



**ROHINI** COLLEGE OF ENGINEERING AND TECHNOLOGY

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**DEPARTMENT OF CIVIL ENGINEERING**

**OAI551-ENVIRONMENT AND AGRICULTURE**

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# SYLLABUS

OAI551

ENVIRONMENT AND AGRICULTURE

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## OBJECTIVE:

☐ To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.

## UNIT I

### ENVIRONMENTAL CONCERNS

Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.

## UNIT II

### ENVIRONMENTAL IMPACTS

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

## UNIT III

### CLIMATE CHANGE

Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification.

## UNIT IV

### ECOLOGICAL DIVERSITY AND AGRICULTURE

Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insects and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

## UNIT V

### EMERGING ISSUES

Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture.

**TOTAL: 45**

## PERIODS

## OUTCOMES:

- ☐ Students will appreciate the role of environment in the current practice of agriculture and concerns of sustainability, especially in the context of climate change and emerging global issues.
- ☐ Ecological context of agriculture and its concerns will be understood

## TEXTBOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

## REFERENCES:

1. T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.

2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century : proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994
3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 198

## **UNIT I**

### **ENVIRONMENTAL CONCERNS**

**Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.**

**The environment matters to agriculture because:**

- It provides the basis for food and agricultural systems.
- Agriculture can have positive (e.g. conserving habitat for wild species) or negative (pollution, soil degradation) impacts on the environment.
- Environmental degradation and lack of access to environmental assets undermines food security and deepens poverty, with women and children most affected

### **THE ENVIRONMENTAL BASIS OF FOOD AND AGRICULTURAL SYSTEMS**

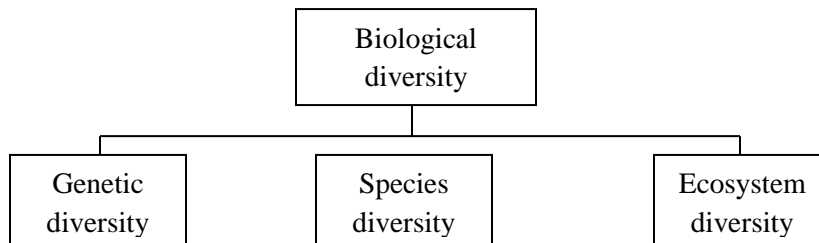
- Agriculture uses about a third of the world's land surface and depends directly on the wider environment for its existence and sustainability. Sunlight, water, nutrients and a diversity of plants, animals and microbes all play fundamental roles in agricultural production and ultimately global food security.
- Farmers and fishermen can often make the best use of their environment through special, locally adapted, agricultural systems. These systems dictate their choices of crops and livestock, land and water management practices, production systems and local institutional arrangements.
- Local knowledge about the environment is crucial in this regard. Farmers in Nigeria, for example, know that the variegated grasshopper severely damages their cassava crops after all their other crops have been harvested. To limit the damage, farmers replant maize and random clusters of sorghum on their cassava plots until harvest time. This conscious manipulation of crop diversity is an important indigenous method of pest control.

## **Biodiversity's role in agriculture:**

Agricultural biodiversity refers to the variety of living species that are important to agriculture. It comprises the diversity of genetic resources (e.g. different varieties and breeds) and species used in agriculture directly or indirectly, including species that support production (e.g. soil organisms and pollinators) and broader ecosystems within which agriculture takes place (e.g. pastoral, forest and aquatic), as well as the diversity of these agro-ecosystems themselves. As part of the living environment, agricultural biodiversity plays key roles in: decomposition and nutrient cycling; natural pest control; soil conservation; pollination and seed dispersal; local and global climate; the water cycle; and biomass production.

## **Levels of Biodiversity**

The Biological diversity includes three interrelated hierarchical levels:



### **Genetic diversity:**

It is the total genetic information contained in the genes of all species. It also refers to the variation in genetic information between species as well as variations between individuals of the same species.

### **Species diversity:**

It is the variety of species on earth. It refers to both the number of species and the number of individuals within each species.

**Ecosystem diversity:**

It is the variety of habitats, natural communities and ecological processes in biosphere.

**Importance of biodiversity:**

- All these diversities helps in maintaining the balance of nature. But gradually there has been a loss of biodiversity.
- The loss of biodiversity could adversely affect our environment as the balance is lost and the natural food web is disturbed.
- As we realize its importance in our survival biodiversity conservation has now become a matter of high priority.

**Agriculture's Impacts on the environment:**

- Agriculture can either sustain or degrade the environment.
- The Millennium Ecosystem Assessment has documented agriculture's main negative effects on land and freshwater, as well as the importance of agricultural landscapes in providing products for human sustenance, supporting biodiversity and maintaining ecosystem services.

**Negative impacts include:**

- (i) Conversion of forests, grasslands and other habitats for agricultural use.
- (ii) Degradation of soil quality (20 per cent of African soils are seriously degraded)
- (iii) Pollution of soil and surface water, aquifers and coastal wetlands through excessive or inappropriate use of pesticides and fertilizers
- (iv) Significant loss of crop and livestock genetic diversity through the spread of industrial monocultures, reducing resilience in the face of climate and other changes in Mexico, for instance, has lost over 80 per cent of its maize varieties since 1930, while native barley is suffering severe genetic erosion and durum wheat is being lost in Ethiopia.

Negative impacts are particularly closely associated with intensive agriculture, which affects the environment through high-energy consumption and the polluting effects of inputs such as pesticides and fertilizers.

- The energy required for irrigation, farm machinery and the production of fertilizer results in large greenhouse gas emissions, which contribute to climate change.
- However, agriculturalists are also the custodians of much of the world's rural landscapes and of the biodiversity represented by hundreds of thousands of crop and livestock varieties.
- Agriculture that practices tillage, fertilization, and pesticide application also releases ammonia, nitrate, phosphorus, and many other pesticides that affect air, water, and soil quality, as well as biodiversity.
- Agriculture also alters the Earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radioactive forcing.
- Agricultural systems, both modern and traditional, that rely on ecosystem management rather than the external inputs of intensive farming can sustain the environment.
- African polyculture systems which grow a variety of different crops on the same piece of land are a case in point. They are used in at least 80 per cent of the cultivated area of West Africa, and are often highly biodiverse.
- As a result, they can be a way of conserving valuable crop and livestock diversity as well as effectively suppressing pests and boosting nutritional values.
- Food and agriculture systems can be designed to enhance both the provision of ecosystem services and human well-being.
- Sustainable agriculture can be achieved by maintaining healthy soils; reducing water pollution; increasing the number and variety of wild species on farms (e.g. soil organisms, pollinators and pest-control agents); maintaining crop and livestock diversity; and being energy efficient, thereby cutting emissions of carbon dioxide to reduce global warming

## **Land use and landscape changes:**

### **Land use:**

- Land is the most important natural resources making use of land for various purposes like cultivation, forestry, grass land, other than agriculture etc, is called as land use.

- It also has been defined as "the total of arrangements, activities, and inputs that people undertake in a certain land cover type".
- Land use involves the management and modification of natural environment or wilderness into built environment such as settlements and semi-natural habitats such as pastures, and managed woods.
- Land management is the process of managing the use and development (in both urban and rural) of land resources.
- Land resources are used for a variety of purposes which may include organic agriculture, reforestation, water resource management.
- Land management can have positive or negative effects on the terrestrial ecosystems.
- Land being misused can degrade and reduce productivity and disrupt natural equilibriums.
- Land use and land management practices have a major impact on natural resources including water, soil, nutrients, plants and animals.
- Land use information can be used to develop solutions for natural resource management issues such as salinity and water quality.
- Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide; agriculture itself is the major contributor to increasing methane and nitrous oxide concentrations in earth's atmosphere.
- Land-use change can be a factor in CO<sub>2</sub> (carbon dioxide) atmospheric concentration, and is thus a contributor to global climate change.

### **Types of Land use:**

There are many types of land use,

- (i) Recreational
- (ii) Transport
- (iii) Agricultural
- (iv) Residential
- (v) Commercial



**(i)Recreational:**

Land is used for human pleasure. It includes parks, museum, sports ground etc.

**(ii)Transport:**

It is used for roads, railways, subways, airports etc.

**(iii)Agricultural:**

It is created by man specifically to grow or raise biological products or food products for consumption.

**(iv)Residential :**

It is used in which housing predominates includes single family housing, multi-family residential.

**(v)Commercial:**

Land is used for commercial purposes and intended to generate a profit.It includes hotels , malls, office building.

**Factors affecting Utilization of land:**

Some of the factors include,

- Landforms
- Climate
- Population
- Demand for agricultural products
- Profession
- Attitude of people
- Land ownership
- Soil condition
- Technology
- Irrigation facility
- Human Capability

**Land use zones:**

Zoning is the process of dividing land in a municipality into zones in which certain land uses are permitted or prohibited.

The various land use zones includes:

1. Residential zones
2. Commercial zones
3. Industrial zones
4. Urban services zones
5. Agricultural and reserve zones
6. Direct control provision

## **1. Residential zones:**

(i) Single detached residential zone:

This zone provides the opportunity for single-family housing.

(ii) Low density infill zone:

This zone provides the opportunity for retaining single-family housing, while allowing some duplex development.

(iii) Small scale infill development zone:

This zone provides the opportunity for single-family and duplex housing while allowing some apartment or row housing with up to four units.

(iv) Residential small lot zone:

This zone provides the opportunity for single-family housing with attached garages on smaller lots.

(v) Planned lot residential zone:

This zone provides the opportunity for single-family housing on smaller lots and accessed by a rear lane.

(vi) Semi-detached zone:

This zone provides the opportunity for primarily semi detached and duplex housing.

(vii) Row housing zone:

This zone provides the opportunity for relatively low to medium density housing such as row houses or town houses

(viii) Medium density multiple family zone:

This zone provides the opportunity for medium density housing such as row houses or town houses that may have separate second storey units.

(ix) Low rise apartment zone:

This zone provides the opportunity for low-rise apartment buildings up to four storey's.

(x) Medium rise apartment zone:

This zone provides the opportunity for medium rise apartment buildings up to 6 storey's in height.

(xi) High rise apartment zone:

This zone provides the opportunity for high rise apartment buildings.

(xii) Rural residential zone:

This zone provides the opportunity for permanent single-family residential development in a rural setting.

## **2. Commercial zones:**

(i) Shopping centre zone:

This zone provides the opportunity for larger shopping centre has intended to serve a community or regional area. Entertainment and cultural uses may be included in this zone.

(ii) Low intensity business zone:

This zone provides the opportunity for low intensity commercial, office and service uses located along arterial roadways that border residential areas.

(iii) General business zone:

This zone provides the opportunity for businesses that requires large sites and location with good visibility and accessibility along or adjacent to major public road ways.

(iv) Highway corridor zone:

This zone provides the opportunity for high quality commercial development along roads serving as entrance roots to the city.

## **3. Industrial zone:**

(i) Industrial business zone:

This zone provides the opportunity for industrial businesses that carry out their operations such that no nuisance is created or apparent outside an enclosed building and the use is compatible with any adjacent non-industrial zones.

(ii) Light industrial zone:

This zone provides the opportunity for high quality, light industrial developments and limited accessory outdoor activities any Nuisance factor associated with these uses will not extend outside an enclosed building.

(iii) Medium industrial zone:

This zone provides the opportunity for manufacturing, processing, assembling, distribution, service and repair uses that carryout part of their operation outdoors or requires outdoor storage areas. Any nuisance associated with the users should not extend beyond these sites.

(iv) Heavy industrial zone:

This zone provides the opportunity for industrial uses that due to their appearance, noise, odour, risks of toxic emissions are incompatible with residential, commercial and other land uses.

## **4. Urban Services Zones**

(i) Urban Service Zone:

This zone provides the opportunity for publicly and privately owned facilities which provide institutional or community services.

(ii) Public Utility Zone:

This zone provides the opportunity for a system or utilities that are used to benefit the public, such as water, sewage disposal, electric power, heating, waste management, drainage, public transportation and telecommunications.

(iii) Municipal Airport Zone:

This zone provides the opportunity for the operations of the Edmonton City Centre Airport.

(iv) Public Parks Zone:

This zone provides the opportunity for an area of public land for recreational uses.

(v) Natural Areas Protection Zone:

This zone provides the opportunity for the conservation, preservation and restoration of identified natural areas, features and ecological processes.

(vi) Metropolitan Recreational Zone:

This zone provides the opportunity for preserving natural areas and parkland along the river, creeks, ravines and other designated areas for recreational uses and environmental protection conforming approved plans.

(vii) River Valley Activity Node Zone:

This zone provides the opportunity for limited commercial development for recreation and tourism uses within designated areas of parkland along the river, creeks and ravines.

(viii) Alternative Jurisdiction Zone:

This zone provides the opportunity for lands that do not require a Development Permit because they are under the jurisdiction of federal or provincial legislation or the Constitution Act. These lands are not required to conform to the Zoning By law.

## **5.Agricultural and Reserve Zones**

(i) Agricultural Zone

This zone provides the opportunity for conserving agricultural and rural land use activities.

(ii) Urban Reserve Zone

This zone provides the opportunity for agricultural and rural land use activities and a limited range of other uses that will not impact future development of the land.

(iii) Industrial Reserve Zone

This zone provides the opportunity for agricultural and rural land use activities that will not impact future use of the land for industrial development.

## **6. Direct Control Provisions**

(i) Direct Development Control Provision:

This zone provides the opportunity for detailed, sensitive control of the use, development, and design of buildings and disturbance of land. This zone is used to establish, preserve or enhance areas of unique character or environmental concern, or areas of special interest as designated under the Historical Resources Act.

## (ii) Site Specific Development Control Provision

This zone provides the opportunity for direct control over a specific proposed development where the proposed mix of uses or the development regulations cannot be accommodated in a standard zone.

### **Advantages of Land Use Pattern in India:**

- It helps to divide the land in order to use it for different purposes.
- Plateaus are filled with minerals, forest and fossil fuels and thus make it productive for the country.
- Plains are most fertile part of land and helps in cultivation of crops by farmers.

### **Disadvantages of Land Use Pattern in India:**

- Human activities like deforestation, overgrazing etc. degrade the quality of land in India.
- Forest area is very less as compared to the geographical area of the country.

### **landscape changes:**

- A landscape is the visible features of an area of land, its landforms, and how they integrate with natural or man-made features.
- A landscape includes the physical elements of geophysically defined landforms such as (ice-capped) mountains, hills, water bodies such as rivers, lakes, ponds and the sea, living elements of land cover including indigenous vegetation, human elements including different forms of land use, buildings, and structures, and transitory elements such as lighting and weather conditions.
- Combining both their physical origins and the cultural overlay of human presence, often created over millennia, landscapes reflect a living synthesis of people and place that is vital to local and national identity.
- The character of a landscape helps define the self-image of the people who inhabit it and a sense of place that differentiates one region from other regions.
- It is the dynamic backdrop to people's lives. Landscape can be as varied as farmland, a landscape park or wilderness.

- The Earth has a vast range of landscapes, including the icy landscapes of polar regions, mountainous landscapes, vast arid desert landscapes, islands, and coastal landscapes, densely forested or wooded landscapes including past boreal forests and tropical rainforests, and agricultural landscapes of temperate and tropical regions.
- The activity of modifying the visible features of an area of land is referred to as landscaping.
- Landscape refers either to all the visible features of an area of land (usually rural), often considered in terms of aesthetic appeal, or to a pictorial representation of an area of countryside, specifically within the genre of landscape painting.
- When people deliberately improve the aesthetic appearance of a piece of land by changing contours and vegetation, etc.
- It is said to have been landscaped, though the result may not constitute a landscape according to some definitions.
- Modification of the landscape by humans for agricultural and other purposes has led to the immense loss of native vegetation, fragmentation and degradation of habitat, factors implicated in the global decline of biodiversity .
- Many landscapes throughout the world are now highly modified with only scattered fragments of native vegetation remaining.
- The modification of landscapes influences ecosystem processes, species richness and distribution, as well as altering physical attributes of the environment, ultimately leading to a poorer environment in which all species, including humans, live.
- Maintaining the integrity of ecosystems is vital if they are to adapt to climate change, if biodiversity is to flourish, and if humans are to continue to receive the ecological goods and services on which we depend for our existence.
- Services provided by functional ecosystems include clean air and water, carbon sequestration, pollination, biological pest control, raw resources, the prevention of soil erosion and degradation, and recreational opportunities.

## Several words associated with landscape:

There are several words that are frequently associated with the word landscape,

1.Scenery: The natural features of a landscape considered in terms of their appearance, when picturesque: spectacular views of mountain scenery.

2.Setting: In works of narrative (especially fictional), it includes the historical moment in time and geographic location in which a story takes place, and helps initiate the main backdrop and mood for a story.

3.Picturesque: The word literally means "in the manner of a picture; fit to be made into a picture", picturesque as "a term expressive of that peculiar kind of beauty, which is agreeable in a picture".

4.A view: "A sight or prospect of some landscape or extended scene; an extent or area covered by the eye from one point".

5.Wilderness: An uncultivated, uninhabited, and inhospitable region.

6.Cityscape (also townscape): The urban equivalent of a landscape. In the visual arts a cityscape (urban landscape) is an artistic representation, such as a painting, drawing, print or photograph, of the physical aspects of a city or urban area.

7.Seascape: A photograph, painting, or other work of art which depicts the sea, in other words an example of marine art.

## Types of landscape:

**1.Natural landscape** is made up of a collection of landforms, such as mountains, hills, plains, and plateaus. Lakes, streams, soils (such as sand or clay), and natural vegetation are other features of natural landscapes.

**2.Cultural landscape**, as defined by the [World Heritage Committee](#), is the "cultural properties that represent the combined works of nature and of man".

(i)"A [landscape](#) designed and created intentionally by man"

(ii)An "organically evolved landscape" which may be a "[relict](#) (or fossil) landscape" or a "continuing landscape"

(iii)An"associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element."



## Major stages of landscape:

landscape change represented by four major stages of landscape condition . Landscapes can be:

1. **Intact** – in which landscapes contain most original vegetation with limited clearing;
2. **Variegated** – in which landscapes are dominated by original vegetation, but include gradients and buffers of modified habitat;
3. **Fragmented** – contains discrete patches of vegetation in a modified matrix.
4. **Relictual** – with little (less than 10%) of the original vegetation remaining, surrounded by highly modified landscape.

## Effects of landscape change on species and populations:

- Different organisms display diverse and individual responses to landscape modification depending on the scale at which they normally operate and the scale at which they perceive the environment.
- The ability to utilize highly modified landscapes (e.g. agricultural pastures), in addition to native habitat, has enabled some generalist species, like galahs, to prosper and expand their ranges.
- Some species are known as ‘edge specialists’; they inhabit the matrix vegetation boundary and benefit from highly fragmented landscapes.
- Generally, the number of species found within an area is proportional to the size of the area and how isolated it is from other core areas.
- This concept is known as the species-area relationship and is derived from the equilibrium theory of island biogeography.
- The theory postulates a relationship between the number of species found on an island and the island’s area and isolation.
- The theory predicts that the number of species on an island represents a dynamic balance between the rate of colonization of new species to the island and the rate of extinction of species already present.
- Within unmodified landscapes, a given species may occur as spatially discrete populations that are functionally connected via the interchange of dispersing individuals.

- Collectively, such connected populations are known as a ‘meta-population’.
- The presence of a species within a patch does not necessarily equate to a locally viable population.
- Species may persist within vegetation patches because of immigration of individuals from resource-rich areas outside the patch or locality.
- These populations are considered ‘sink’ populations as they are unable to sustain their numbers in the absence of immigration.

### **WATER QUALITY ISSUES:**

- Contamination of both ground and surface waters caused by high levels of production and use of manure and chemical fertilizers is a serious problem, particularly in areas of intensive livestock or specialized crop production.
- Issues here include leaching of nutrients and pesticides, water extraction and drainage and flooding.
- Water quantity problems arise in regions where water consumption exceeds critical levels in relation to available water resources.

### **Water quality as a global issue:**

1. Agriculture, as the single largest user of freshwater on a global basis and as a major cause of degradation of surface and groundwater resources through erosion and chemical runoff, has caused to be concerned about the global implications of water quality. The associated agro food-processing industry is also a significant source of organic pollution in most countries
2. Aquaculture is now recognised as a major problem in freshwater, estuarine and coastal environments, leading to eutrophication and ecosystem damage.

**The principal environmental and public health dimensions of the global freshwater quality problem are highlighted below:**

- Five million people die annually from water-borne diseases.
- Ecosystem dysfunction and loss of biodiversity.
- Contamination of marine ecosystems from land-based activities.

- Contamination of groundwater resources.
- Global contamination by persistent organic pollutants.

Experts predict that, because pollution can no longer be remedied by dilution (i.e. the flow regime is fully utilized) in many countries, freshwater quality will become the principal limitation for sustainable development in these countries early in the next century. This "crisis" is predicted to have the following global dimensions:

- Decline in sustainable food resources (e.g. freshwater and coastal fisheries) due to pollution.
- Cumulative effect of poor water resource management decisions because of inadequate water quality data in many countries.
- Many countries can no longer manage pollution by dilution, leading to higher levels of aquatic pollution.

### **Agricultural impacts on water quality:**

| <b>Agricultural activity</b> | <b>Impacts</b>  |   |
|------------------------------|---|---|
|                              | <b>Surface water</b>  | <b>Groundwater</b>  |
| Tillage/ploughing            | <b>Sediment/turbidity:</b> sediments carry phosphorus and pesticides adsorbed to sediment particles; <b>siltation</b> of river beds and loss of habitat, spawning ground, etc.              |   |
| Fertilizing                  | Runoff of nutrients, especially phosphorus, leading to eutrophication causing taste and odour in public water supply, excess algae growth leading to deoxygenation of water and fish kills. | Leaching of nitrate to groundwater; excessive levels are a threat to public health. |
| Manure spreading             | Carried out as a fertilizer activity; spreading on frozen ground results in high levels of contamination of receiving waters by pathogens, metals, phosphorus and                           | Contamination of ground-water, especially by  |

|                         |   |  |
|-------------------------|---|--|
|                         | nitrogen leading to eutrophication and potential contamination.   | nitrogen   |
| Pesticides              | Runoff of pesticides leads to contamination of surface water and biota; dysfunction of ecological system in surface waters by loss of top predators due to growth inhibition and reproductive failure; public health impacts from eating contaminated fish. Pesticides are carried as dust by wind over very long distances and contaminate aquatic systems 1000s of miles away (e.g. tropical/subtropical pesticides found in Arctic mammals). | Some pesticides may leach into groundwater causing human health problems from contaminated wells.  |
| Feedlots/animal corrals | Contamination of surface water with many pathogens (bacteria, viruses, etc.) leading to chronic public health problems. Also contamination by metals contained in urine and faeces.   | Potential leaching of nitrogen, metals, etc. to groundwater.   |
| Irrigation              | Runoff of salts leading to salinization of surface waters; runoff of fertilizers and pesticides to surface waters with ecological damage, bioaccumulation in edible fish species, etc. High levels of trace elements such as selenium can occur with serious ecological damage and potential human health impacts.  | Enrichment of groundwater with salts, nutrients (especially nitrate).  |
| Clear cutting           | Erosion of land, leading to high levels of turbidity in rivers, siltation of bottom habitat, etc. Disruption and change of hydrologic regime, often with loss of perennial streams; causes public health problems due to loss of potable water.   | Disruption of hydrologic regime, often with increased surface runoff and decreased groundwater recharge; affects surface water by decreasing flow in |

|              |  |  |
|--------------|--|--|
|              |  | dry periods and concentrating nutrients and contaminants in surface water. |
| Silviculture | Broad range of effects: pesticide runoff and contamination of surface water and fish; erosion and sedimentation problems.                                  |  |
| Aquaculture  | Release of pesticides (e.g. TBT) and high levels of nutrients to surface water and groundwater through feed and faeces, leading to serious eutrophication. |  |

## **Types of water pollution:**

There are many types of water pollution because water comes from many sources. Here are a few types of water pollution:

### **1. Nutrients Pollution**

Some wastewater, fertilizers and sewage contain high levels of nutrients. If they end up in water bodies, they encourage algae and weed growth in the water. This will make the water undrinkable, and even clog filters. Too much algae will also use up all the oxygen in the water, and other water organisms in the water will die out of oxygen starvation.

### **2. Surface water pollution**

Surface water includes natural water found on the earth's surface, like rivers, lakes, lagoons and oceans. Hazardous substances coming into contact with this surface water, dissolving or mixing physically with the water can be called surface water pollution.

### **3. Oxygen Depleting**

Water bodies have micro-organisms. These include aerobic and anaerobic organisms. When too much biodegradable matter (things that easily decay) end up in water, it encourages more

microorganism growth, and they use up more oxygen in the water. If oxygen is depleted, aerobic organisms die, and anaerobic organisms grow more to produce harmful toxins such as ammonia and sulfides.

#### **4. Ground water pollution**

When humans apply pesticides and chemicals to soils, they are washed deep into the ground by rainwater. This gets to underground water, causing pollution underground. This means when we dig wells and bore holes to get water from underground, it needs to be checked for ground water pollution.

#### **5. Microbiological**

In many communities in the world, people drink untreated water (straight from a river or stream). Sometimes there is natural pollution caused by microorganisms like viruses, bacteria and protozoa. This natural pollution can cause fishes and other water life to die. They can also cause serious illness to humans who drink from such waters.

#### **6. Suspended Matter**

Some pollutants (substances, particles and chemicals) do not easily dissolve in water. This kind of material is called particulate matter. Some suspended pollutants later settle under the water body. This can harm and even kill aquatic organisms that live at the bottom of water bodies.

#### **7. Chemical Water Pollution**

Many industries and farmers work with chemicals that end up in water. This is common with Point-source Pollution. These include chemicals that are used to control weeds, insects and pests. Metals and solvents from industries can pollute water bodies. These are poisonous to many forms of aquatic life and may slow their development, make them infertile and kill them

#### **8. Oil Spillage**

Oil spills usually have only a localized effect on wildlife but can spread for miles. The oil can cause the death to many fish and get stuck to the feathers of seabirds causing them to lose their ability to fly.

## **Effects of water pollution:**

Infectious diseases can be spread through contaminated water. Some of these water-borne diseases are Typhoid, Cholera, Paratyphoid Fever, Dysentery, Jaundice, Amoebiasis and Malaria.

**Chemicals** - in the water also have negative effects on our health.

**Pesticides** – can damage the nervous system and cause cancer because of the carbonates and organophosphates that they contain. Chlorides can cause reproductive and endocrinal damage.

**Nitrates** – are especially dangerous to babies that drink formula milk. It restricts the amount of oxygen in the brain and cause the “blue baby” syndrome.

**Lead** – can accumulate in the body and damage the central nervous system.

**Arsenic** – causes liver damage, skin cancer and vascular diseases

**Flourides** - in excessive amounts can make your teeth yellow and cause damage to the spinal cord.

**Petrochemicals** – even with very low exposure, can cause cancer.

## **Water quality parameters:**

### **1.physical properties:**

- Temperature
- Colour
- Odour
- Turbidity
- Electrical conductivity

### **2.chemical properties:**

- pH of water
- Total Dissolved Solids(TDS)

- Major ions
- Minor or trace elements
- Hardness
- Salinity
- Alkalinity

### 3. Biological properties:

- Dissolved Oxygen(DO)
- Biochemical Oxygen Demand(BOD)
- Chemical Oxygen Demand (COD)

## Causes of Water Pollution:

**Water pollution** is caused due to several reasons. Here are the few major causes of water pollution:

**1.Sewage And Waste Water:** Sewage, garbage and liquid waste of households, agricultural lands and factories are discharged into lakes and rivers. These wastes contain harmful chemicals and toxins which make the water poisonous for aquatic animals and plants.

**2.Dumping:** Dumping of solid wastes and litters in water bodies causes huge problems. Litters include glass, plastic, aluminum, styrofoam etc. Different things take different amount of time to degrade in water. They affect aquatic plants and animals.

**3.Industrial Waste:** Industrial waste contains pollutants like asbestos, lead, mercury and petrochemicals which are extremely harmful to both people and environment. Industrial waste is discharged into lakes and rivers by using fresh water making the water contaminated.

**4.Oil Pollution:** Sea water gets polluted due to oil spilled from ships and tankers while traveling. The spilled oil does not dissolve in water and forms a thick sludge polluting the water.

**5.Acid Rain:** Acid rain is pollution of water caused by air pollution. When the acidic particles caused by air pollution in the atmosphere mix with water vapor, it results in acid rain.



**6.Global Warming:** Due to global warming, there is an increase in water temperature. This increase in temperature results in death of aquatic plants and animals. This also results in bleaching of coral reefs in water.

**7.Eutrophication:** Eutrophication is an increased level of nutrients in water bodies. This results in bloom of algae in water. It also depletes the oxygen in water, which negatively affects fish and other aquatic animal population.

### **Treating polluted water :**

It is very important to prevent the polluting of water bodies and remove existing contaminants or reducing the concentration of these contaminants so as to make it fit for desired use. Following are some of the ways of treating polluted water:

**1.Industrial Treatment:** The raw sewage is needed to be treated correctly in a water treatment plant before it can be safely released into the environment. To reduce the amount and toxicity of waste, it is passed through a number of chambers and chemical processes in water treatment plant.

**2.Denitrification:** Conversion of nitrates in gas is called Denitrification. It is an ecological approach to prevent leaching of nitrates in soil. It stops ground water from getting contaminated.

**3.Ozone Waste Water Treatment:** Ozone waste water treatment method is becoming very popular. In this method, the pollutants in water are broken down by an ozone generator. Ozone oxidizes bacteria, molds, organic material and other pollutants in water.

**4.Septic Tanks:** Septic tanks are used to treat sewage at the place of location instead of treating it in any plant or sewage system. This system is used at the individual building level. The sewage is separated into solid and liquid components and treated separately.

## **CHANGING SOCIAL STRUCTURE AND ECONOMIC FOCUS**

Environmental changes are one of the many sources of social change:

- Major sources of social change include population growth and composition, culture and technology, the natural environment, and social conflict.
- Environmental problems have a significant impact on people, and solutions to these problems require changes in economic and environmental policies. Air pollution, global climate change, water pollution and inadequate sanitation, and hazardous waste are major environmental problems that threaten the planet.
- Environmental changes have enormous implications for changes in societies around the globe.
- Modernization promotes creativity and individual freedom and autonomy. These developments in turn usually mean that a society becomes more tolerant of beliefs and behaviors that it formerly would have disapproved and even condemned. Modern societies, then, generally feature more tolerance than older societies. Many people, undoubtedly including most sociologists, regard greater tolerance as a good thing, but others regard it as a bad thing because they favor traditional beliefs and behaviors.
- Beyond these abstract concepts of social bonding, sense of community, and tolerance, modern societies are certainly a force for both good and bad in other ways. They have produced scientific discoveries that have saved lives, extended life spans, and made human existence much easier than imaginable in the distant past and even in the recent past. But they have also polluted the environment, engaged in wars that have killed tens of millions, and built up nuclear arsenals that, even with the end of the Cold War, still threaten the planet. Modernization, then, is a double-edged sword. It has given us benefits too numerous to count, but it also has made human existence very precarious.
- Changes in the natural environment can also lead to changes in a society itself. We see the clearest evidence of this when a major hurricane, an earthquake, or another natural disaster strikes. Three recent disasters illustrate this phenomenon. In April 2010, an oil rig operated by BP, an international oil and energy company, exploded in the Gulf of Mexico, creating what many observers called the worst environmental disaster in U.S.

history; its effects on the ocean, marine animals, and the economies of states and cities affected by the oil spill will be felt for decades to come.

- The effects of these natural disasters on the economy and society of each of these two countries will certainly also be felt for many years to come.
- Slower changes in the environment can also have a large social impact. As noted earlier, one of the negative effects of industrialization has been the increase in pollution of our air, water, and ground.
- Climate change, a larger environmental problem, has also been relatively slow in arriving but threatens the whole planet in ways that climate change researchers have already documented and will no doubt be examining for the rest of our lifetimes and beyond

The natural and physical environment is something that geologists, meteorologists, oceanographers, and other scientists should be studying, not sociologists. Yet the environment is very much a sociological topic for at least five reasons.

1.First, our worst environmental problems are the result of human activity, and this activity, like many human behaviors, is a proper topic for sociological study.

2.Second, environmental problems have a significant impact on people, as do the many other social problems that sociologists study.

3.Third, solutions to our environmental problems require changes in economic and environmental policies, and the potential impact of these changes depends heavily on social and political factors.

4.Fourth, many environmental problems reflect and illustrate social inequality based on social class and on race and ethnicity: as with many issues in our society, the poor and people of color often fare worse when it comes to the environment.

5.Fifth, efforts to improve the environment, often called the environmental movement, constitute a social movement and, as such, are again worthy of sociological study.

- Environmental sociology assumes “that humans are part of the environment and that the environment and society can only be fully understood in relation to each other
- Perhaps more than anything else, environmental sociologists emphasize that environmental problems are the result of human decisions and activities that harm the environment.
- Masses of individuals acting independently of each other make decisions and engage in activities that harm the environment, as when we leave lights on, keep our homes too warm in the winter or too cool in the summer, and drive SUVs and other motor vehicles that get low gas mileage.
- Corporations, government agencies, and other organizations also make decisions and engage in activities that greatly harm the environment. Sometimes individuals and organizations know full well that their activities are harming the environment, and sometimes they just act carelessly without much thought about the possible environmental harm of their actions. Still, the environment is harmed whether or not they intend to harm it.
- Environmental problems are largely the result of human behavior and human decision making. Changes in human activity and decision making are thus necessary to improve the environment.
- Environmental inequality and environmental racism are significant issues. Within the United States and around the world, environmental problems are more often found where poor people and people of color reside.

### **Summary of social change:**

1. Social change involves the transformation of cultural norms and values, behavior, social institutions, and social structure. As societies become more modern, they become larger, more heterogeneous, and more impersonal, and their sense of community declines. Traditions decline as well, while individual freedom of thought and behavior increases. Some sociologists view modernization positively, while others view it negatively.
2. A functionalist understanding of social change emphasizes that it is both natural and inevitable. Talcott Parsons’s equilibrium model recognized that gradual change is desirable and ordinarily stems from such things as population growth and technological

advances, but that any sudden social change disrupts society's equilibrium. Such social change often stems from intentional efforts by social movements to correct perceived deficiencies in the social, economic, and political systems.

3. Several sources of social change exist. These include population growth and changes in population composition, changes in culture and technology, changes in the natural environment, and social and ethnic conflict.
4. Environmental sociology is the sociological study of the environment. One major emphasis of environmental sociology is that environmental problems are largely the result of human activity and human decision making.
5. A second major emphasis of environmental sociology is that environmental problems disproportionately affect low-income people and people of color. These effects are called environmental inequality and environmental racism, respectively.

### **Common features of social change:**

**Universality:** Change is universal, an eternal and invariable law of nature. Social changes take place in all the societies of the world. Therefore, social change is universal in character.

**Continuity:** Social change is a continuous process. It does not take place at one point of time only. It takes place all the time at all the places. However, we can predict some direction of change.

**Variation:** Social change is relative in time, and according to a specific period in time, its rate may be high or low. The rate and quantum of change varies from one society to another depending upon the prevailing conditions.

**Criteria of larger population:** Only those changes are considered as social change that affects larger population. Social change is accepted as such only when the majority of individuals in a society accept it in their life, behaviour and beliefs.

**Independence:** Social change is independent of the desire and will of the people or society.

**Forces:** Social change is caused due to internal and external forces.

**Planned as well unplanned:** There was a time when changes were unplanned and un directed. But in the modern time changes can be planned to achieve the goals of the society.

**Structural or functional:** Any change in the social structure or its function is social change.

### **Aspects of social change:**

**Economic aspect:** economic changes include changes in industry, trade, business, commerce, agriculture and materialistic attitude.

**Political aspect:** Political changes include changes in political power and administration of the state, such as adopting the values of democracy, secularism, socialism, communism and fascism.

**Religious aspect:** In religious aspect we include those changes which affect changes in various religious institutions like Gurudwara, Temple, Church, Mosque etc. Their importance in the present age has been decreased because of modernisation.

**Moral aspect:** Moral changes are the changes in moral values, ideas, beliefs, such as co-education was not thought to be good in ancient times. It is not regarded as immoral in the modern age.

**Cultural aspect:** Cultural changes are the change in the culture , values, traditions and customs such as dancing was thought to be an immoral act in the past, where as it is culturally accepted every where now. Similarly, actors and actresses has become a role model for the present generation where as they were not socially accepted earlier as the same.

**Scientific and technological aspect:** Scientific and technological changes are caused by scientific and technological discoveries and inventions.

### **Factors affecting social changes in India:**

**Geographical factor (Physical environment):** Social change takes place due to physical environment or geographical factor. Floods, earthquakes, famine, epidemics, fires, excessive rains, drought hot or cold climate transform the life style of people. The changing face of the earth due to advancing deserts or due to irrigation also affects population to a great extent.

**Biological factor:** Biological factors like heredity prepare the way for social change. The biological heredity determines the general and glandular constitution of the offspring which is closely related to temperament, intelligence, physique, activity level and other potentialities of individuals. Biological factors result into better equipped or less equipped persons, strong or weak persons and several other changes in social set up.

**Demographic factor:** Population plays a vital role in social change. Due to increase or decrease in population the possibility of social change is also influenced. Because of these factors change in social structure of the country is taking place at a rapid speed. Decrease or increase in the population has an immediate effect upon economic institutions and associations. The ratio of men to women in a society affects marriage, family and the condition of women in a society.

**Technological and scientific factors:** Technological and scientific inventions such as various types of machines and equipments etc. are potent factors in social change. They break regional barriers by providing easy and fast means of communication as well as of conveyance. The press, radio and aeroplane together have brought the world closer and provided for intercultural impacts. Scientific inventions in the field of medicine, public health, community organization, the means of transportation, the means of knowledge, dissemination and interaction, and physical environment are regarded as significant factors in social change.

**Ideological factors:** Social change is caused by ideological factors. Ideas rule the world. Philosophical, scientific and political ideas significantly influence social change. New scientific thoughts, new religious ideas, new philosophies revolutionize the world. Rise of Buddhism, Communism, and Fascism have magically influenced new thought and human mind and changed its attitudes and values of life.

**Cultural factors:** Human culture is a process of change. Any change in cultural order is accompanied by a corresponding change in the whole social order. Culture gives speed and direction to social change and determines the limits beyond which social changes cannot occur. Cultural factors change from generation to generation and they bring about the change in the society.

**Psychological factors:** Psychological factors are important elements in social change. Man by nature is a lover of change. He is always trying to discover new things in every sphere of his life and is always anxious for new experiences. As a result of this tendency the most traditions, customs etc. of every human society are undergoing perpetual change.

**War:** War is also a cause of social change because it influences the population, the economic situation and ratio of males to female, etc.

**New opinions and thoughts:** Another factor of social change is the appearance of new opinions and thoughts. For example changes in the attitudes towards dowry, caste system, female education, etc. have resulted in wide spread social variations and modifications. In fact, a majority of the social revolutions take place as a result of the evolution of new ways of thinking.

**Voluntary acts of individuals:** History is replete with examples where "all important social and cultural changes are brought about by men of genius." In the modern world, Lenin in Russia and Mahatma Gandhi in India, have had a profound influence, and it would be difficult to demonstrate that our world would have been different had they not lived and acted as they did.

**Acceptance by high status individuals:** Any change would become easily accepted in the society if the people who are in high position would accept the change.

**Legislation:** Legislation plays an important role in bringing about planned social change. Abolition of slavery in the U.S.A. could be affected by legislation and it brought about massive change in the social structure and systems of not only the U.S.A. But other parts of the world as well. Compulsory primary and secondary education in Western and Asian countries, legislation against practice of untouchability, raising the age of marriage by law, ensuring the property rights of women, are a few measures which have brought about radical social changes in various countries including India.

**Education:** Education is the most powerful factor of social change and it is discussed separately.

### **Other Factors:**

**Westernization:** Westernization means blind imitation of the social ways and values prevailing in western countries. The trend towards Westernization in India can be seen in all fields— social,



economic, political, cultural, religious and educational. India is following the example of the West. In the social sphere we are following the West in matters like dress, life style and town-planning etc.

**Industrialization:** India is fully resolved to bring about fast industrialization. There is increase in industrialization. Industries have taken the place of agriculture. Agriculture has itself transformed into an industry. The application of science and technology to industry has increased substantially. Chemical fertilizers, improved seeds, mechanical devices, pesticides etc. have come into wide spread use. Thus industrialization in India is responsible for social change.

**Urbanization:** Urbanization is the result of industrialization. Moreover, the fast growth of population of India has led to fast urbanization in India. Urbanization has resulted in an increase in the number of industrial cities and mobility of villagers towards the cities.

**Secularization:** Secularization promotes change. The people of India have adopted the ideal of secularism according to which everybody is free to follow the religion of their choice. In the wider sense secularism includes compassion, tolerance, diversification, broad outlook and unorthodoxy.

**Mechanicalization:** Our way of thinking, standard of living, means of communication, transportation and production, business and industries have been influenced by machines. Mechanicalization and social changes are related to each other.

**Democratization:** India is becoming progressively democratized. In India there is universal adult franchise. Everybody above a certain age is entitled to elect his representative. Every body is equal before law and enjoys equal rights and privilege.

**Monopolization:** Selected few persons have monopolized over big business concerns because of the development of capital.

**Politicalization:** There is politicalization due to political parties, political leaders, rights and duties, and regional, national and international relations. Student unrest, teacher unrest and unrest among the masses is because of politicalization.

**Capitalism:** Large scale production, development of business, expansion of education, increase in number of specialists, scientific inventions, progress in literature, music and art are the contributions of capitalism. More capitalistic view point is the result of capitalism

**Culturalization:** The most important feature of social change is culture. In cultural sphere, change is characterized by the spread of literacy and secular education, emergence of new cultural outlook and emergence of new personality orientation, traits and characteristics revealed in greater ability to adjust to the broader social horizons.

**Materialistic attitude:** We have become materialistic. We want to enjoy all the comforts of modern life such as television, refrigerator, air conditioning, means of conveyance, etc. Materialistic attitude is conducive to change.

**Indianisation:** In the development of India society there has never been divorce from past traditions and noble values of life. A glimpse of Indianisation is observed in meditation, prayer, recitation of hymns. Many foreigners in India have stated dressing and behaving in Indian style.

**Modernization:** Modernization is a process which brings desired types of changes in material as well as non-material culture including the way of life as a whole. It brings positive changes in the social, economic, industrial, technological, cultural, moral, religious and educational structure, value orientations, motivations, achievements and aspirations. It means a value change, significant institutional modifications and improvement.

### **Economic Focus:**

- **Economics** is the social science that studies the production, distribution, and consumption of goods and services.
- Economics focuses on the behaviour and interactions of economic agents and how economies work
- Economic analysis can be applied throughout society, in business, finance, health care, and government.
- Economic analysis is sometimes also applied to such diverse subjects as crime, education, the family, law, politics, religion, social institutions, war, science, and the environment.

- Economics has been defined as "the study of scarcity and choice" and is basically about the choices people make.
- The subjects in economic study are households, business companies, the government (the state), and foreign countries.

### **General economic rules:**

1. All people have to decide between their options.
2. The cost of goods is what a person gives up for the goods.
3. People choose between options based on the rewards ("incentives") or bad things ("disincentives") they expect from each option. Adding to the rewards for an option will often make more people choose it.
4. Trade can make everyone better off .
5. Sometimes prices do not fully show the cost or benefit to society. For example, air pollution is bad for society, and education is good for society. The government can put a tax (or do something to reduce sales) on items that are bad for society. It can also support (like giving money for) items that are good for society.
6. The living standard of a country depends on the skills to produce services and goods. Productivity is the amount of the produced goods divided by total working hours.
7. When there is an increase in the total money supply, or when the cost to produce things rises, prices go up. This is called inflation.

### **Branches of economics**

The two main branches of economics are,

#### **1. Microeconomics**

Microeconomics is about smaller and more specific things such as how families and households spend their money and how businesses operate.

#### **2. Macroeconomics.**

Macroeconomics is about the economy in general. For example, macroeconomists study things that make a country's wealth go up and things that make millions of people lose their jobs.

**Other branches of economics:**

- Behavioral economics
- Business economics
- Constitutional economics
- Cultural economics
- Development economics
- Ecological economics
- Economic geography
- Environmental economics
- Energy economics
- Financial economics
- Industrial economics
- Information economics
- International economics
- Labor economics
- Managerial economics
- Mathematical economics or econometrics
- Resource economics
- Urban economics
- Public economics
- Descriptive, theoretical and policy economics
- Monetary economics

**Types of economic system:****1. Traditional Economic System**

The traditional economic system is the most traditional and ancient types of economies in the world. Vast portions of the world still function under a traditional economic system. These areas tend to be rural, second- or third-world, and closely tied to the land, usually through farming. In general, in this type of economic system, a surplus would be rare. Each member of a

traditional economy has a more specific and pronounced role, and these societies tend to be very close-knit and socially satisfied. However, they do lack access to technology and advanced medicine.

## **2. Command Economic System**

In a command economic system, a large part of the economic system is controlled by a centralized power. For example, in the USSR most decisions were made by the central government. This type of economy was the core of the communist philosophy. Since the government is such a central feature of the economy, it is often involved in everything from planning to redistributing resources. A command economy is capable of creating a healthy supply of its resources, and it rewards its people with affordable prices. This capability also means that the government usually owns all the critical industries like utilities, aviation, and rail road. In a command economy, it is theoretically possible for the government to create enough jobs and provide goods and services at an affordable rate. However, in reality, most command economies tend to focus on the most valuable resources like oil.

## **3. Market Economic System**

In a free market economy, firms and households act in self-interest to determine how resources get allocated, what goods get produced and who buys the goods. This is opposite to how a command economy works, where the central government gets to keep the profits. There is no government intervention in a pure market economy . However, no truly free market economy exists in the world. For example, while America is a capitalist nation, our government still regulates (or attempts to control) fair trade, government programs, honest business, monopolies, etc.

In this type of economy, there is a separation of the government and the market. This separation prevents the government from becoming too powerful and keeps their interests aligned with that of the markets.

## **4. Mixed Economic System**

A mixed economy is a combination of different types of economic systems. This economic system is a cross between a market economy and command economy. In the most common types

of mixed economies, the market is more or less free of government ownership except for a few key areas like transportation or sensitive industries like defense and railroad. However, the government is also usually involved in the regulation of private businesses. The idea behind a mixed economy was to use the best of both worlds – incorporate policies that are socialist and capitalist. To a certain extent, most countries have a mixed economic system. For example, India and France are mixed economies.

### **GLOBALIZATION AND ITS IMPACTS**

- Globalization or globalisation is the process of interaction and integration among people, companies, and governments worldwide.
- Globalization has grown due to advances in transportation and communication technology. With the increased global interactions comes the growth of international trade, ideas, and culture.
- Globalization is primarily an economic process of interaction and integration that's associated with social and cultural aspects.
- Globalization has had far-reaching effects on our lifestyle. It has led to faster access to technology, improved communication and innovation. Apart from playing an important role in bringing people of different cultures together, it has ushered a new era in the economic prosperity and has opened up vast channels of development.
- However, globalization has also created some areas of concern, and prominent among these is the impact that it has had on the environment. Globalization has featured extensively in the debates on environmentalism, and green activists have highlighted its far-reaching effects. Let us know about the impact of globalization on our environment.
- Activists have pointed out that globalization has led to an increase in the consumption of products, which has impacted the ecological cycle. Increased consumption leads to an increase in the production of goods, which in turn puts stress on the environment. Globalization has also led to an increase in the transportation of raw materials and food from one place to another.

- Earlier, people used to consume locally-grown food, but with globalization, people consume products that have been developed in foreign countries.
- The amount of fuel that is consumed in transporting these products has led to an increase in the pollution levels in the environment. It has also led to several other environmental concerns such as noise pollution and landscape intrusion.
- Transportation has also put a strain on the non-renewable sources of energy, such as gasoline. The gases that are emitted from the aircraft have led to the depletion of the ozone layer apart from increasing the greenhouse effect.
- The industrial waste that is generated as a result of production has been laden on ships and dumped in oceans. This has killed many underwater organisms and has deposited many harmful chemicals in the ocean.
- The damage caused to ecosystem from the oil that spilled from one of the leaking containers of British Petroleum in 2010 is just one of the examples of the threat globalization poses to the environment.
- Due to globalization and industrialization, various chemicals have been thrown into the soil which has resulted into the growth of many noxious weeds and plants. This toxic waste has caused a lot of damage to plants by interfering in their genetic makeup. It has put pressure on the available land resources.
- In various parts of the world, mountains are being cut to make way for a passing tunnel or a highway. Vast barren lands have been encroached upon to pave way for new buildings. While humans may rejoice on the glimmer with these innovations, these can have long-term effects on the environment. Various studies over the years, have found that plastic is one of the major toxic pollutants, as it is a non-biodegradable product.
- However, plastic is of immense use when it comes to packaging and preserving goods that are to be exported. This has led to increased use of plastic, causing widespread environmental pollution.
- It has made so many changes in our lives that reversing it is not possible at all. The solution lies in developing effective mechanisms that can check the extent to which it can impact the environment. Researchers are of the view that the answer to this problem lies in the problem itself, that is, globalization itself can lend support to building a better structure which is economically feasible and environment-friendly. Globalization is about

competition, and if certain privately owned companies can take the lead in being environment friendly, then it will encourage others to follow suit.

- Further, environmental challenges such as global warming, cross-boundary water, air pollution, and over-fishing of the ocean are linked with globalization. Globalizing processes affect and are affected by business and work organization, economics, socio-cultural resources, and the natural environment.
- It is important that we put in some efforts to maintain harmony with the environment. The survival of human race on this planet is dependent on the environment to such a large extent that we cannot afford to ignore the consequences of our own actions. While there is a lot of debate and discussion on this issue, the need of the hour is to have effective policies in place, and implementation of those policies. The people that we have chosen to represent us have the responsibility of ensuring that the extent of damage on environment is curtailed, if not totally prevented.
- We hope this article helped you in understanding globalization and its impact on the environment and the importance of taking concrete actions against it.

**Identified four basic aspects of globalization:**

1. Trade and transactions,
2. Capital and investment movements,
3. Migration and movement of people, and
4. The dissemination of knowledge.

**Globalization subdivides into three major areas:**

- (i) Economic globalization,
- (ii) Cultural globalization, and
- (iii) Political globalization



## **Effects of globalization:**

### **1.Positive effect of globalization:**

#### **Global market**

The privatization of industries owned by the state has enabled the emerging markets to be successful. Most of the companies are increasing the consumer demand through extension and expansion of their value chain to international levels. As a result, the positive effects of globalization are expressed by the rising transactions across the borders.

Globalization has resulted in the formation of multinational corporations. The concentration of corporations in specific geographical economies has led to investment in other new geographical areas, where market competition is very high. Due to increased competition, the corporations continue to enlarge their market, in order to enjoy the economies of scale. This is because globalization enables economies to compete fairly at all levels, hence attracting investors.

#### **Competition**

Competition in the market is largely due to globalization. As a result, the positive effects are visible, since global competition leads to products of high quality. The enhanced quality of both products and services are based on production approaches of customer demands and customer services.

For domestic companies to survive in the market, they are forced to raise their customer satisfaction levels, as well as their standards, while fighting competition from foreign companies. Besides, a global product must live to its goodwill when it gets into a new country. For example, the competition between Samsung and Apple has raised the market standards, as well as the customer service. Also, the two brands are living on their goodwill to survive the competition.

#### **Culture**

Globalization has resulted in numerous positive effects on culture. There is no single civilization that had all good practices. Instead, the coming together of various cultures has made the world

today a better place. The welcoming of people from various backgrounds and civilizations has resulted in the creation of new cultures, thus leading societal growth.

### **Legal effects**

Human rights have been improved as a result of globalization since media coverage on violations of the rights receives attention from all over the world. It is through globalization that leaders address inequalities since information and openness get promoted. In most cases, the result is enhanced prosperity and democracy.

### **Stable security**

Although the effect cannot be seen directly, globalization has contributed greatly in enhancing the world security. For example, it is extremely difficult to see two countries attacking each other if the economy of one of the countries depends largely on the economy of the other country.

Irrespective of the many violence that is being experienced in the world today, it is evidently clear that if some countries were not depending on each other's economy, deadlier conflicts could have or would occur, but all have been halted by globalization.

## **2.Negative Effects of Globalization**

### **Environmental Damage**

Increased production means increased utilization of natural resources. Besides, increased trade results to increased transport, which uses fossil fuels. As a result, pollution has increased, leading to climate change. The changes in climate are now a serious threat to humanity and the future of the world, all because of globalization.

### **Fluctuation in prices**

Globalization has led to increased market competition, hence leading to fluctuation in prices. For example, developed countries like the USA have been forced to reduce their products prices, because countries such as China offer the same products at cheaper prices. This is because the production cost in China is lower than in the USA. As a result, for developed countries like the

US to withstand the competition and have customers, they are forced to lower their prices. The impact is adverse, as the ability to sustain social welfare in the US gets reduced.

### **Job insecurity**

Due to globalization, most global economy jobs are insecure and temporary. The impact is mostly felt in developed countries since they can outsource cheaper white collar and manufacturing jobs. For example, wages and manufacturing costs are lower in India and China, making countries like US and UK to outsource cheaper labor. The effect is people in developed countries losing or having few jobs.

### **List of the Advantages of Globalization:**

#### **1. Globalization allows us to pool all our resources together.**

One of the best examples of globalization within our lifetime is the construction of the International Space Station. The United States, Russia, Canada, Europe, and Japan are all involved in the financing and continued operations of the program.

#### **2. Globalization would also reduce labor exploitation issues.**

When borders become less restrictive around the world, people tend to move to locations where their best opportunities exist. Under the current structure of our planet, impoverished nations with a lower standard of living offer wages that the developed world would find abysmal. Someone in Bangladesh making clothes for 10 hours per day earns less in a month than some workers in the U.S. earn before lunch.

By focusing on globalization, we could reduce child labor issues. Human trafficking concerns would be limited because of more border freedom. People could live, work, or go where they please with fewer restrictions, making it easier to chase their dreams.

#### **3. Globalization reduces the prospects of tyranny.**

As the world moved slowly toward globalization in the 20th century, the nations realized that having a concentrated power with one administration reduced the likelihood of tyranny in pockets around the globe. Although there have still be issues with government oppression,

including the chemical attacks on populace centers in Syria, the number of incidents is slowly declining. When we're able to move toward a global-centric society instead of a nation-centric one, these issues will continue to decline over time.

#### **4. Globalization improves communication access.**

Under a globalization perspective, people would have their risks associated by a central perspective instead. It would be like the United Nations vetting immigrants instead of the individual country. By reducing border restrictions, we improve communication access because we're no longer restricting the movements and actions of people on a per-nation basis.

#### **5. Globalization would remove tax havens for wealthy individuals and businesses.**

Tax havens are defined as either a country or independent area where taxation levies are at low rates. They offer foreign businesses and individuals an opportunity to keep their profits in local institutions with little or no liability. These havens share little, if any, information about these finances with other tax authorities.

Globalization reduces this issue because it eliminates the administrative structures in place which allow the wealthy to hide their funds from being taxed. That would mean these businesses and people would be treated as an average citizen is today. Greater transparency here would lead to better funding of social programs, which could reduce poverty and food insecurity over time.

#### **6. Globalization would help the developing world progress faster.**

Most of the world today is not developed. Outside of about 40 countries which have gone through their own version of the Industrial Revolution, the rest of the population still struggles as a primarily agricultural society. By reducing border restrictions, creating common payment formats, and opening product access by reducing export barriers, more people could improve their way of life. Higher incomes often lead to lower maternal and infant mortality rates too, which means we would be saving lives with this effort.

#### **7. Globalization would reduce currency manipulation problems.**

There are three primary currencies traded in the world today: the Dollar, the Euro, and the Pound Sterling. When a nation offers access to a weaker currency, those with stronger currencies buy

and sell more often with them. It offers better value than spending at home. Globalization would reduce the efforts made to build weakness or strength into these currencies to influence local markets. We would be working toward a society where economic growth occurs on a global scale instead of in only local economies.

#### **8. Globalization encourages free trade.**

Borders create restrictions to the free flow of goods and services. One example of this issue is a duty and taxes paid on imported goods originating in the U.S. when purchased in Canada. These taxes apply on luxury items and other items of high value. The HST in Canada may be collected at a rate of 13%. Canadians use shipping service receptacles at locations like Point Roberts, WA to get around this tax simply because the laws haven't globalized like our access to goods.

#### **9. Globalization could create more employment opportunities.**

With fewer barriers to the import/export market, the cost of producing goods or offering services would decline without affecting the profit margins of companies. Consumers would benefit from the lower prices, consume more, and create additional job opportunities around the world. By creating an environment where free trade encouragement readily exists, more innovation, creativity, and engagement would occur at every level of society.

### **List of the Disadvantages of Globalization**

#### **1. Globalization may encourage more off shoring instead of less.**

With fewer restrictions in place at the national level, some businesses may use off shoring to their advantage. Even if they kept jobs local, the threat of sending jobs to a different, cheaper region overseas could be used to justify lower wages at home. The end result of an effort to remove borders would be an increase in wages in the developing world, but a decrease in developed countries. Many households could see their standard of living go down if consumable price decreases don't occur simultaneously.

#### **2. Globalization benefits the wealthy more than the poor.**

Value-added taxes above 25% exist in some nations. Tariffs above 70% exist for some products. Unless borders are completely removed, the advantages of globalization are challenging to

achieve. The people who have the power to dictate policy would reap the most significant rewards. Those with money to invest would see their bank accounts continue to rise. At the same time, households living paycheck-to-paycheck would struggle to access what they require, suppressing their ability to pursue a better job.

### **3. Globalization would encourage disease transfer.**

The outcome of the Columbian Exchange was profound at the time. Over 90% of some population centers died because of their exposure to smallpox, chickenpox, and other diseases that the Europeans were somewhat immune to at the time. The Europeans brought back syphilis and other diseases as well. If global travel restrictions eased, then issues with malaria and tropical disease could spread to portions of the world where exposures are minimal. Tuberculosis, certain influenza strains, and other communicable disease could produce outbreaks at epidemic levels.

### **4. Globalization could reduce social safety net programs.**

Most nations today offer those in extreme poverty access to safety net programs for basic supplies..

### **5. Globalization would create a new system of politics.**

We have already received a sneak peek of what a global society would be like from a political perspective. The individuals and organizations who spend the most to lobby politicians would receive the best chance of having their needs met first. We have seen billions spent in U.S. elections lately to influence legislation and policy to become favorable toward specific outcomes. This issue would translate to a global economy, where only the richest and most influential would influence laws which would impact everyone.

### **6. Globalization would not prevent resource consumption.**

The goal of globalization is to equalize patterns of consumption for populations around the world. Even though there would be movement toward doing so, there is no getting around the fact that the wealthiest nations will still consume the most resources. The 20 richest countries in the world today consume almost 90% of the planet's resources each year. The United States

constitutes 5% of the global population right now, but it consumes 24% of the world's energy as a country.

### **7. Globalization would make it easier for people to cheat.**

The statistics of consumption (especially food) show us already that those who are in power take the majority of resources away from the general population. Globalization would likely centralize distribution of necessary resources. With only a few controlling access to the many, the chance to negatively impact populations on a large scale become greater when borders are reduced.

### **8. Globalization doesn't fix a lack of skills.**

The future of employment involves programming, robotics, and artificial intelligence. Workers who adapt to automation with their skillset are the most likely to find employment in the coming generations. Jobs which require repetitive functions will be the first to go away, which are the employment opportunities often found in the developing world. With no meaningful skills to a globalized economy, there could be a higher unemployment rate if border restrictions reduce because only those in the developed world would be trained for the new economy. Unless new vocational development opportunities implement with the globalization structures, the boundaries between the developed and developing world will likely continue to exist.

### **9. Globalization changes how humans would identify themselves.**

Humans are global citizens in some ways already. We all share the same planet, after all, so we are united with that common ground. If we lose borders, however, we also lose a piece of our culture, ethnicity, or family heritage. People identify themselves based on their history, so being Irish in a global world would have less impact than it does today..

### **10. Globalization would negatively impact the environment.**

Micro-plastics invaded our oceans, creating negative impacts on marine life. The waters of our planet are slowly acidifying, creating economic and health impacts every day.

## **The important factors are:**

### **(1) Historical:**

The trade routes were made over the years so that goods from one kingdom or country moved to another. The well known silk-route from east to west is an example of historical factor.

### **(2) Economy:**

The cost of goods and values to the end user determine the movement of goods and value addition. The overall economics of a particular industry or trade is an important factor in globalisation.

### **(3) Resources and Markets:**

The natural resources like minerals, coal, oil, gas, human resources, water, etc. make an important contribution in globalisation. The mineral based industries like steel, aluminium, coal in Australia are examples. Few of these Australian mining and metal companies are owned by European / Japanese / American companies.

Near distance to end user or consumer also is an important factor in globalisation. The large markets as consumer bases in Asian countries have led many European, Korean to Japanese manufacturing conglomerates and shift their manufacturing and trading bases in Asian countries.

### **(4) Production Issues:**

Utilization of built up capacities of production, sluggishness in domestic market and over production makes a manufacturing company look outward and go global. The development of overseas markets and manufacturing plants in autos, four wheelers and two wheelers is a classical example.

### **(5) Political:**

The political issues of a country make globalisation channelised as per political bosses. The regional trade understandings or agreements determine the scope of globalization.

### **(6) Industrial Organisation:**



The technological development in the areas of production, product mix and firms are helping organizations to expand their operations. The hiring of services and procurement of sub-assemblies and components have a strong influence in the globalization process.

### **(7) Technologies:**

The stage of technology in a particular field gives rise to import or export of products or services from or to the country. European countries like England and Germany exported their chemical, electrical, mechanical plants in 50s and 60s and exports high tech (then) goods to under developed countries. Today India is exporting computer / software related services to advanced countries like UK, USA, etc.

### **Eight barriers in economic activities:**

Many countries in Particular developing ones impose restrictions to globalisations by:

- i. Imposing high taxes and duties for capital goods, spares and materials,
- ii. Licensing restrictions,
- iii. Foreign exchange restrictions,
- iv. Investment restrictions,
- v. Incentives and prioritization to specific domestic industries, and
- vi. Banning / restricting products of foreign origin.
- vii. Procedural hassles, bureaucracy
- viii. Closed mind-set

## **AGRO ECOSYSTEMS**

An agroecosystem is the basic unit of study in agroecology, and is somewhat arbitrarily defined as a spatially and functionally coherent unit of agricultural activity, and includes the living and nonliving components involved in that unit as well as their interactions.

An agroecosystem can be viewed as a subset of a conventional ecosystem. As the name implies, at the core of an agroecosystem lies the human activity of agriculture. However, an agroecosystem is not restricted to the immediate site of agricultural activity (e.g. the farm), but rather includes the region that is impacted by this activity, usually by changes to the complexity of species assemblages and energy flows, as well as to the net nutrient balance. Traditionally an agroecosystem, particularly one managed intensively, is characterized as having a simpler species composition and simpler energy and nutrient flows than "natural" ecosystem. Likewise, agroecosystems are often associated with elevated nutrient input, much of which exits the farm leading to eutrophication of connected ecosystems not directly engaged in agriculture.

Some major organizations are hailing farming within agro ecosystems as the way forward for mainstream agriculture. Current farming methods have resulted in over-stretched water resources, high levels of erosion and reduced soil fertility. According to a report by the International Water Management Institute and the United Nations Environment Programme, there is not enough water to continue farming using current practices; therefore how critical water, land, and ecosystem resources are used to boost crop yields must be reconsidered. The report suggested assigning value to ecosystems, recognizing environmental and livelihood tradeoffs, and balancing the rights of a variety of users and interests, as well addressing inequities that sometimes result when such measures are adopted, such as the reallocation of water from poor to rich, the clearing of land to make way for more productive farmland, or the preservation of a wetland system that limits fishing rights

Forest gardens are probably the world's oldest and most resilient agroecosystem. Forest gardens originated in prehistoric times along jungle-clad river banks and in the wet foothills of monsoon regions. In the gradual process of a family improving their immediate environment, useful tree and vine species were identified, protected and improved whilst undesirable species

were eliminated. Eventually superior foreign species were selected and incorporated into the family's garden.

One of the major efforts of disciplines such as agroecology is to promote management styles that blur the distinction between agroecosystems and "natural" ecosystems, both by decreasing the impact of agriculture (increasing the biological and trophic complexity of the agricultural system as well as decreasing the nutrient inputs/outflow) and by increasing awareness that "downstream" effects extend agroecosystems beyond the boundaries of the farm . In the first case, polyculture or buffer strips for wildlife habitat can restore some complexity to a cropping system, while organic farming can reduce nutrient inputs. Efforts of the second type are most common at the watershed scale. An example is the National Association of Conservation Districts' Lake Mendota Watershed Project, which seeks to reduce runoff from the agricultural lands feeding into the lake with the aim of reducing algal blooms.

Agroecosystems are often more difficult to study than natural ecosystems because they are complicated by human management which alters normal ecosystem structures and functions. There is no disputing the fact that for any agroecosystem to be fully sustainable, a broad series of interacting ecological, economic, and social factors and processes must be taken into account. Still, ecological sustainability is the building block upon which other elements of sustainability depend. An agroecosystem is created when human manipulation and alteration of an ecosystem take place for the purpose of establishing agricultural production. This introduces several changes in the structure and function of the natural ecosystem and as a result, changes in a number of key system level qualities. These qualities are often referred to as the emergent qualities or properties of systems , qualities that manifest themselves once all of the component parts of the system are organized.

### **Agro ecosystem analysis :**

- Agro ecosystem analysis is a thorough analysis of an agricultural environment which considers aspects from ecology, sociology, economics, and politics with equal weight.
- There are many aspects to consider; however, it is literally impossible to account for all of them. This is one of the issues when trying to conduct an analysis of an agricultural environment.
- In the past, an agro ecosystem analysis approach might be used to determine the sustainability of an agricultural system.

- It has become apparent, however, that the "sustainability" of the system depends heavily on the definition of sustainability chosen by the observer.
- Therefore, agro ecosystem analysis is used to bring the richness of the true complexity of agricultural systems to an analysis to identify reconfigurations of the system (or holon) that will best suit individual situations.
- Agro ecosystem analysis is a tool of the multidisciplinary subject known as Agroecology. Agro ecology and agro ecosystem analysis are not the same as sustainable agriculture, though the use of agro ecosystem analysis may help a farming system ensure its viability.
- Agro ecosystem analysis is not a new practice, agriculturalists and farmers have been doing it since societies switched from hunting and gathering (hunter-gatherer) for food to settling in one area.
- Every time a person involved in agriculture evaluates their situation to identify methods to make the system function in a way that better suits their interests, they are performing an agro ecosystem analysis.

## **Elements of Agroecology:**

There are ten elements of agroecology,

- 1.Diversity
2. Co-creation and sharing of knowledge
- 3.Synergies
- 4.Efficiency
- 5.Recycling
6. Resilience
- 7.Human and social values.
8. Culture and food traditions
- 9.Responsible Governance
- 10.Circular and Solidarity economy

**Some of the key emergent qualities of ecosystems, and how they are altered as they are converted to agro ecosystems, are as follows:**

- **Energy Flow**

Energy flows through a natural ecosystem as a result of complex sets of trophic interactions, with certain amounts being dissipated at different stages along the food chain, and with the greatest amount of energy within the system ultimately moving along the detritus pathway. Annual production of the system can be calculated in terms of net primary productivity or biomass, each component with its corresponding energy content. Energy flow in agroecosystems is altered greatly by human interference. Although solar radiation is obviously the major source of energy, many inputs are derived from human-manufactured sources and are most often not self-sustaining. Agroecosystems too often become through-flow systems, with a high level of fossil fuel input and considerable energy directed out of the system at the time of each harvest. Biomass is not allowed to otherwise accumulate within the system or contribute to driving important internal ecosystem processes (e.g. organic detritus returned to the soil serving as an energy source for microorganisms that are essential for efficient nutrient cycling). For sustainability to be attained, renewable sources of energy must be maximized, and energy must be supplied to fuel the essential internal trophic interactions needed to maintain other ecosystem functions.

- **Nutrient Cycling**

Small amounts of nutrients continually enter an ecosystem through several hydrogeochemical processes. Through complex sets of interconnected cycles, these nutrients then circulate within the ecosystem, where they are most often bound in organic matter. Biological components of each system become very important in determining how efficiently nutrients move, ensuring that minimal amounts are lost from the system. In a mature ecosystem, these small losses are replaced by local inputs, maintaining a nutrient balance. Biomass productivity in natural ecosystems is linked very closely to the annual rates at which nutrients are able to be recycled. In an agroecosystem, recycling of nutrients can be minimal, and considerable quantities are lost from the system with the harvest or as a result of leaching or erosion due to a great reduction in permanent biomass levels held within the system. The frequent exposure of bare soil between crop plants during the season, or from open fields between cropping seasons, creates "leaks" of nutrients from the system. Modern agriculture has come to rely heavily upon nutrient

inputs derived or obtained from petroleum-based sources to replace these losses. Sustainability requires that these “leaks” be reduced to a minimum and recycling mechanisms be reintroduced and strengthened. Ultimately, human societies need to find ways to return nutrients consumed in agricultural products back to the fields – the agroecosystems that consumed and produced them in the first place.

- **Population Regulating Mechanisms**

Through a complex combination of biotic interactions and limits set by the availability of physical resources, population levels of the various organisms are controlled, and thus eventually link to and determine the productivity of the ecosystem. Selection through time tends toward the establishment of the most complex structure biologically possible within the limits set by the environment, permitting the establishment of diverse trophic interactions and niche diversification. Due to human directed genetic selection and domestication, as well as the overall simplification of agroecosystems (i.e. the loss of niche diversity and a reduction in trophic interactions), populations of crop plants or animals are rarely self-reproducing or self-regulating. Human inputs in the form of seed or control agents, often dependent on large energy subsidies, determine population sizes. Biological diversity is reduced, natural pest control systems are disrupted, and many niches or microhabitats are left unoccupied. The danger of catastrophic pest or disease outbreak is high, often despite the availability of intensive human interference and inputs. A focus on sustainability requires the reintroduction of the diverse structures and species relationships that permit the functioning of natural control and regulation mechanisms. We must learn to work with and profit from diversity, rather than focus on agroecosystem simplification.

- **Dynamic Equilibrium**

The species richness or diversity of mature ecosystems permits a degree of resistance to all but very damaging perturbations. In many cases, periodic disturbances ensure the highest diversity, and even highest productivity. System stability is not a steady state, but rather a dynamic and highly fluctuating one which permits ecosystem recovery following disturbance. This promotes the establishment of an ecological equilibrium that functions on the basis of sustained resource use which the ecosystem can maintain indefinitely, or can even shift if the environment changes. At the same time,

rarely do we witness what might be considered large-scale disease outbreaks in healthy, balanced ecosystems. But due to the reduction of natural structural and functional diversity, much of the resilience of the system is lost, and constant human derived external inputs must be maintained. An over-emphasis on maximizing harvest outputs upsets the former equilibrium, and can only be maintained if such outside interference continues. To reintegrate sustainability, the emergent qualities of system resistance and resiliency must once again play a determining role in agroecosystem design and management. We need to be able to analyze both the immediate and future impacts of agroecosystem design and management so that we can identify the key points in each system on which to focus the search for alternatives or solutions to problems. We must learn to be more competent in our agroecological analysis in order to avoid problems or negative changes before they occur, rather than struggle to reverse the problems after they have been created. The agroecological approach provides us one such alternative.

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## **Why AESA is needed:**

It improves decision –making skills, through a field situation analysis by observing, drawing and discussing.

## **The methodology of AESA (Agro ecosystem analysis):**

### **A. Field Observations:**

- a) Enter the field at least 5 ft. away from the bund. Select a site with a dimension of 1 sq. mt. randomly.
- b) Record visual observations in following sequence:-
  - (i) Flying insects (both pests & defenders)
  - (ii) Close observation on pests and defenders which remain on the plants.
  - (iii) Observe pests like *Spodoptera litura* and defenders like ground beetle/ rove beetle/ earwigs by scrapping the soil surface around the plants.
  - (iv) Record disease and its intensity.
- c) Record parameters like number of leaves, branches, plant height and reproductive parts of the selected plants which should be flagged for making observation in the following weeks.
- d) Record the types of weeds, their size and population density in relation to crop plant.
- e) Record soil conditions viz. flooded, wet or dry.
- f) Observe rodent live burrows.
- g) Repeat the step (a) to (f) in four sites randomly selected.
- h) Record the climatic factors viz. sunny, partially sunny, cloudy, rainy etc. for the preceding week.

### **B. Drawing:**

First draw the plant with actual number of branches/ leaves etc. at the centre on a chart. Then draw pests on left side and defender on the right side. Indicate the soil condition, weed population, rodent damage etc. Give natural colours to all the drawing, for instance, draw healthy plant with green colour diseased plant/ leaves with yellow colour. While drawing the pests and the defenders on the chart care should be taken to draw them at appropriate part of the plant, where they are seen at the time of observation. The common name of pest and defenders and their population count should also be given along with diagram. The weather factor should be



reflected in the chart by drawing the diagram of sun just above the plant if the attribute is sunny. If cloudy, the clouds may be drawn in place of sun. In the case of partially sunny, the diagram of sun may be half masked with clouds.

### **C. Group Discussion and Decision making:**

The observations recorded in the previous and current charts should be discussed among the farmers by raising questions relating to change in pest and defender population in relation to crop stages, soil condition weather factors such as rainy, cloudy or sunny, etc. The group may evolve a strategy based upon weekly AESA, ETL and corresponding change in P: D ratio and take judicious decision for specific pest management practices.

### **D. Strategy for decision mating: (Examples):**

- i) When large number of egg masses and early instar larvae of Spodoptera / Helicoverpa are observed, the group may advocate application of NPV.
- ii) Some of the defenders like lady bird beetles, groundnut beetles,rove beetles and wasps play useful role in arriving at P: D ratio.

