Evaporation: During part of the water cycle, the sun heats up liquid water and changes it to a gas by the process of evaporation. Water that evaporates from Earth's oceans, lakes, rivers, and moist soil rises up into the atmosphere.
Transpiration: Transpiration is the process by which plants lose water from their leaves. The water rises in to the air.
Condensation: Water vapour in the air gets cold and changes back into liquid, forming clouds. This is called condensation. Condensation will be in the form of Fog, Dew, and Clouds .
Fog: Fog forms when air near the surface is cold and nearly saturated with water.
Dew: Dew forms at night when air becomes saturated with water vapor.
Clouds: The condensed tiny water droplets forms clouds due to relative humidity to increase in atmosphere.

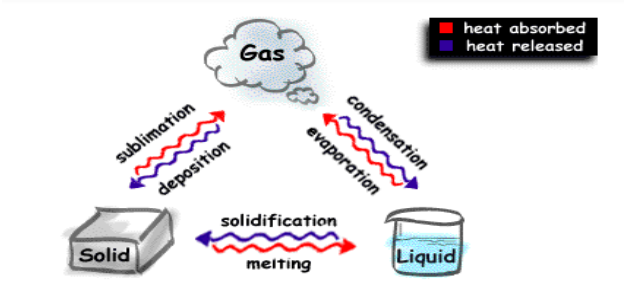
Precipitation: When the water in the clouds gets too heavy, the water falls back to the earth. This is called precipitation.
Precipitation will be in the form of Hail, Snow, Sleet, Rain
Hail: precipitation in the form of balls or irregular lumps of ice (5 mm or more in diameter)
Snow: precipitation composed of white or translucent ice crystals, chiefly in the form of snowflakes.
Sleet: A mixture of rain and snow.
Rain: Rain that falls when surface temperatures are below freezing

Infiltration: downward movement of water into soil.

P**ercolation:** Rainfall seeps underground through a process called percolation, where water travels downwards through the tiny spaces between rocks and soil particles. The water eventually saturates the underlying rock much like water fills the tiny holes of a sponge. This helps to replenish aquifers under the ground.

Run-off: When rain falls on the land, some of the water is absorbed into the ground forming pockets of water called groundwater. Most groundwater eventually returns to the ocean. Other precipitation runs directly into streams or rivers. Water that collects in rivers, streams, and oceans is called runoff.

THE 6 CHANGES OF STATE OF WATER DURING WATER CYLCLE



2. a. What is an Aquifer and Explain types of Aquifer with neat diagram.
b. Define Auitard, Aquiclude, Aquifuge

1. Aquifer

An aquifer is a saturated formation of the earth. It not only stores the water but also yields it in adequate quantity. Aquifers are highly permeable formations and hence they are considered as main sources of groundwater applications. Unconsolidated deposits of sand and gravel are examples of an aquifer.

Aquifers are classified into two types based on their occurrence which are as follows :

- **Unconfined aquifer**
- **Confined Aquifer**

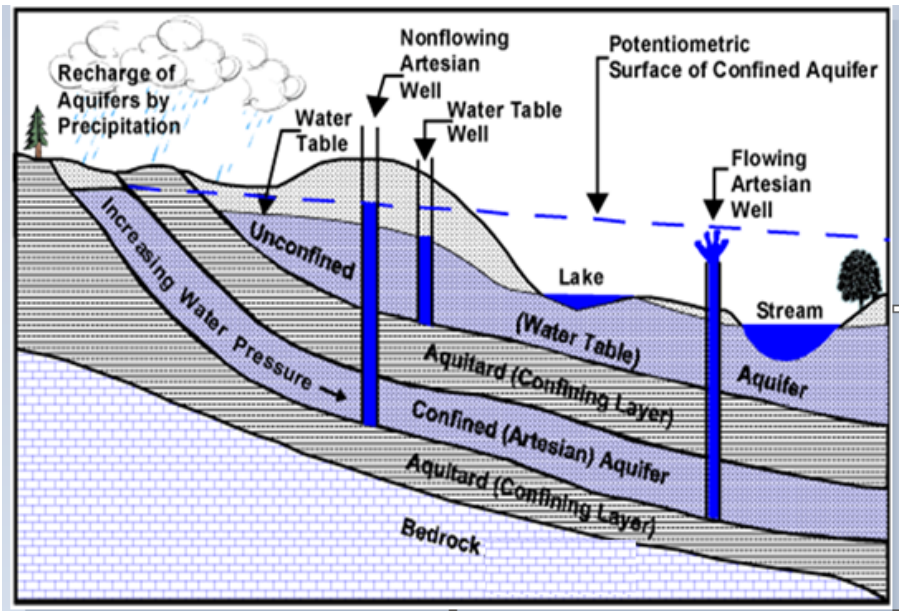
Unconfined aquifer

An unconfined aquifer is an aquifer which has free water surface – which means the water table exists for this type of aquifer. This is also called as water table aquifer or free aquifer or phreatic aquifer. **Unconfined aquifers are recharged by the infiltration of precipitation from the ground surface.**

Unconfined aquifers are those into which water seeps from the ground surface directly above the aquifer.

Confined Aquifer

A confined aquifer is an aquifer confined between two impermeable beds such as aquifuge, aquiclude, etc. The water in the confined aquifer will be under greater pressure which is greater than atmospheric pressure. Hence, the water level shown by piezometer is always higher than the top level of the confined aquifer. The recharge of confined aquifer occurs at a place where it exposes to the ground surface.



2. Aquitard

An aquitard is also a saturated formation. It permits the water through it but does not yield water in sufficient quantity as much as aquifer does. It is because of their partly permeable nature. But however, if there is an aquifer under the aquitard then the water from aquitard may seep into the aquifer. **Sandy clay** is a perfect example of an aquitard. Here, the clay particles block the voids present in the sand and make it partly permeable.

3. Aquiclude

An aquiclude is a geological formation which is impermeable to the flow of water. It contains a large amount of water in it but it does not permit water through it and also does not yield water. It is because of its high porosity. **Clay** is an example of aquiclude.

4. Aquifuge

An aquifuge is an impermeable geological formation which is neither porous nor permeable – which means it cannot store water in it and at the same time it cannot permit water through it. Compact rock is an example of aquifuge.

3. **Explain the sources of Groundwater contamination**

Sources of Groundwater Contamination

1. Natural Sources

Naturally occurring substances found in the soils and rocks can be dissolved in water causing contamination. This substances are sulfates, iron, radionuclides, fluorides, manganese, chlorides and arsenic. Others such as the decaying materials in the soil may seep in underground water and move with it as particles.

2. **AGRICULTURE**

Agriculture can also adversely affect groundwater quality. The spreading of slurry, fertilisers and animal waste on the land can result in pollutants such as nitrates and bacteria seeping into underground water sources. These pollutants can have serious adverse effects on the plants, animals and people who rely on these water sources.

3. **Storage Tanks**

May contain gasoline, oil, chemicals, or other types of liquids and they can either be above or below ground. There are estimated to be over 10 million storage tanks buried in the United States and over time the tanks can corrode, crack and develop leaks. If the contaminants leak out and get into the groundwater, serious contamination can occur.

4. **Septic Systems**

Wastewater disposal systems used by homes, offices or other buildings that are not connected to a city sewer system. Septic systems are designed to slowly drain away human waste underground at a slow, harmless rate. An improperly designed, located, constructed, or maintained septic system can leak and release bacteria, viruses, household chemicals, and other contaminants into the groundwater causing serious problems.

5. **Uncontrolled Hazardous Waste**

Hazardous waste, which is any solid or liquid waste that is considered toxic, chemically reactive, flammable or corrosive. Hazardous waste sites can lead to groundwater contamination if there are barrels or other containers laying around that are full of hazardous materials. If there is a leak, these contaminants can eventually make their way down through the soil and into the groundwater.

6. **Landfills**

Landfills are locations where disposable materials are sent, which are then buried underground. Landfills are supposed to have a protective bottom layer to prevent contaminants from getting into the water. However, if there is no layer or it is cracked, contaminants from the landfill (car battery acid, paint, household cleaners, etc.) can make their way down into the groundwater.

7. **Chemicals and Road Salts**

The widespread use of chemicals and road salts is another source of potential groundwater contamination. Chemicals include products used on lawns and farm fields to kill weeds and insects and to fertilize plants, and other products used in homes and businesses. When it rains, these chemicals can seep into the ground and eventually into the water. Road salts are used in the wintertime to put melt ice on roads to keep cars from sliding around. When the ice melts, the salt gets washed off the roads and eventually ends up in the water.

8. **Atmospheric Contaminants**

Since groundwater is part of the hydrologic cycle, contaminants in other parts of the cycle, such as the atmosphere or bodies of surface water, can eventually be transferred into our groundwater supplies.

4. Write a note on a) Flood and its control b) Cyclone and its effect

a. Flood and its control

Flood is overflow of excess water that submerges land and inflow of tide onto land. Floods can form where there is no stream, as for example when abnormally heavy precipitation falls on flat terrain at such a rate that the soil cannot absorb the water or the water cannot run off as fast as it falls.

Floods are caused not only by rain but also by human interference to the surface of the earth. Farming, deforestation, and urbanization increase the runoff from rains; thus storms that previously would have caused no flooding today inundate vast areas.

Some of the major causes are:

- Heavy rainfall
- Heavy siltation of the river bed reduces the water carrying capacity of the rivers/stream.
- Blockage in the drains lead to flooding of the area.
- Landslides blocking the flow of the stream.
- In areas prone to cyclone, strong winds accompanied by heavy down pour along with storm surge leads to flooding

Prevention <u>methods</u> for effective Control of Flood

- **Mapping of the flood prone areas**

  Historical records give the indication of the flood inundation areas and the period of occurrence and the extent of the coverage. Warning can be issued looking into the earlier marked heights of the water levels in case of potential threat. In the coastal areas the tide levels and the land characteristics will determine the submergence areas. Flood hazard mapping will give the proper indication of water flow during floods.

- **Land use control**

  In areas where people already have built their settlements, measures should be taken to relocate to better sites so as to reduce vulnerability.

  No major development should be permitted in the areas which are subjected to high flooding. Important facilities like hospitals, schools should be built in safe areas.

  In urban areas, water holding areas can be created like ponds, lakes or low-lying areas.

- **Construction of engineered structures**

  Construction of Engineering structures like Embankments , Dams & reservoirs, Channel improvement ,Drainage improvement , Diversion of flood rivers to withstand flood forces and seepage.

  The buildings should be constructed on an elevated area. If necessary build on stilts or platform.

- **Flood Control , Detention, Flood proof , Channelization**

  Flood Control aims to reduce flood damage. This can be done by decreasing the amount of runoff with the help of reforestation, protection of vegetation, clearing of debris from streams and other water holding areas, conservation of ponds and lakes etc.

  Detention facilities, such as dams, store flood waters and release them at lower rates, thus reducing or eliminating the need for major downstream flood control facilities, the construction of which would disrupt the developed areas.

  Flood Proofing reduces the risk of damage. Measures include use of sand bags to keep flood water away, blocking or sealing of doors and windows of houses etc. Houses may be elevated by building on raised land.

  The construction of open channels is a commonly used method of reducing the size of a floodplain or floodway. To prevent erosion, channels can be lined with grass, wire-enclosed rock, concrete, riprap or cobblestones placed a few layers deep. Open channels allow water to enter them at almost any point, thus compensating for inadequate tributary collection systems.

- **Flood Management**

  Flood plain zoning ,Flood preparedness ,Flood forecasting ,Afforestation ,Public relief

b. Cyclone and its effect

Cyclones are huge revolving storms caused by winds blowing around a central area of low atmospheric pressure. In the northern hemisphere, cyclones are called hurricanes or typhoons and their winds blow in an anti-clockwise circle. In the southern hemisphere, these tropical storms are known as cyclones, whose winds blow in a clockwise circle.

Effects of Cyclone

Rainfall and Flooding

The thunderstorms produced in a cyclone system produce intense rainfall causing massive flooding, mudslides and landslides.

Storm Surges

A storm surge is an abnormal rise in water that occurs during a cyclone. Potentially disastrous surges occur in coastal areas with low-lying terrain that enables inundation.

Strong Winds

The most prevalent and perhaps best understood effect of cyclones is strong wind. In fact, these strong winds tend to affect the other destructive agents of cyclones.

Erosion

A cyclone's high winds can erode the soil, thereby damaging existing vegetation and ecosystems. This erosion leaves the area exposed and prone to even more wind erosion.

Other Effects

- Tropical Cyclones causes heavy rain fall and land slides
- They causes a lot of damage to life and habitation
- Agriculture land severely effects especially in terms of water supply and soil erosion
- Communication system is badly affected due to cyclone.

5. What is an Earthquake Explain the causes and Effects

An earthquake is a sudden and rapid shaking of the ground due to passage of vibrations beneath the earth surface of rocks. An earthquake is the vibration of the earth produced by the rapid release of energy.

Earthquake Causes

1. Volcanic Eruptions

- When boiling lava tries to break through the surface of the earth, with the increased pressure of gases, certain movements are caused in earth's crust.
- Movement of lava beneath the surface of the earth can also cause certain disruptions. This sends shockwaves through the earth, causing damage.
- These earthquakes are mild. Their range is also limited. However, there have been certain exceptions, with volcanic earthquakes bring death to thousands of people.

2. Tectonic Movements

- The surface of the earth consists of some plates, comprising of the upper mantle. These plates are always moving, thus effecting earth's crust.
- Constructive is when two plates move away from each other, they correspond to mild earthquakes.
- When two plates move towards each other and collide, this is known as destructive plate boundaries. This is very destructive.
- Conservative corresponds to passing by of plates of crust. Earthquakes of this type have varying intensities.

3. Geological Faults

- A geological fault is known as the displacement of plates of their original plane. The plane can be horizontal or vertical. These planes are not formed suddenly but slowly develop over a long period.
- The movement of rocks along these planes brings about tectonic earthquakes. These faults occur due to the impact of geological forces. The displacement of plates creates the fracturing of rocks, which releases a lot of energy. This type of earthquake can be disastrous.

4. Man Made

The interference of man with nature can also become a cause of the earthquake.

Nuclear bombing can send specific type of shockwaves throughout the surface of the earth, which can disturb the natural alignment of tectonic plates.

- Mining can also cause disturbance due to the extensive removal of rocks from different areas.

5. Minor Causes

Some minor causes such as Ground water depletion, landslides, avalanches, Meteoritic impact the collapse of heavy rocks, etc. can also cause minor shockwaves. The gases beneath the surface of earth contract and expand, giving rise to movements in plates beneath the crust.

Effects of Earthquake

1. Ground Vibration/ shaking

Vibration Shaking of the ground caused by the passage of seismic waves , especially surface waves near the epicenter of the earthquake are responsible for the most damage during an earthquake.

The intensity of ground shaking depends on:

- Nature of Rocks , Structure of Rock, Rock Deformation features (Cleavage, Joints,Fracture)
- Duration and intensity
- Distance: the distance from the epicentre drops off so the intensity of the shaking decreases.

2.Faulting and Ground Rupture

Due to earthquake numerous faults and rupture of ground rupture takes place

3. Landslides and ground subsidence

Avalanches, landslides, slumps and rock slides are triggered by ground vibration. These landslides are often more destructive than the earthquakes.

4. Damage to man-made structures

Damage to man-made structures, such as roads, bridges, dams and buildings from ground motion depends on the type of construction, concrete and masonry structures that are brittle and therefore more susceptible to damage and collapse compare to the damage to wood and steel structures is far less because of its flexibility.

5. Fires

Fires, often associated with broken electrical and gas lines, is one of the common side effects of earthquakes.

6. Tsunamis

The most dangerous effects of an earthquake is a Tsunami. Tsunamis are giant waves that can cause floods. These deadly waves strike a great distance from the epicentre.

6. What are landslides? Give a note on their Control

A landslide is a slow or sudden downhill movement of slope forming rock and soil material under the force of gravity. Landslides or slopes failures are natural Erosional process. They occur in hillsides valley slopes, seacoasts, riverbanks and bends, on the slopes of volcanic cones and in earthquake prone areas. They also occur underneath as on lake or sea floor.

Preventative measures of Landslides

Many methods for controlling the slides are available and choice of many methods will depend of factors like nature of slide, the underlying cause for it, the nature and amount of material involved and the economical consideration, of such method most important are.

1) Providing adequate drainage
2) Construction of retaining walls
3) Stabilizing the slopes

Providing adequate drainage: - It involves the removal of moisture form within the rocks as well as preventing any further moisture to approach the material to sliding. This may be achieved either by surface drainage or by subsurface drainage; construction of interpretation ditches, waterways, trenches and drainage tunnels may become necessary. Grouting the joints and other fractures may also prove helpful.

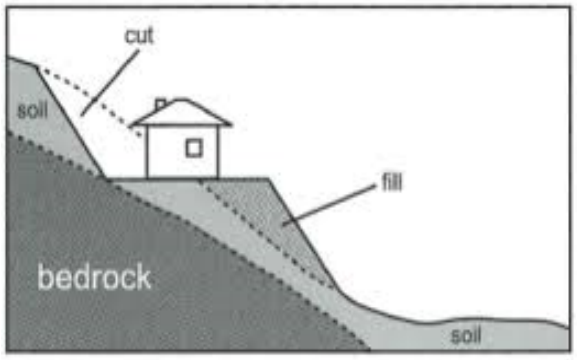
Retaining structure: - Retaining wall are aimed at stopping the mass movement of land mass. Construction of retaining wall requires an accurate assessment of the forces, which the wall has to withstand. Retaining walls may prove exceptionally, successful where,

A) The ground is neither too fine nor too plastic
B) The sliding mass is likely to remain dry
C) The movement is of shallow nature

Slope treatment: - When the material is unconsolidated sediment and the situation is a slope, which leads to loss of ground stability/ Landslide. In such cases the treatment involves stability for the particular type of soil and slope and if such computation indicate that a given slope of soil will not be stable then the solution lies in either,

A) Flattening the slope
B) Decreasing the load
C) Increasing the shearing resistant of the soil by decreasing its water content with help of drains and evaporation

Cut and Fill: For small unconsolidated sediment hillocks where open cut road can be done.



Construction excavation may oversteepen slopes, increasing the chance for slope failure. Fill material may settle, causing cracking in buildings.

D) Aforestation that is growth of vegetation cover with intricate and interwoven root system has also been found useful in stabilizing the barren slopes.

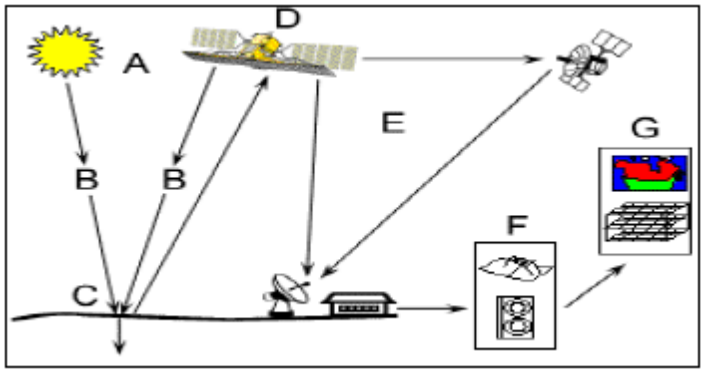
7.What is Remote sensing? Explain the concept of Remote sensing with neat sketch

Remote Sensing is the technique of acquiring information about objects on the earth‘s surface without physically coming into contact with them.

Concept / Principle in remote sensing

Remote sensing involves the detection and discrimination of objects or surface features means detecting and recording of radiant energy reflected or emitted by objects or surface. Different objects return different amount of energy in different bands of the electromagnetic spectrum, incident upon it and depend upon the property of material (physical, structural, and chemical), surface roughness, angle of incidence, intensity, and wavelength of radiant energy. The following are the process involved in Remote sensing

1. Energy Source or Illumination (A)
2. Radiation and the Atmosphere (B)
3. Interaction with the Target (C)
4. Recording of Energy by the Sensor (D)
5. Transmission, Reception, and Processing (E)
6. Interpretation and Analysis (F)
7. Application (G)



1. Energy Source or Illumination (A)
The first requirement for remote sensing is to have an energy source to illuminate the target (unless the sensed energy is being emitted by the target). This energy is in the form of electromagnetic radiation.

2. Energy Interactions with Atmosphere As the energy travels in the form of Electromagnetic radiation from its source to the target, it will come in contact with and interact with the atmosphere it passes through.

3. Interaction with the Target (C)
Radiation that is not absorbed or scattered in the atmosphere can reach and interact with the Earth's surface.
4. Recording of Energy by the Sensor (D)
After the energy has been scattered by, or emitted from the target, we require a sensor (remote - not in contact with the target) to collect and record the electromagnetic radiation.
Transmission, Reception, and Processing
The energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).
6. Interpretation and Analysis (F)
The processed image is interpreted, visually and/or digitally or electronically, to extract information about the target which was illuminated.

8.Describe the impact of Mining, Quarrying and Reservoirs on Environment

Impact of mining and quarrying on environment

Relief and landscape alterations: Mining operation and installation of
various allied units will change the existing topography and will cause creation of huge pits or leveling of hills or creation of wastes heaps etc.

Impact on hydrology: Mining activities in some cases may disturb the aquifer,
the ground water flow and recharge capacity of the surrounding areas are affected due to change in topography.

Contamination of water: Limestone mining by and large does not adversely contaminate the rain waters and ground water flowing through the exposed mine cuts but may carry fine particle of Limestone dust, which may cause silting problems, but they are non-toxic. Surface runoff from mine cuts may however be turbid during monsoons due to seepage of overburden soil etc.

Air pollution or dust pollution: In mining air pollution is mainly caused by dust generation. Blasting is one of the pollutants as it creates fumes, dust, vibrations, air blaster, noise and fly rock fragments. The other activities such as drilling excavation, waste dumping will also cause dust nuisance. Crushing plant, conveyors and transfer points will be the other sources of dust generation.

Noise pollution: Noise may be defined as‖ Unwanted sound‖. This implies sounds,
which interfere with human communication, comfort health etc. The noise pollution in the Limestone blasting and movement of heavy earth moving equipment cause mine.

Impact on Forestry /Vegetation: The mining operation if carried out on hills, which are usually associated with forests and vegetation causes. Impairment (spoil) and affects climate, rainfall, soil erosion and causes in equilibrium between biotic substance and macro/microorganisms. When carried out on plains affect agriculture and grazing lands.

Impact on Wildlife: Noise and habitation may probably cause migration of the existing wild life.

Impact of Human Environment: The impact of mining on human environment
can be both beneficial and detrimental as it may provide job opportunities and overall development of the region, can also deprive some of them of their agricultural land.
Sometimes it can help in water resources for water irrigation and domestic use.

Vibration, Air Blast And Noise Control: The noise in mines is caused by
blasting, movement of heavy earth moving equipment which in terms causes vibration and air blast. The following can control these.

a). Avoiding blasting during night and foggy weather which associated with temperature inversion.

b). Stemming of the blast hole properly

c). Avoid blasting when wind velocity is more than 25km/hr.

d). Large scale plantation or shade giving trees also reduce the noise and Vibration level.

e). Using rock breaking, the secondary blasting (which usually produces a huge noise) can be avoided.

Fumes control: ensuring complete detonation with the use of proper primers and boosters can reduce Production of blast fumes containing toxic gases. By maintaining well the engines of mining machinery the fumes from them can be controlled well.

Dust control: During mining the dust can be controlled by the following
a). Drilling: the using suitable dust can control Dust Collector, which is also a stationary requirement.
b). Blasting: If the topsoil is completely removed before blasting, dust generation during the same can be minimized.
c). Crushing: Dust can be reduced by using dust Collectors or by spraying dust suppressants including water.
d). Transportation: Dust is generated when loaded dumpers move over unconcerned roads. This can be overcome by concreting the roads or by sprinkling water over the roads regularly.

Impacts of the reservoir:

The creation of a reservoir provides a habitat for wetland species, especially water birds. The reservoir can also be a source of water to animals and plants in the adjoining areas and, where such areas have become unnaturally dry, this can be a significant environmental benefit. These benefits were not included in the cost-benefit analysis for any of the projects studied.
Impacts of backwater build-up: When a free flowing river meets the relatively static reservoir, there is a build-up of back-pressure and a resultant backwater. This can destroy the upstream ecology and cause damage to property. Backwaters can also build up due to the deposition of sediments and silt upstream of the reservoir as _backwater deposits‘.
Impacts on aquatic ecosystems: Construction activities, including the diversion of the river through a tunnel, have major adverse impacts on the aquatic ecosystem. Vulnerable species, with either limited distribution or low tolerance, could become extinct even before the dam is completed.
Impact on terrestrial fauna and flora: The disturbance caused by construction activities,
including noise and movement, building of roads, extraction of stone and soil, construction of buildings, etc. also negatively impact the fauna and flora at the dam site. As impoundment starts, the reservoir invariably submerges large tracts of forests and other ecosystems, including grasslands and wetlands. .
Impacts on cultivated biodiversity: Reservoirs also submerge productive agricultural
land in the valley. This not only has a social and economic cost but also adversely affects cultivated biodiversity and a host of birds, insects, mammals and reptiles that have adapted to agricultural ecosystems. In many cases, traditional crop varieties and methods of cultivation disappear because of dams.