There are many environmental concerns in the matter of land use. Pollution, pollution issues, preservation of our biological resources, mineral and energy requirements, and production of food are all related to use of land. Humans use an estimated 32% or 4.7 billion hectares of all the world’s total land area for agriculture. 30% of the total land area is rock, ice, tundra or desert unsuitable for long-term human use. 37% of the land surface remains as natural ecosystems.

**Agriculture** is the raising of plants and animals for food. Between 1945 and the mid 1980’s, the overriding aim of agricultural policy was to increase production resulting in mechanisation, use of artificial chemicals, animal and plant breeding, genetic engineering and monocropping. A plant that is cultivated is protected from natural competition with other plants and from plant eating animals and over time may become quite different from their ancestors and are said to be domesticated.

**Agriculture can be divided into three main types:**

- **High input or industrialised agriculture** – mostly practised by developed countries and relies on large inputs of energy in the form of fossil fuels to produce and run machinery, to irrigate crops and produce chemicals such as fertilizers and pesticides.

- **Small Scale agriculture** - is the production of crops and livestock on a small-piece of land without using advanced and expensive technologies. ... This type of farming is usually characterised by intensive labour and in most cases, animal traction, limited use of agrochemicals and supply to the local or surrounding markets.

- **Subsistence agriculture** – practised mostly by farmers in developing countries: the production of enough food to feed oneself and one’s family with left over to sell or reserve for hard times. This also requires a large input of energy but instead from humans rather than fossil fuels.

Modern agriculture involves the use of mechanisation i.e. the use of machinery to replace manual labour. Productivity was increased by the use of larger and more effective implements such as deeper cutting ploughs. Harvesting could now be done in a fraction of the time previously taken.

Mechanisation led to increasing use of monoculture – large areas of land dedicated to a single crop. Monocultures may increase the risk of pest epidemics leading to increased use of pesticides and to deficiencies in particular soil nutrients thus increasing the use of fertilizers.
Mechanisation led to farm specialisation i.e. farmer using most of his land for production of one crop.

Farmyard manure is replaced by compound fertilisers supplying nitrogen, phosphorus and potassium (N,P,K). A wide array of insecticides, herbicides and fungicides were developed which has had many benefits as well as drawbacks. Demand for higher yields in rearing of animals has also led to the use of hormones designed to increase growth in animals, or to increase milk production. The use of antibiotics as growth promoters and to treat diseases such as Salmonella is also a concern.

Modern agriculture also uses genetic engineering where useful genes can be transferred from one organism to the next. Concerns are that genetically altered organisms might mutate (spontaneously change during copying), producing changed organisms which might cause unforeseen effects. Introduction of genetically altered organisms into an ecosystem may disturb natural population balances.

**Negative effects of Agriculture includes:**

**Soil erosion**
Soil erosion is the movement of soil components, especially surface litter and topsoil, from one place to another. The two main agents of erosion are flowing water and wind. Some soil erosion is natural process. However, human activities such as farming, logging, construction etc. can speed up soil erosion and destroy in a few decades what nature took thousands of years to produce.

Soil erosion is increased by large-scale mechanised operations causing a decline in soil fertility. Sediments lost due to erosion may damage water quality and is the largest source of water pollution. Sediment laden water is cloudy and tastes bad and may cause the death of aquatic organisms. Losing topsoil makes a soil less fertile and less able to hold water. Soil, especially topsoil is classified as a renewable resource because natural processes continuously generate it. If topsoil erodes faster than it forms on a piece of land, the soil then becomes a non-renewable resource. Annual erosion rates for farmers throughout the world are 7-100 times the natural renewal rate.

**Soil Contamination by Excess Salts and Water**
18% of the world’s cropland is now irrigated, producing about one-third of the world’s food. Irrigated land can produce crop yields that are two to three times greater than those from rain
Irrigation water contains dissolved salts. In dry climates, much of the water evaporates, leaving its salts in the topsoil. The accumulation of these salts is called salinisation and it stunts crop growth, lowers yields and eventually kills crop plants and ruins the land. At least $\frac{1}{10}$ of the world’s irrigated lands suffer from severe salinisation, while 30% has been moderately salinised.

Salts can be flushed out of soil by applying much more irrigation water than is needed for crop growth. This practice increases pumping and crop-production costs, and it wastes enormous amounts of water. Heavily salinised soil can be renewed by taking land out of production for two to five years, installing an underground network of perforated drainage pipes, and flushing the soil with large quantities of low-salt water.

**Waterlogging:** Farmers often apply large amounts of irrigation water to leach salts deeper into the soil. Without adequate drainage, however, water accumulates underground, gradually raising the water table. Saline water then envelops the roots of plants and kills them. 10% of all irrigated land, worldwide, suffers from waterlogging.

**Desertification:** can occur on lands used for grazing. When overgrazing occurs in combination with an extended period of drought, once fertile rangeland can be converted into a desert.

**Solutions – Soil Conservation**

Soil conservation involves reducing soil erosion and preventing and restoring soil fertility.

**Conservation-tillage farming:** To reduce erosion, many farmers are trying conservation-tillage farming (also called minimum tillage or no-till farming). The soil is disturbed as little as possible while planting crops. Special tillers break up and loosen the subsurface soil without turning over the topsoil, previous crop residues or any cover vegetation. Special planting machines inject seeds, fertilizers and weed killers into slits made in the unploughed soil. This saves fuel, cuts cost, and holds more water in the soil, prevents compaction of the soil, and allows more crops to be grown during a season (multiple cropping).

**Terracing** can be used to reduce soil erosion on steep slopes, each of which is converted into a series of broad, nearly level terraces that run across the land contour. Terracing retains water for crops at each level and reduces soil erosion by controlling runoff.
**Contour farming** reduces soil erosion by 30-50% on gently sloping land. Rows are planted along the contour of the land thus helping to hold slow and slow the runoff of water.

**Strip cropping** is where a row crop such as corn is alternated in strips with another crop such as grass that completely covers the soil, thus reducing erosion. The strips of cover trap soil that erodes from the row crop, catch and reduce water runoff, and help prevent the spread of pests and plant diseases. This may help to restore soil fertility if nitrogen-fixing legumes such as soybeans are planted in some of the strips.

**Alley cropping or Agroforestry** is a form of intercropping in which several plants are planted in strips or alleys between trees and shrubs that can provide fruit or fuelwood. The trees provide shade, which reduces water loss. Tree and shrub trimmings can be used as mulch for the crops or fodder for livestock.

**Windbreaks or shelterbeds** can reduce wind erosion where long rows of trees are planted so that they partially block the wind.

**Maintaining and Restoring Soil Fertility**
Fertilisers partially restore plant nutrients lost by erosion, crop harvesting and leaching. Farmers can use either organic fertiliser from plant and animal materials or commercial inorganic fertiliser produced from various minerals. Three basic types of organic fertiliser are animal manure, green manure and compost.

**Animal manure** includes the dung and urine of cattle, horses, poultry and other farm animals. It improves soil structure, adds organic nitrogen, and stimulates beneficial soil bacteria and fungi.

**Green manure** is fresh or growing green vegetation ploughed into the soil to increase the organic matter and humus available to the next crop.

**Compost** is a rich natural fertiliser and soil conditioner that aerates soil, improves its ability to hold water and nutrients, helps prevent soil erosion and prevents nutrients from being wasted in landfills.

Farmers and landowners can produce compost by piling alternate layers of nitrogen rich wastes (such as grass clippings, weeds and vegetable kitchen wastes), carbon rich wastes (dead leaves, straw, sawdust) and topsoil.

**Crop rotation** is another method for conserving soil nutrients. Crops such as corn, deplete the soil of nitrogen while legumes add nitrogen to the soil. Farmers can rotate these crops on a yearly basis.

Today, many farmers rely on the use of commercial inorganic fertilizers containing nitrogen, phosphorus and potassium (N,P,K). Other plant nutrients may be present in trace amounts.
Commercial inorganic fertilizers are responsible for a 40% increase in food production worldwide.

However, there are disadvantages.

- They do not add humus to the soil, therefore, the ability to hold water will decrease leading to soil compaction.
- They decrease the soil porosity thus lowering the oxygen content of the soil.
- Most provide the plant with only three of the 20-odd nutrients needed by plants.
- Producing, transporting and applying inorganic fertilizers require large amounts of energy in the form of fossil fuels.
- They cause eutrophication (nutrient enrichment) of water bodies when they are washed away.

PESTICIDES
Pesticides kill insects and include herbicides, nematicides, insecticides and fungicides. A pest is any organism that occurs where it is not wanted or in populations that are large enough to cause damage.

Problems associated with pesticides:

i) Persistence – They do not break down rapidly in the environment. When they are no longer being used, they still remain in the environment, become dispersed and less concentrated but more widespread.

ii) Mobility in the environment – when sprayed the pesticide may drift in the wind and be inhaled or ingested if they remain on food. Pesticides may enter streams, rivers or ground water supplies. They do not remain where they are sprayed but move through the soil, water and air.

iii) Bioaccumulation or Biomagnification in organisms – if the pesticide is not broken down or excreted by an organism, it becomes stored, usually in fatty tissues. Over time the organism may accumulate high concentrations of pesticide. Organisms at higher trophic levels on the food web tend to have greater concentrations of bioaccumulated pesticides stored in their bodies than those lower on the food webs.

iv) Kills non-target species – they often kill useful insects and sometimes birds and mammals as well as the target pest. Killing the natural predator of the pest may cause huge outbreaks. New pests can be created as a result.

v) Development of Genetic resistance – they often have to be sprayed at the right time in the pest’s life span if they are to work. Pests that are not killed when the pesticide is inappropriately applied may develop genetic resistance. Pests invariably evolve resistance to any pesticide that is used on them frequently in large quantities. This often occurs rapidly making the pesticide useless.
vi) Risk to Human Health – Short-term exposure to high levels of pesticides can result in harm to organs and even death. Long-term exposure can lead to cancer. Exposure to trace amounts can disrupt the human hormone system.

Alternatives to pesticides

i) Agricultural Methods; Tillage of land making the pest more visible to predators such as birds; proper timing of planting, fertilising and irrigating which promotes healthy plants that are able to resist pests.

ii) Biological controls – this involves the use of naturally occurring disease organisms, parasites or predators to control the pest.

iii) Genetic control – this involves sterilising some members of the pest population or to breed crop plants and domesticated animals so that they can resist pests.

iv) Use of hormones and pheromones – using natural substances produced by organisms to trap and kill the pest. Hormones can be used to disrupt the life cycle of the pest while pheromones can be used to lure and trap the pest.

v) Quarantine – Governments attempt to prevent the importation of foreign pests and disease by practising quarantine, or restriction of exotic plant and animal material that might harbour pests. Infected crop or animals may be burned.

Integrated Pest Management

Many pests cannot be controlled effectively with a single technique: a combination of methods is often more effective. Integrated pest management (IPM) combines the use of biological, cultural and chemical controls that are tailored to the conditions and crops of an individual farm. Non-chemical controls are used as much as possible and pesticides are used sparingly and only when other methods fail. IPM allows control of pests with a minimum of environmental disturbance. It involves proper management of pests and education of farmers.