the study of more complex systems, such as meteorology, ecology, or evolutionary biology,

many interesting hypotheses cannot be subjected to an appropriate experimental test. For instance, evolutionary theory suggests that the extent to which males and females differ from each other in size and appearance increases with the level of competition for mates. It is not readily possible to experimentally manipulate the parameters to test this hypothesis. However, there are groups of animals in which the males pair with one or more females. In several species of sparrows, for instance, a male pairs with a single female at a time, whereas in related weaver birds, a male pairs with several females during a single nesting season. One may then hypothesise that weaver birds would exhibit a greater degree of difference between males and females than the sparrows. This hypothesis may be tested by measuring incidence of bright or dull colouration in male and female sparrows and weaver birds. This is the comparative method—that of taking advantage of natural experiments.

Currently, the projects undertaken in environmental awareness courses tend to be descriptive, for instance, a listing of the bird species in a locality, or recording the manner in which drinking water is obtained in a village. This systematic recording of information is, of course, a useful exercise. It will be our endeavour, however, to go beyond this and relate such information collection to a variety of specific hypotheses. This would locate the observations in the context of some patterns in the world that one expects to obtain because of the operation of some processes. Invoking such possible patterns or processes greatly adds to the interest in making the necessary observations on part of the students. While presenting the various hypotheses, it is appropriate to explain the rationale, or scientific understanding behind each hypothesis, thereby contributing to building up their disciplinary knowledge. Furthermore, this approach helps acquaint students with how science, the most effective method of adding to human knowledge, works. Hence, each project will be presented in the form of a testable hypothesis, accompanied by an explanation of the rationale, a statement of the methodology, and suggestions for follow up. Here we provide such a write up for 30 projects, followed by hypotheses relating to another 37 projects.

(1) Pet vs. Stray Dog Densities

Hypothesis: Ratio of pet to stray dogs increases with density of houses.

Rationale: Dog is the first animal domesticated by man and today exists over much of India in goodish numbers, both as pets maintained by particular households and as strays subsisting on garbage and other food sources associated with human habitation. There has been a programme of reducing the number of stray dogs through sterilisations. However no data is available on both stray and pet dogs and their relative numbers. One may hypothesise that as density of housing increases, the resource availability for stray dogs does not increase, although the proportion of households maintaining pet dogs remains the same so that there are relatively more pet dogs.

Methodology: There are several possible approaches to collection of the relevant data. One may explore availability of such data with the Municipal Corporation, ideally ward by ward. The Municipal Corporation could also provide data on density of houses in different wards. It is however unlikely that much accurate data on dogs will be available from this source. It would therefore be better to undertake direct field observations or to interview people. Field observations on stray dogs may involve (a) identification of sources of food such as garbage dumps, followed by (b) counting of dogs at such food sources. Pet dog numbers may be estimated by counting on roads in early mornings or evenings when the dogs are taken out for walks, or by interviewing people from randomly selected households.

Follow up: One may study the ecology of stray dogs in terms of their food and foraging behaviour, movement patterns, breeding success. One may identify ways of eliminating their access to food or of increasing the success of sterilisation drives.

(2) Stray Dog Populations

Hypothesis: Number of stray dogs has decreased over the past five years.

Rationale: A new regime of management of stray dogs involving sterilisation has been instituted in the country over last few years. There are no quantitative studies to document its efficacy, although it may be expected that it has led to a decrease in stray dog populations. It is useful to begin to document the situation.

Methodology: Since no baseline data is available, the information has to be generated through interviews of individuals who would have no vested interest in reporting either increase or decrease in the number of stray dogs. Workers involved in handling garbage, and rag-pickers making a living from recycling it may be particularly well informed about stray dog populations. Autorikshaw drivers may also have good information. It would be best to interview such people individually, without asking any leading questions. Stray dogs should no longer be breeding if the sterilisation programme is successful. Therefore, questions may be asked about numbers of adult dogs as well as the extent of breeding success. The information may be compiled with reference to specific localities.

Follow up: It might be useful to get information on various agencies involved and the programmes of catching, sterilisation and release of sterilised dogs.

(3) Gender Differences in Knowledge of Biodiversity

Hypothesis: Women can name more avenue tree species correctly than men.

Rationale: There have been few careful studies of people's knowledge of the living organisms in their environment. It has been suggested that women tend to have a greater interest in the natural world, or that younger people are increasingly less knowledgeable about the living world actually encountered by them. It would be worthwhile documenting the relevant facts.

Methodology: Locate well grown avenue trees of twenty different species. Make sure of the correct scientific name as well as local names in commonly spoken languages. Interview 100 men and women each with similar social, economic, educational background, not in a group, but individually as to the names of as many as possible of the selected trees. Assign these to categories of correct identification, wrong identification, and do not know. Test the hypothesis that women can name more avenue tree species correctly than men.

Follow up: Collect more information about the interviewees such as age, educational background, whether brought up in urban or rural areas, duration of stay in the locality, etc., and study how these relate to their knowledge.

(4) Educational Background and Knowledge of Biodiversity

Hypothesis: Science students can name more avenue tree species correctly than non-science college students.

Rationale: There have been few careful studies of people's knowledge of the living organisms in their environment. However, a scientific education may be expected to create an interest in the natural world, and therefore students with science background may be more knowledgeable about trees that they see.

Methodology: As in the project 21, on gender differences in knowledge of living organisms, locate well grown avenue trees of twenty different species. Make sure of the correct scientific name as well as local names in commonly spoken languages. Interview 100 science and 100 non-science students, not in a group, but individually as to the names of as many as possible of the selected trees. Assign these to categories of correct identification, wrong identification, and do not know. Test the hypothesis that science students can name more avenue tree species correctly than non-science students.

Follow up: Undertake finer analysis, for instance, if biology students are more knowledgeable than physics students, or science teachers more than language teachers.

(5) Fish/Molluscan Diversity in relation to Pollution

Hypothesis: Fish/ molluscan species diversity is significantly higher in waters with lower levels of nutrient contents.

Rationale: There are many hypotheses as to what governs the level of diversity of species of some given group of organisms such as plants, fish or reptiles in any locality. More productive and more stable environments are expected to support higher levels of diversity. Similarly, environments where the communities have evolved over long periods are also expected to support higher levels of diversity. Any recent drastic change is likely to reduce the levels of diversity because few species would have had a chance to evolve so as to adapt to these conditions. In case of many freshwater bodies, recent decades have witnessed a huge increase

in nutrient content, in particular because of discharge of sewage from towns and cities or of fertilisers from tracts of intensive agriculture. This leads to blooms of some algal species and conditions under which few fish/ molluscan species can thrive. As a result one expects lower levels of fish/ molluscan diversity in waters with high levels of nutrients.

Methodology: Many rivers would exhibit much higher levels of nutrients downstream of areas of sewage discharge. Thus Mutha and Mula rivers will have low nutrient levels in stretches closer to their origin near crestline of Western Ghats, and much higher levels in stretches passing through Pune city. One may select several such points for comparison. Throughout its entire extent river fishes are caught by members of Bhoi community. These should be contacted and with their help fish caught in any particular locality documented. This documentation could be in terms of their local names and careful photography by digital camera. If needed specimens may also be purchased from the fishermen. Alternatively, molluscan species can be sampled on the basis of an all-out search by a certain number of investigators over a certain time period. Simultaneously water samples should be collected and analysed for N and P content and opacity. One may then plot N, P, opacity and number of fish species recorded to test whether the latter declines with increasing N and P content and opacity.

Follow up: It would be interesting to see the extent to which N and P content and opacity are correlated amongst each other and the relative extent to which these variables explain the changes in fish diversity. One may investigate attributes of fish/ molluscan species that are tolerant of high levels of nutrient loading.

(6) Decline in Bamboo Densities Over Time

Hypothesis: Bamboo densities have declined more rapidly over time than densities of tree species not in commercial use.

Rationale: There has been an overharvest of many tree species in commercial use. Hence their densities are likely to be reducing more rapidly.

Methodology: In any specific locality, interview people on (a) tree species known to them, (b) uses of each species, and (c) trends in change in abundance of the various species.

Follow up: Undertake similar studies on fish species in local rivers or lakes.

(7) School Paper Use and Economic Status

Hypothesis: The use of paper per student in the schools increases with the fee charged to the students.

Rationale: Different socio-economic classes make very different and variable levels of demands on resources, and thereby have different levels of environmental impacts. It is necessary to appreciate and document this fact. Paper use is one form of demand on resources; fee charged by the school is an index of the social and economic stratum to which the students belong.

Methodology: This could be pursued as a collaborative study by students from 3-4 different schools. These may represent schools with very different levels of fees. The students may then document the amount of paper used by them for notebooks, books, projects etc. They may also monitor the wastepaper baskets in the classrooms and offices, reading rooms, library, and note the amount being thrown as waste.

Follow up: Similar studies could be undertaken on the amount of water, electricity etc. being used per student in different schools.

(8) Economic Status and Forest related Concerns

Hypothesis: Landless labourers rank depletion of bamboo from forests as a matter of greater concern than landowning cultivators do.

Rationale: People harbour different kinds of and different levels of environmental concerns, strongly related to how these affect the quality of their lives. Thus city dwellers are more likely to be concerned with traffic congestion, while agriculturists with depletion of ground water. Rural poor who depend on forest resources for their energy and house construction needs would have a greater level of concern for depletion of forest resources, while landowning cultivators would derive many of these resources from agricultural by-products.

Methodology: Select a sample of about 100 people representing different socio-economic strata and livelihood activities. Ask them to rank amongst a set of environmental concerns such as (1) depletion of bamboo resources, (2) depletion of firewood resources, (3) depletion

of fodder resources, (4) lowering of underground water table, (5) local extinction of many wildlife species. (6) river water pollution, (7) traffic congestion, (8) global warming, and so on. The list may be prepared after a preliminary discussion with a cross-section of local people about the environmental issues that concern them.

Follow up: Analyse the data so collected to understand how factors like age and gender affect environmental concerns.

(9) Computers and Resource Use

Hypothesis: Paper consumption has declined in bank branches following computerisation.

Rationale: The ever escalating scale of human resource use is the root cause of environmental problems today. It is therefore, important to aim at reducing the amount of resources needed to obtain a given level of services. Computerisation and other modern Information and Communication Technologies are expected to make a major contribution in this context. It is important to assess whether, in fact, this is happening.

Methodology: Study the records of bank branches where computerisation is yet to take place, or where it has taken place relatively recently. From these records estimate the actual amount of paper purchased, or, if this is not available, the amount of money spent on paper purchase. The expense figures will have to be adjusted for inflation. Ideally one should have for comparison at least 20 data sets each, without and with computerisation, on paper consumption per year in a branch, normalised by taking into account the number of cheques processed by the bank branch per year.

Follow up: Carry out a similar analysis in the context of the functioning of the school office.

(10) Resource Catchments of Markets

Hypothesis: Fruit purchased from malls come from significantly greater distances than the fruit from fruit-stalls in the market.

Rationale: People use resources drawn from varying distances. Many poor rural households subsist on resources collected with their own labour from their surroundings. On the other hand the urban well-off have access to resources brought from far off through state sponsored schemes, e.g., for drinking water, and

increasingly through markets. The shopping malls, in particular, bring in materials from greater and greater distances. This is true even of perishable goods such as fresh fruit. This phenomenon has important implications for resource use intensity, and in turn, impacts on environment.

Methodology: Select a sample, 10 of each, of three kinds of fruit shops; namely, pavement vendors, stalls in old city markets and modern shopping malls. Interview the sellers/ managers as to source of fruit. With the help of maps and literature ascertain the distances involved. Thus *jamun* often comes from private gardens within a few kilometers, apples may come from hundreds of kilometers away from Himachal Pradesh, while kiwi fruit may come from as far away as New Zealand. Plot on a map the resource catchments of the three types of fruit sellers.

Follow up: Estimate the levels of energy consumption involved in transporting fruit from various distances, and thereby contribution to global warming of consuming fruit from different sources.

(11) Waste of Food and Economic Status

Hypothesis: Per capita production of kitchen waste in households is proportional to the average Ponderal Index (weight/height³) of the household members.

Rationale: Human demand on resources is in part governed by the level of wastefulness of resource use. One form of wasteful resource use, namely, excessive intake of food is associated with obesity. Ponderal Index increases with obesity. Hence, one may expect the two to be correlated.

Methodology: Select about 50 households who would be willing to participate in a study of solid waste generation. To ensure comparability these households should not include any pets or non-family members. Ensure that they separate wet or organic waste from dry waste. Weigh both the wet and dry waste generated for 10 consecutive days. Divide this by the number of family members. Take the height and weight of all family members, and calculate the median Ponderal Index. Study the correlation between daily per capita wet waste production and median PI.

Follow up: Study and interpret the variation in Ponderal Index amongst members of a family. Study the correlation

between generation of dry and wet waste. Estimate how much compost manure/biogas could be produced from such kitchen waste.

(12) Gender and Health Concern

Hypothesis: Boys have a lower level of knowledge than girls of the vitamin content of the common foods consumed in the locality.

Rationale: Women and girls are believed to have a greater level of concern for the health of their family members. They also tend to be more responsible for planning of family meals. If this is so, school or college going girls may be expected to learn more than boys about the nutritional value of common food items consumed at home.

Methodology: Select a sample of 25 boys and 25 girls with similar socio-economic background from XI – XII standards. In a group interview prepare a list of food items commonly consumed in their households. Such a list may include rice, banana, milk, *tur dal*, tamarind, tomato, onion, egg and so on. From literature, or by consulting a nutrition laboratory, ascertain the vitamin content of these foods. Administer a well designed multiple choice questionnaire to assess the knowledge of the participants.

Follow up: Do a similar study on mineral content of the foods.

(13) Domestic Energy use Patterns

Hypothesis: Amount of energy consumed in preparation of the food at home exceeds the energy content of the prepared food.

Rationale: Primitive man's primary demand for energy is food. Additional energy demands came into play when food began to be cooked. Today it is also processed by the use of blenders/grinders etc. It is worthwhile understanding the relative magnitude of these components of energy use.

Methodology: Select a sample of ten households. Make a list of all kitchen appliances and the amount of time per day that they are, on average, in use. With inputs from Engineers and other experts make an estimate of the energy consumption that this entails. Estimate the calorific value of the basic ingredients that go into making of the food in the household. Compare the values of the energy contents of food and that is consumed in preparing it.

Follow up: Find out about lifecycles of kitchen appliances and energy that goes into producing them. Make an appropriate correction to the energy consumed in preparing food by adding this component.

(14) Health and Waste Disposal

Hypothesis: Residents close to solid waste disposal sites suffer from a higher level of gastro-intestinal disorders.

Rationale: Modern societies generate large quantities of waste that have to be either dispersed, as with sewage discharged into rivers, or sequestered as with solid waste landfill sites. Inevitably some people have to stay in the vicinity of sites where concentrations of wastes build up, such as near solid waste disposal sites on the outskirts of cities these people may be at health risks, for instance, through some waste products leaching into their water supply. Consequently, they may exhibit greater incidence of health disorders.

Methodology: Select for comparison two localities: one close to a city solid waste disposal site, and another one of similar socio-economic status, but far away from any solid waste disposal site. Select 25 households in each locality of people who would be willing to maintain a record of health or sickness of their family members. Design a diary for maintaining such a record in consultation with faculty members of a Social and Preventive Medicine department in a local medical college. Compare the health records of people in the two localities with respect to incidence of gastro-intestinal diseases.

Follow up: Compare the drinking water supplied in the two localities with respect to their microbial content. Do similar studies on respiratory disorders in two localities, one downwind of an air polluting industry, and another free from air pollution.

(15) Feeding Ecology of Stray Dogs

Hypothesis: Stray dogs obtain a greater proportion of their food from garbage dumps than direct feeding by dog lovers.

Rationale: Increasing populations of stray dogs have become a serious environmental concern in many parts of the country. However, really very little is understood of their numbers, how they sustain themselves, the extent to which sterilisation of these dogs is effective in bringing their numbers under check, and so on. Such information

will begin to be generated if students begin to investigate different facets of their ecology. An important aspect is where they obtain their food, and the role played by lovers of stray dogs in providing food.

Methodology: Locate about 20 stray dogs in one or more groups. Note the size, colour, and body markings of the various individuals so that they can be individually identified and followed. With students taking turns in shifts, observe them for three full days, compiling a time-activity budget, and recording their movements. Record in detail all activities related to search of food, competition over food, and actual feeding. Note the source, the nature of food, the time of feeding, and the duration of feeding.

Follow up: Contact members of city corporation entrusted with the responsibility of controlling dog population, members of dog catching squad, veterinarians entrusted with sterilisation and compile available information on stray dogs and changes in their numbers and ecology over time.

(16) Social Distribution of Global Environmental Concerns

Hypothesis: Global warming figures more prominently in discussions in English language than in Indian language press.

Rationale: Different segments of society have different environmental concerns depending on how different factors affect their quality of life. The Indian language press caters more to rural, farming and working class audiences. The English language press caters more to wealthier, urban audiences, many of whose relatives are settled abroad. Global warming does not immediately impinge on the quality of people's lives. At the same time, it is a hot issue in Western countries. It is therefore more likely to be dealt with in English language press.

Methodology: Select three English language and three Indian language newspapers with wide circulation in your locality. Visit the offices of these newspapers and carefully scan all the issues of previous three months. Note all references to environmental issues including global warming, the page on which these are covered, and the amount of space devoted to these items. Compare the coverage of global warming in English and Indian language newspapers.

Follow up: Analyse the overall coverage of environmental issues, ranking the various concerns. How similar or dissimilar different papers are in their coverage? What are the major gaps in the coverage?

(17) Signature of Global Warming

Hypothesis: A comparison of maximum monthly temperature for the last five years as compared to previous five years shows an increasing trend.

Rationale: Substantial scientific evidence is now emerging that the earth is getting warmer. Since temperature keeps fluctuating over a day and over seasons, evidence for such warming is to be sought in long term averages. The India Meteorology Department maintains records of mean monthly temperature for thousands of stations in the country. Trends over years in this parameter should furnish evidence of possible global warming trend.

Methodology: Obtain mean monthly temperature figures for last five years for a number of cities. Compare the series for a given city for a given month, e.g., for the month of February for Ludhiana. The change from one year to the next, e.g., February 2003 to February 2004 may be an increase or +, or a decrease or -. A five year series would provide 4 such signs; thus ++++ would denote a continuous rise over the 5 year period. Records for any given city would then provide a series of $12 \times 4 = 48$ signs of + or -. If global warming is taking place, + should be significantly more common.

Follow up: Do a similar analysis for daily minimum and maximum temperatures of the hottest and coldest months of the year.

(18) Occupation and Concern Over Coastal Pollution

Hypothesis: Fishermen have a higher level of concern about oil spills than non-fishermen from the locality.

Rationale: People harbour different kinds of and different levels of environmental concerns, strongly related to how these affect the quality of their lives. Thus city dwellers are more likely to be concerned with traffic congestion, while agriculturists with depletion of ground water. Fishing communities who depend on marine resources for their livelihoods would have a greater level of concern for coastal pollution.

Methodology: Select a sample of about 100 people representing different socio-economic strata and livelihood activities. Ask them to rank amongst a set of environmental concerns such as (1) depletion of fishery resources, (2) oil spills in the sea (3) depletion of fodder resources, (4) lowering of underground water table, (5) local extinction of many wildlife species. (6) river water pollution, (7) traffic congestion, (8) global warming, and so on. The list may be prepared after a preliminary discussion with a cross-section of local people about the environmental issues that concern them.

Follow up: Interview members of marine fishing community and coastal hotel owners about the manifold impacts of oil spills.

(19) Water Treatment and Health Status

Hypothesis: Incidence of gastro-intestinal diseases in household members decreases with greater technological inputs in its drinking water supply.

Rationale: Water sources may be ranked in terms of increasing technological inputs in the following order: pond, lake, stream, river, open well, bore well, piped water supply, water treated through an aquaguard type of system, bottled water like Bisleri. One of the aims of these technological inputs is to reduce the microbial content, especially in terms of organisms that constitute a health hazard, and thereby improve the health status of consumers. It is important to assess whether in fact this objective is fulfilled.

Methodology: Select for comparison 25 households of people using different kinds of drinking water sources who would be willing to maintain a record of health or sickness in their family members. Design a diary for maintaining such a record in consultation with faculty members of a Social and Preventive Medicine department in a local medical college. Compare the health records of people using different kinds of drinking water sources with respect to incidence of gastro-intestinal diseases.

Follow up: Assess whether overall susceptibility to diseases is positively correlated with incidence of gastro-intestinal diseases. Conduct in depth interviews of a few selected households to assess whether factors other than the source of drinking water such as diet and exercise may be impinging on the health status.

(20) Water Treatment and Economic Status

Hypothesis: Per capita floor space available to members of the household increases with greater technological inputs in its drinking water supply.

Rationale: It is important to assess whether poorer people are at a disadvantage in terms of the quality of drinking water available to them, and thereby in terms of overall health status. Per capita floor space available to members of the household is a good measure of the economic status. Hence one may expect a correlation amongst these two variables.

Methodology: Water sources may be ranked in terms of increasing technological inputs in the following order: pond, lake, stream, river, open well, bore well, piped water supply, water treated through an aquaguard type of system, bottled water like Bisleri. Select for comparison 100 households of people using different kinds of drinking water sources. Estimate the per capita floor space available to members of the sample households. Examine the correlation amongst these two variables.

Follow up: Conduct in depth interviews of a few selected households to assess whether they differ in factors such as diet and exercise that may be impinging on the health status.

(21) Understanding of Water Quality

Hypothesis: There is better information available on microbial status than the content of pesticides of drinking water.

Rationale: Very limited information is available on many aspects of water quality, including pesticide pollution. It would be worthwhile to document the extent of information available on the whole range of parameters of possible interest.

Methodology: By consulting literature and experts compile a list of the whole range of parameters relating to water quality. Approach the city Water Supply Board, Pollution Control Board, various industries operating effluent treatment plants, and Research and Academic organisations to ascertain the extent to which information is available on these various parameters. Verify that very little information is available on pesticide levels.

Follow up: Apply to private industry operating effluent treatment plants for data on level of various

pollutants in their effluents under the Right to Information Act. Document the whole experience, regardless of whether the attempt to obtain information is successful or not.

(22) Floods and Health Status

Hypothesis: The incidence of gastro-intestinal diseases increases significantly following the overflowing of the river in the locality.

Rationale: Many environmental disasters have adverse influence on human health. Floods may lead to a mixing of sewage water with drinking water and lead to an increase in the incidence of gastro-intestinal diseases.

Methodology: Select a locality regularly affected by the overflowing of some river. Select 50 households of people who would be willing to maintain a record of health or sickness in their family members. Design a diary for maintaining such a record in consultation with faculty members of a Social and Preventive Medicine department in a local medical college. Compare the health records of people before and following the overflowing of the river in the locality with respect to incidence of gastro-intestinal diseases. Does the incidence increase significantly following the floods?

Follow up: Compare the drinking water supplied in the localities with respect to their microbial content prior to and following the overflowing of the river.

(23) Economic Status and Organic Farming

Hypothesis: Organic farming may be categorised as by design or by default. In case of organic farming by design, the organic farmers have significantly larger landholdings than those practicing non-organic farming.

Rationale: Intensive chemicalised farming has a number of adverse environmental impacts. It is important to document the conditions under which farmers switch to organic methods.

Methodology: Organic farmers may be divided into two categories: (1) Firstly, those who have never practiced intensive farming. These tend to be smallholders in relatively remote, often tribal, areas. (2) Our interest here is on study of the second category, of farmers who have deliberately shifted to organic farming from

earlier practice of intensive farming. Such farmers may be identified with the help of various organic farmers' federations. Select a district which has fair numbers of organic farmers. Select at random 25 organic farmers, along with 50 non-organic farmers with farm immediately adjacent to their farms for further study. Record the sizes of their landholdings.

Follow up: Interview the organic farmers as to what motivated them to make a switchover.

(24) House Compound Fruit Trees

Hypothesis: Slum areas have a greater diversity of fruiting trees than private gardens in other localities.

Rationale: People in slum areas are more motivated to use whatever little area they have to plant trees of direct use to them. People living in better off localities are not so motivated, and tend to favour ornamental plants. Hence, one expects a greater proportion of fruit trees around slums.

Methodology: Select 3 slum and 3 non-slum localities, locate and note the local names of 200 trees in a randomly selected compact block in each locality. Compile an overall list of all species noted and their uses such as fruit, ornamental flowers, worship of gods and so on. Test whether slum areas have a greater diversity of fruiting trees than private gardens in other localities.

Follow up: Interview selected residents of the study localities as to reasons behind the choice of trees to be planted.

(25) Man–Wildlife Conflict

Hypothesis: Over time there has been a significant trend towards quicker settlement of claims relating to wild life damage.

Rationale: A very significant number of Indians live on fringes of wild life sanctuaries, national parks and other areas rich in wild animals. Other wild animals, including monkeys live amidst human settlements. The wild animal populations have increased in many cases with effective protection, so have human populations and their demands. This has resulted in growing human wildlife conflict. In response, the wildlife protection agencies have improved their redressal, including payment of compensation for wildlife damage. It is useful to document how far this has been successful.

Methodology: This study should focus on regions where there is a known history of wildlife damage and its compensation by the Forest Department. In such an area, the study should tap two kinds of sources of information, namely, official records and interviews of people affected. Thus one may select for study the cases of crop damage and killing of people by elephants in Kanakapura Forest Division south of Bangalore. The records of this Forest Division over last ten years may be examined, if necessary by using an RTI application, as to (1) date on which damage occurred, (2) date on which a claim was filed, and (3) date on which compensation was paid. In parallel, interview groups of people as to their experiences in this regard over the last ten years. Such group interviews could be effectively organised by taking advantage of scheduled meetings of Women's Self Helps Groups, or Gram Sabha meetings.

Follow up: In a region of acute man-wildlife conflict, conduct a study of all forms of wildlife damage, the official system of reporting the damage, assessing the damage and payment of compensation. Analyse where the system could be made more efficient, while reducing the scope for corruption.

(26) Tree Survival and Religious Protection

Hypothesis: Largest sized trees in any locality are significantly more likely to be associated with religious sentiments than be maintained as ornamental trees.

Rationale: Both rural and urban habitations throughout India have some tree cover, as trees in house yards, public parks, near temples and other institutions, along avenues and so on. Two of the commonest reasons for protection of such trees is because of their showy flowers, e.g., gulmohar, or because they are considered sacred, e.g., banyan or peepal. It is of interest to find out which of these is more effective in ensuring that the trees are allowed to grow large.

Methodology: Girth at breast height, namely, 1.4 metres is a standard measure of the size of a tree, and may be used for the purpose of this study. Select a village, or a city ward and make a list of the most significant tree species occurring in the area and the motivation behind planting them. Locate the 25 largest trees and measure their girth. Test whether sacred trees tend to be larger than ornamental trees.

Follow up: Interview people about the largest trees of the locality that have been cut over the last 2 years, their names and whether they included sacred/ornamental trees.

(27) Landholding and Use of Fire Wood

Hypothesis: Use of firewood, rather than crop wastes or commercial fuel such as LPG gas, for cooking declines with an increase in the size of agricultural landholding.

Rationale: This hypothesis is pertinent to rural areas where relatively poor families extensively use firewood collected with their own labour, often from wastelands, for cooking. Agricultural wastes, also an important source of fuel for cooking, are much more accessible to landowners. Hence, the use of firewood for cooking is expected to decline with an increase in the size of agricultural landholding.

Methodology: This hypothesis is pertinent to regions where a significant proportion of people are involved in agriculture. Select for such a study 25 households of landless agricultural labourers, 25 households of smallholders, 25 households with medium land holdings and 25 households with large land holdings. The definitions of marginal, medium and large landholdings should be based on the local pattern of landholding, with roughly one-third households allocated to each category. Members of these households should be interviewed as to the relative importance of various sources of cooking energy, employed during the previous one week. These may be classified as: (1) fire wood collected from forest or scrubland or roadside trees, (2) waste from tree crops like coconut leaf rachis (3) crop waste such as stems of pigeon pea (4) wood charcoal (5) coal (6) LPG gas (7) electricity and so on.

The expectation to be tested is that the relative importance of source - fire wood collected from forest or scrubland or roadside trees, would be least for large landholders and would successively increase amongst medium, marginal landholders and landless agricultural labourers.

Follow up: Undertake a study of the indoor environment in the kitchens of large, medium, marginal landholders and landless agricultural labourers. It might be expected that use of firewood and the resultant smoke would have negative health consequences, especially for the landless labourer households. This may be tested.

(28) Physique and Occupation

Hypothesis: People engaged in MFP collection have lower levels of subcutaneous fat.

Rationale: It is pertinent to understand the various occupations followed by people in the Indian society, the environmental consequences of their activities, and how these relate to their quality of life. A person's diet, in particular calorific and fat intake, in relation to his/her energy expenditure is reflected in his/her level of fat accumulation. In the Indian society people with amongst the lowest levels of calorific and fat intake, and high levels of energy expenditure are engaged in the collection of minor forest produce (MFP).

Methodology: This study may be conducted in a rural area around forest fringe, where collection of minor forest produce is an important occupation. In such a locality identify 100 volunteers engaged in MFP collection, 100 volunteers with small landholdings, and 100 volunteers with relatively large landholdings. Make sure that there is roughly the same proportion of men/ women and people belonging to different age groups in each of these 3 categories. A person's level of accumulation of fat is readily estimated by measuring skin folds under the shoulder blade, by an instrument called skin calipers. Make such measurements on all volunteers and analyse the data.

Follow up: Do a similar study in an urban area, comparing students from three different schools, one with very high, one with medium, and one with low school fees.

(29) Age and Knowledge of Living Organisms

Hypothesis: Number of distinct taxonomic entities that a person can name increases with age.

Rationale: As industrialisation and reach of markets and TV increases, even in rural and tribal areas, the younger generation is losing touch with the natural world. With this they are likely to be familiar with a smaller number of names of living organisms than the older generation. However, while this may hold in rural and tribal areas, it may not hold in urban areas. In urban areas the younger people may be more familiar with living organisms than the older generation through watching programmes such as the Discovery channel on TV. Thus, this hypothesis may be true in some contexts and false in others.

Methodology: Select a sample of 100 families willing to participate in this study. Note the age and gender of the participants and then ask them to spend as much time as they wish over a one week period, noting in a diary words corresponding to the names of living organisms that they are familiar with, in one or more languages of their choice. These may refer to many different levels of taxonomic categories, thus, they should be requested to separately note bird, bird of prey, kite and black-winged kite as four terms they are familiar with. During this exercise of writing down such names, they should be requested to rely entirely on their memory, and not discuss the issue with any persons, or consult books, TV or websites. Analyse the data so generated with respect to differences with age.

Follow up: While collecting such information, request the participants to mention the source of their knowledge of the various names in terms of following categories: (1) communication from friends, relatives or parents; (2) personal observation coupled to communication from friends, relatives or parents; (3) in school; (4) from books; and (5) watching TV. Analyse the data in terms of relative importance of different sources of knowledge for people of different ages, gender, and so on.

(30) Folk Songs of Men and Women

Hypothesis: Folk songs of women include mention of a greater number of living organisms than folk songs of men.

Rationale: Women, especially in rural areas have been traditionally responsible for dealing with natural resources, such as fetching water from rivers or wells, collecting fire wood for working, or fodder for cattle. This may be reflected in their folk songs.

Methodology: Select at random 100 folk songs of women and 100 folk songs of men from published anthologies of folk literature. Estimate the number of references to living organisms in these folk songs.

Follow up: Make a similar comparison of poems of men and women published in magazines/ books.

(31) **Hypothesis:** Mosquito densities are significantly positively correlated with tree densities.

(32) **Hypothesis:** Stray dogs exhibit a lesser variety of colours than pet dogs.

(33) *Hypothesis:* Stray dogs are significantly less variable in adult sizes than pet dogs.

(34) *Hypothesis:* Families maintaining pet dogs have significantly fewer children living with them.

(35) *Hypothesis:* Indigenous species show a significantly higher level of leaf damage than exotic species.

(36) *Hypothesis:* Natural habitats have significantly more irregular shapes than man-made habitats.

(37) *Hypothesis:* Proportion of raw materials from more natural/ near-natural sources (e.g., bamboo) used in house construction decreases with the size of the house.

(38) *Hypothesis:* Height of males above 18 years of age from the basket-weaving communities decreases with age.

(39) *Hypothesis:* Ratio of price at which the product is sold/cost of raw material has decreased over time for the basket weavers.

(40) *Hypothesis:* Over time, paper mills have been bringing in forest based raw material from greater and greater distances.

(41) *Hypothesis:* Over time, paper and polyfibre mills have switched from use of forest based to farm produced raw material.

(42) *Hypothesis:* Over time, proportion of paper produced from imported pulp has been increasing.

(43) *Hypothesis:* The number of distinctive uses of bamboo that a person can name increases with age.

(44) *Hypothesis:* The ratio of price of paper to the royalty paid to the Forest Departments has decreased over time.

(45) *Hypothesis:* Outside harvesters of bamboo remove a larger fraction of culms from bamboo clumps in comparison with local users.

(46) *Hypothesis:* Bamboo densities are inversely proportional to cattle densities as assessed from cattle dung densities.

(47) *Hypothesis:* The proportion of new to old culms (as assessed by nature of leaf sheaths) increases with distance from habitation.

(48) *Hypothesis:* The proportion of new to old culms (as assessed by nature of leaf sheaths) increases with total number of culms in the clumps.

(49) *Hypothesis:* Fish diversity is greater upstream as compared to downstream of release of paper mill effluent.

(50) *Hypothesis:* The proportion of paper collected from domestic garbage by rag pickers increases with per capita number of cars for residents of the locality.

(51) *Hypothesis:* Bamboo densities are higher in reserved as compared to protected forests.

(52) *Hypothesis:* Bamboo and other forest species would be mentioned more frequently in oral as compared to literature committed to print.

(53) *Hypothesis:* In a forest patch, bamboo densities are inversely proportional to the proportion of evergreen species.

(54) *Hypothesis:* Incidence of bamboo shoots as food is inversely proportional to the floor area of a family's residence.

(55) *Hypothesis:* A comparison of the species that have declined over the last five years with those that have increased reveals that more xerophytic species are on the increase.

(56) *Hypothesis:* Number of reported oil spills is significantly greater in last five years as compared to previous five years.

(57) *Hypothesis:* Microbial content of water decreases with greater technological inputs.

(58) *Hypothesis:* The greater the population of a village/town/city, greater the technological inputs in its drinking water supply.

(59) *Hypothesis:* Per capita expenditure on drinking water in a household increases with greater technological inputs in its drinking water supply.

(60) *Hypothesis:* Females rank scarcity of drinking water as a more serious environmental concern than males do.

(61) *Hypothesis:* The greater the population of a village/town/city, greater the distance to its drinking water source.

(62) *Hypothesis:* The amount of water consumed in a household is proportional to the mean monthly temperature.

(63) *Hypothesis:* The amount of drinking water consumed by a person is proportional to his/her body weight.

(64) *Hypothesis:* The amount of drinking water supplied to a town/city has increased at a slower rate than its population.

(65) *Hypothesis:* The number of days that the river has overflowed is significantly greater in the recent past as compared to previous five years.

(66) *Hypothesis:* The chance of flooding of street in front of the school increases with the amount of rain received in the previous two days.

(67) *Hypothesis:* The lake receives more water from sewage than natural water flow.

(68) *Hypothesis:* The ratio of money spent on flood relief/ annual budget of the state shows an increasing trend over the years.

(69) *Hypothesis:* Organic farms exhibit a significantly greater diversity of crops than non-organic farms.

(70) *Hypothesis:* Organic farms exhibit a significantly greater abundance of spiders than non-organic farms.

(71) *Hypothesis:* Organic farms exhibit significantly lower per hectare yields of any given crop than non-organic farms.

(72) *Hypothesis:* Insect/disease damage to crops is significantly higher in monoculture than in mixed crops.

(73) *Hypothesis:* Bird and mammal damage to crops is significantly higher in fields closer to forest patches.

(74) *Hypothesis:* Urban birds include a significantly higher proportion of species from forest than grassland habitats.

(75) *Hypothesis:* Fish species diversity is significantly lower in reservoirs than in rivers.

(76) *Hypothesis:* Rates of transition of Landscape Element Types with higher tree densities to those with lower tree densities are significantly higher than the reverse transitions.

(77) *Hypothesis:* Rates of transition of Landscape Element Types with smaller average patch sizes to those with larger average patch sizes are significantly lower than the reverse transitions.

(78) *Hypothesis:* Ornamental plants include a

significantly higher proportion of species pollinated by insects.

(79) *Hypothesis:* As reported by experienced bird watchers, there has been a greater decline in the populations of insectivorous as compared to omnivorous birds.

(80) *Hypothesis:* There is a significantly greater proportion of larger sized fish amongst species reported to have gone locally extinct by knowledgeable fishermen.

(81) *Hypothesis:* Amongst urban students personal observations is a significantly less important source of knowledge about living organisms that they can name than information gathered from books, magazines or TV.

(82) *Hypothesis:* Central government agencies are more open to sharing information than state government agencies as revealed by experience of requesting for information under the Right to Information Act.

(83) *Hypothesis:* Municipal Corporation agencies are more open to sharing information than Pollution Control Boards as revealed by experience of requesting for information under the Right to Information Act.

(84) *Hypothesis:* Number of cars per head owned by households is proportional to the floor area of the house per head.

(85) *Hypothesis:* Domestic electricity consumption is proportional to the mean monthly temperature over a year.

(86) *Hypothesis:* Distance commuted per day by a person is greater/smaller than the number of people travelling in the vehicle used.

(87) *Hypothesis:* Density of oil globules on beaches is positively correlated with mean monthly temperature.

(88) *Hypothesis:* Density of oil globules is inversely proportional to the crab density on the beach.

(89) *Hypothesis:* Density of oil globules is inversely proportional to the number of people bathing in the sea.

(90) *Hypothesis:* Organic farms exhibit significantly lower expenditure per kilogram of farm produce than non-organic farms.

(91) *Hypothesis:* Organic farms exhibit significantly higher input of labour per kilogram of farm produce than non-organic farms.

(92) *Hypothesis:* In cities, shops selling organic produce are situated in economically more affluent localities as indicated by shop rents.

(93) *Hypothesis:* Communal roosting sites are significantly commoner around human habitations than in farms/ orchards.

(94) *Hypothesis:* Densities of barnacles on rocks is inversely correlated with phosphorus content of sea water.

(95) *Hypothesis:* Intensity of infestation by semi-parasitic Loranthaceae increases with tree density.

(96) *Hypothesis:* Insect/ disease damage to crops is significantly higher in larger than in smaller patches of any given crop.

(97) *Hypothesis:* Insect/ disease damage to crops is significantly higher in fields with higher levels of fertiliser application.

(98) *Hypothesis:* Plant species grazed upon by livestock include a significantly lower proportion of species with spines/thorns.

(99) *Hypothesis:* In localities with natural vegetation, the diversity of tree species is positively correlated with proportion of evergreen tree species.

(100) *Hypothesis:* In localities with natural vegetation, the diversity of epiphytic plants species is positively correlated with proportion of evergreen tree species.

(101) *Hypothesis:* Lichen species diversity is significantly higher in wetter habitats.

(102) *Hypothesis:* Lichen species diversity is significantly higher in cooler habitats.

(103) *Hypothesis:* Mollusk species diversity of fresh water bodies declines with increasing opacity of water.

(104) *Hypothesis:* Diversity of insects caught in light traps declines significantly following forest/grassland fire.

(105) *Hypothesis:* Diversity of semi-parasitic Loranthaceae increases with tree diversity.

(106) *Hypothesis:* Urban birds include a significantly higher proportion of species using a wider range of habitats than birds from rural habitats.

(107) *Hypothesis:* Medicinal plants include a significantly higher proportion of species belonging to wet tropical forest habitat.

(108) *Hypothesis:* Tree species used for leaf fodder include a significantly higher proportion of successional species.

(109) *Hypothesis:* Plant species used for basket/mat weaving include a significantly higher proportion of monocot species.

(110) *Hypothesis:* Species whose wood is used for carving include a significantly higher proportion of species from wet tropical forest.

(111) *Hypothesis:* Cultivated plants include a significantly higher proportion of successional/ pioneer species.

(112) *Hypothesis:* Cultivated plants include a significantly higher proportion of species belonging to grassland habitats.

(113) *Hypothesis*: Under similar levels of pesticide applications, traditional cultivats show significantly lower levels of leaf damage as compared with HYVs.

(114) *Hypothesis*: Sizes of monkey troops with access to food from human provisioning or garbage is significantly higher than of troops without access to such food sources.

(115) *Hypothesis*: Educational institutions have a lower density of trees per unit open space than housing societies.

(116) *Hypothesis*: Proportion of households consuming self caught fish declines with size of agricultural landholding.

(117) *Hypothesis*: Proportion of people consuming wild roots and tubers at home has declined over time.

(118) *Hypothesis*: Number of distinct taxonomic entities that a person can name based on personal experience decreases with his/her educational level.

(119) *Hypothesis*: Number of distinct taxonomic entities that a person can name based on sources like books and TV increases with his/her educational level.

(120) *Hypothesis*: Number of distinct taxonomic entities that a person can name based on personal experience decreases with the amount of land owned.