

# **GEOGRAPHY**

## **FORM TWO**

### **NOTES**

# HUMAN ACTIVITIES

Human activity refers to something that people do or cause to happen in order to achieve certain goals. Human activities contribute to climate change by causing changes in Earth's atmosphere in the amounts of greenhouse gases, aerosols (small particles), and cloudiness. The largest known contribution comes from the burning of fossil fuels, which releases carbon dioxide gas to the atmosphere.

## Concept of Human Activities

### Meaning of Human Activities

*Give the meaning of human activities*

Human activities refer to what people do or cause to happen in order to achieve certain goals in life.

- Also human activities can be defined as acts or processes of production as intended by people in a certain place. Which can be a country, region, district or a village.
- Human activities are also referred to as functions or tasks or work carried out or done by human beings over time for achieving certain purposes or goals.

Therefore human activities are carried out with certain goals or purposes; these purposes can either be:

- Production of food crops.
- Production of cash crops.
- Construction of infrastructure that facilitate movement of goods, services and people; cleaning the area to avoid pollution and outbreak of diseases like cholera, amoebic dysentery, etc.
- Human activities use up resources to produce products and services.

These activities combine to form business processes.

## Major Types of Human Activities

*Identify major types of human activities*

Human activities may be classified into four types namely:

1. Primary activities
2. Secondary activities
3. Tertiary activities
4. Quaternary activities

### Primary activities

Primary activities involve exploitation of nature in the production of materials. Production in this kind of activities largely depends on the earth's natural resources. Examples of primary activities include:

- Farming (Agriculture)
- Mining and Quarrying
- Fishing
- Forestry (Lumbering)
- Hunting, gathering and livestock keeping

Most products from primary activities are raw materials for industrial activities. For example cotton from agriculture is used in textile industries, timber for paper industries and leather for shoe-making industries.

- **Agricultural** activities involve growing and harvesting of crops from farms. It is an important activity since it contributes to the provision of food and other raw materials. Some of the crops are used as sources of food, examples: maize, millet, sorghum, soya, bean and peas.
- **Mining** leads to the extraction of minerals like gold, copper, diamond, platinum and uranium. These materials act as raw materials for the industries. Some minerals such as coal and

uranium are the sources of power, uranium leads to the production of nuclear energy that is highly demanded all over the world due to its importance.

- These materials act as raw materials for the industries.
- Some minerals such as coal and uranium are the sources of power, uranium leads to the production of nuclear energy that is highly demanded all over the world due to its importance.
- **Fishing** leads to the supply of food. (Some fish remains are used in preparation of animal food).
- **Lumbering** leads to the production of timber that is very important in construction and furniture making.
- **Hunting** leads to provision of food, decorations and tourism.
- **Livestock** farming leads to supply of meat, milk for food and commercial purposes.
- **Quarrying** leads to the supply of stones used for construction of roads, bridges and foundation of buildings and houses.

## **Secondary activities**

These are human activities that involve a process of manufacturing raw materials into useful products.

- Secondary activities involves processing of raw materials such as ginning cotton from raw cotton and heating crude rocks to get precious stones.
- Other secondary activities include cloth-making, construction of houses, car assembling, making dyes and making glue.

Secondary activities are of great importance as they lead to fast economic development since they produce products that have immediate demands in the society.

They also accelerate development of primary activities by providing a market for raw materials produced through lumbering, agriculture and mining.

## **Tertiary activities**

These are the activities that involve the provision of services that are needed in the society.

Examples of tertiary activities include:

1. Trade (restaurants, hotels, lodges, supermarkets)
2. Schools (Teachers)
3. Hospitals (Doctors)
4. Transportation (Driving)

Others include plumbing, mechanics, entertainment, water supply, waste management, advertising, legal services, in court clerical services or religious services.

## **Quaternary activities**

These are activities that involve provision of intellectual services and information

- These activities were formally included in the tertiary activities.
- Quaternary activities include high-tech industries with information technology, scientific research, consultancies and library services. Computer based activities like making software are part and parcel of quaternary activities.
- In general quaternary activities are considered to be new and started in the last decade.

## **Quinary activities**

These are activities that are done by top executives or officials in fields such as governments.

- They involve the highest level of planning and decision making in the society or economy.

Quaternary and quinary activities e.g. research and information are important in the development of farming, mining, tourism and trade.

## **Importance of human activities**

Below is the importance of human activities:

1. They facilitate the development of manufacturing industries by producing raw materials such as cotton for textile industries.
2. Helps in creating employment in the country. People are employed in industries and become managers, technicians, drivers and engineers.
3. Human activities such as agriculture and fishing lead to production of food.
4. Activities like construction of roads contribute to the development of transport and communication networks.
5. Recreation/ activities attract tourists who in turn bring about foreign currency in the country and facilitate development of the country.

### **Environmental problems caused by human activities**

1. **Air pollution:** This can be caused by Industrial emission, burning of agricultural wastes and grains when cleaning the land for cultivation and mining.
2. **Water pollution:** Caused by dumping of untreated materials into the water bodies. Waste materials may come from industries, farmyards and tourist centres.
3. **Soil pollution:** Can be caused by dumping of radioactive materials on the ground, applying chemicals in the farms, irrigation using saline (salt) water and acid iron fall in heavily industrialised areas.
4. **Deforestation:** This can take place when trees excessively cleared during preparation of large farms lumbering. Overgrazing and development of settlements.
5. **Soil erosion:** This takes place easily because of cutting of trees for lumbering, construction and establishing extensive farms.

### **Measures for controlling environmental problems caused by human activities**

1. Undertaking agricultural activities using modern methods such as crop rotation, inter cropping, fallowing strips, contour ridging.
2. Planting trees where the land is bare and restricting people from cutting down trees unnecessarily and excessively.

3. Excessive use of chemicals in the control of pests should also be discouraged. Accumulation of chemicals in the soil can lead to soil pollution, which can disrupt the soil structure.
4. Improper dumping of waste in the soil or water should be discouraged.
5. Population control should be encouraged so that people can not excessively clear vegetation for establishing settlement and farms.

# AGRICULTURE

Agriculture refers to a fundamental human activity involving cultivation of crops and domestication of animals (livestock husbandry). It is categorised as a primary activity since it involves the production of raw materials that can be used by other industries.

Agriculture is the practice of cultivating land, growing crops and rearing animals. Originally, agriculture was considered to involve cultivation of crops only. In modern times, it has expanded to include rearing of animals, poultry keeping and fish farming. Even activities like storage, processing and marketing of agricultural produce are also regarded as part of agriculture. There are two types of agriculture: small-scale agriculture and large-scale agriculture.

## Small Scale Agriculture

Small-scale agriculture is the type of agriculture that is practiced on relatively small plots of land that usually does not exceed four hectares. Small-scale agriculture is practiced for both subsistence and commercial purposes.

### Characteristics of Small Scale Agriculture at Subsistence Level:

*Explain the characteristics of small-scale agriculture at subsistence level*

There are two levels in which small scale farmers can operate, commercial and subsistence level. When farmers produce with a basic focus on selling, this is typical commercial level but when they operate farms to feed their families and provide their needs, it is farming for subsistence level. The following are specific features of small scale agriculture at subsistence level;

1. Labor force. Mostly agriculture at subsistence level involves the use of members of the families; they do not hire extra labor force outside.
2. Mainly traditional. This has the implication on the use of simple tools like hoes, pangas to cultivate and few cases they use animals. It goes further to the use of seeds from the previous harvest.
3. Ways to improve fertility. There are varieties of ways to improve the fertility such as the use of organic manure from animals such as goats, cows and sheep, mulching (covering the top



soil with dead crops and animal remains to retain moisture), various farming techniques like use of crop rotation.

4. Many crops are grown at once. You can find the farm with mixed crops such as beans, maize, sunflower and some watermelon.
5. Very little or no surplus. This is because; the major motive of subsistence agriculture is consumption.
6. Size of the land. The land cultivated for subsistence farming is always small; this is the result of increasing in number of people occupying an area.
7. Little or no use of technology in form of seeds, manure and tools.
8. Mainly food crops. The common are maize (African staple food), millet, sunflower, fruits and vegetables.

### The Effects of Rapid Population Growth on Small Scale Agriculture

*Explain the effects of rapid population growth on small scale agriculture*

Continuous increase in the number of people is a serious problem facing small scale agriculture because: it reduce the average size of land, results to over exploitation which lead to reduced soil fertility. In the other side increasing population has increased amount of labour force in agriculture.

### Advantages and Disadvantages of Small Scale Agriculture

*Describe advantages and disadvantages of small-scale agriculture*

## **ADVANTAGES OF SMALL SCALE AGRICULTURE**

Although small scale agriculture is very powerful to reduce poverty levels, in many cases it has been given less priority. The following are some of the merits of small scale agriculture.

- Varieties of crops are grown on a small piece of land. This is very helpful because, crops such as beans are used to retain soil fertility and members of family eat healthy and natural balanced diet.

- Reduction of costs. Because small scale agriculture uses family members, there is no big burden in the production cost. With regard to the use of small tools such as hoes and seeds from previous harvest, it makes the production input cheaper.
- Growth of trade. Small scale farmers can sell their little surplus to gain money, it promote the supply and demand chain. Example, you can find many rice markets at Ifakara district in Morogoro region during the harvesting season.
- Care for the crops. I.e the small farms are easy to manage closely. It becomes very easy to trace the development of crops and to control pests.
- Environmental conservation. There is little or no use of chemicals like inorganic fertilizers; this makes it possible to conserve the quality of the soil.
- If it will be improved, small scale agriculture will reduce poverty and reduce number of people fleeing to urban areas (rural-urban migration).

## **DISADVANTAGES OF SMALL SCALE AGRICULTURE**

- It is rain feed agriculture. Farmers depend on favorable weather condition, they do not focus on irrigation and when the rain fail or during the period of heavy storms, it is great loss and people will suffer from hunger.
- Small harvest caused by poor techniques, poor seeds and small area.
- Pest and diseases destroy crops. There is little use of pesticides, when pests attacks the small areas, the impacts will be huge loss and hunger.
- The intensive use of small farms will make them infertile in the long term.
- Due to its small size, it is makes it very hard and expensive to use machines.

### **Large Scale Agriculture**

Large- scale agriculture is the farming system which takes place on a large area. Examples of plantation agriculture include sisal plantation in Morogoro and Tanga –Tanzania, Tea plantation in Kericho – Kenya, Rubber plantations in Liberia, Ranching in Australia, Argentina and USA for sheep farming, Kongwa-Tanzania for beef farming and sheep ranches in South Africa. The

types of systems of large-scale agriculture in the world are categorised according to land use intensity as follows:

## 1. Intensive Farming

*Name types of large-scale agriculture in the world*

This is the system of agriculture in which large amount of capital and labour are applied to a small piece of land including the use of scientific methods of production so as to get high production. Horticulture is a good example.

## 2. Extensive Farming

This system takes place where a large area of land is worked by a small labour force. This usually requires the use of modern machines. It takes advantage of economies of scale that produce highly on a large area using low labour costs. For example tea, sheep farming and coffee. The following are the characteristics of large-scale agriculture:

1. It takes place on a large area and the farms are large for example plantations and ranches.
2. It involves the use of modern farming equipment like machines.
3. The farmers are skilled.
4. It needs a lot of capital for investing.
5. It needs cheap and efficient transport system from the farms to the market.
6. Production is mostly for commercial purposes.
7. It is monoculture in nature.
8. It involves the use of chemicals.
9. Production is high.

## Major Crops Grown in Each Type of Large Scale Agriculture

*List the major crops grown in each type of large-scale agriculture*

Large scale agricultural production is done mainly for commercial purposes. However, in intensive farming where the population is high, food crops are grown together with cash crops.

Crops which are grown in large scale include tea, coffee, cocoa, bananas, sisal, sugarcane, grain and rubber. Large scale cultivation is very common in Asia, Africa and America.

## Characteristics of Large Scale Agriculture

*Describe characteristics of large-scale agriculture*

Large scale agriculture is organized scientifically and involves the cultivation of large area about 100 to 400 hectares and above. Single type of crop is grown normal and due to higher cost of establishing and need for sophisticated technology, farms are owned by big companies and government. The cultivated large plots are called estates or plantations.

## Requirements for Growth, Farm Preparation, Planning, Care, Harvesting, Processing, Storage and Transport

*Describe the requirements for growth, farm, preparation, planning, care, harvesting, processing, storage and transport.*

The following are the requirements for large-scale farming:

1. There should be enough capital and reliable supply of skilled labour and unskilled labour.
2. There should be a ready market where the produce can be sold and reliable transport for carrying the crops from the farm to the market and industries.
3. There should be a large area which is almost a flat land or undulating surface for easy mechanisation, sparsely populated and efficient management.
4. The climate should be conducive depending on the nature of the crop to be grown.
5. There should be reliable storage facilities and efficient processing facilities.

## Farm Preparation

### Planting

### Care Given to Crops

The following care must be given once crops are planted:

1. Young plants should be shaded for four weeks.
2. Mulching should be done in that newly established estate to avoid excessive soil water evaporation.
3. Apply fertilisers containing nitrogen.
4. There should be weeding and pruning.

## **Harvesting of Crops**

### Tea

Tea harvesting is done in the following ways:

1. Tea leaves are ready for picking three years after planting. Usually it is after four years that is when one gets a very good harvest and harvesting goes on for 50 years.
2. Plucking goes on throughout the year and the leaves are packed and sent to factories for processing.

### Clove

Clove harvesting takes place just before the flowers open and the buds are picked by hand. This is done twice a year and harvesting on one clove tree can go on up to 50 years.

### Coffee

Harvesting coffee may start three years after planting, a very good harvest can start after four or five years. Coffee-picking is done by hand by removing the ripe berry from the stalk. The harvesting interval is from 7 to 14 days.

### Rubber

Harvesting of rubber is done through tapping; the trees are ready for tapping after about seven years. This long maturity time makes it difficult to invest a large amount of capital which is required to establish rubber plantations.

## **Major Producing Countries for Respective Crops in the World**

*Identify and locate major producing countries for respective crops in the world*

## **Tea**

Tea is grown in Tanzania mainly in Mbeya, Bukoba, Iringa, Kagera and Tanga regions.

## **Cotton**

In Kenya, cotton is grown in Nyanza district while in Uganda cotton is grown in the Buganda District.

## **Sisal**

In Tanzania sisal is mostly grown in Tanga, Kilimanjaro, Arusha, Morogoro, Lindi and Mtwara regions. Mombasa, Thika, Murang'a, Machakos and Taita Taveta are areas where sisal is produced in Kenya.

## **Sugar Cane**

Sugar cane is grown in small farms and in estates like Kilombero in Tanzania. Sugar cane is also widely grown in Kenya, America and Australia.

## **Cocoa**

Cocoa is grown in central America, Ghana, Nigeria, Cote d' Ivoire (Ivory Coast), Cameroon and East Indies.

## **Palm**

Palm originated and is widely grown in West African countries including Nigeria, Ghana, Cote d'Ivoire (Ivory Coast) and the Democratic Republic of Congo (DRC).

## **Clove**

Clove is grown in the West Indies, Tanzania Islands of Zanzibar and Mauritius.

## **Wheat**

The wheat yields in the world are highest from countries of Western Europe. The following are leading producers of wheat: Russia, USA, China, India, Canada, France, Turkey, Australia, Pakistani, German, Romania, Italy and Argentina. In East Africa, Kenya is the leading producer of wheat followed by Tanzania.

## **Coffee**

Coffee producing countries include Brazil, Mexico, Colombia, Tanzania, Kenya, Uganda, Ethiopia, India and Angola.

## **Rubber**

Rubber is mainly produced in Malaysia, Indonesia, Thailand, India, Sri-Lanka, Nigeria, Liberia and Vietnam.

### **Contribution of Produced Crops to the Economy of USA and Tanzania**

*Describe contribution of produced crops to the economy of USA and Tanzania*

The following are the major contributions of produced crops to the economy of USA and Tanzania:

1. It has stimulated the development of industries. Cash crops provide raw materials for processing and manufacturing industries for example Mbeyatex in Tanzania.
2. It has led to the creation of employment opportunities in the country.
3. It has contributed to the generation of government revenue in the country and capital development.
4. It has stimulated external trade and international relations.
5. It has contributed to the development of transport and communication systems.
6. Encourages the improvement of living standard of the people in the country.

### **Explain Problems Facing Large Scale Agriculture (Tanzania and USA Case Study)**

*Drawing example from Tanzania and USA explain problems facing large scale agriculture*

The following are the problems facing large- scale agriculture in Tanzania:

1. Low capital for investment.
2. Land is becoming smaller and smaller due to the increase in population and land degradation
3. There are frequent tribal conflicts like those in Mara and Morogoro between the Maasai pastoralists and non-Maasai agriculturalists.
4. There is poor support from the Government.
5. Climatic problems like drought and too much rainfall that cause price fluctuation and especially low prices discourage the farmers.
6. Rural-urban migration lead to the problem of labour supply.
7. Mismanagement of funds set for agriculture as well as poor pro-agricultural policies.

## Livestock Keeping

Livestock farming refers to the rearing of animals and birds such as goats, cattle, sheep and poultry. Livestock farming is segmented into traditional or subsistence livestock farming and modern or commercial livestock keeping.

### How Pastoralism, Sedentary and Commercial Livestock Keeping are Practised

*Describe how pastoralism, sedentary and commercial livestock keeping are practiced*

## **TRADITIONAL LIVESTOCK KEEPING**

### 1. Traditional Livestock Keeping

Traditional livestock keeping is also known as **nomadic herding**. This is livestock farming where the livestock are let out in search of pasture and water. A person who moves from place to



place in search of pasture and water is called a nomad. The system is extensive and subsistence in nature as farmers keep animals for food and not for sale.

### **Example 1**

Places where nomadic pastoralism takes place

Fulani tribe in West Africa. Also the Sukuma and Maasai in East Africa who sometimes move between Kenya and Tanzania.

Characteristics of nomadic pastoralism

Below are the main characteristics of nomadic pastoralism:

- The cattle are kept for prestige and traditions such as paying bride price.
- The breeding process is controlled and depends on the local breeds.
- The herds of animals are large in size.
- Diseases are common because of poor care given to animals.
- It is not expensive as the production does not involve investment of large capital.
- There is no permanent settlement as farmers move constantly with their animals.
- Many animals are grazed on the same field.

### 2. Semi-nomadic or Semi-sedentary Pastoralism

Semi-nomadic pastoralism is a system whereby a livestock farmer starts settling and begins growing crops like maize, millet and sorghum (apart from keeping animals). A livestock farmer can also use some cattle dung as manure for plant growth. Example: The Sukuma of Tanzania and the Karamajong of Northern Uganda.

### 3. Sedentary Pastoralism

Sedentary livestock keeping is the system by which a livestock farmer keeps animals while settled permanently in one place. He does not move from place to place.

Characteristics of Sedentary Pastoralism

Below are the characteristics of sedentary pastoralism:

- The method uses more advanced technology than nomadic technology.
- The number of animals is not so high but provides high yield.
- The animals are kept in sheds, can feed using fodder as zero grazing.
- There is diseases control since the number of animals is very low and modern methods are applied in the controlling of diseases.
- The system can take place where is high population like in towns and villages for example on the slopes of Kilimanjaro among the Chagga.

## **COMMERCIAL LIVESTOCK KEEPING**

This is a system of keeping animals and birds for sale. It can be intensive or extensive. Examples of commercial livestock farming are beef farming on ranches and dairy farming.

### **Extensive Commercial Livestock Farming**

This is a livestock keeping system that takes place on large scale. It involves keeping a large number of animals on a large stretch of land called a ranch. Animals kept in a ranch are usually cattle for beef (beef farming), sheep for wool, mutton/goats for meat and milk production and pigs for pork. Examples of ranches include beef farming in the pampas of Argentina, USA and Kenya; sheep ranching in Australia and South Africa. Tanzania ranches include Kongwa in Dodoma, Kalambo in Rukwa, Mzeri in Kagera, West Kilimanjaro, Dakawa in Morogoro, Mkwaja and Uvinza in Kigoma etc.

### **Characteristics of Ranches**

The following are characteristics of a ranch:

- They are usually established on a large area and they are scientifically managed due to use of high technology.
- There is little or no migration due to permanent and reliable food.
- Animals are kept in large numbers and production is for sale.
- They involve high capital investment in relation to the labour required.

- Usually the type of animals kept are aimed at one type of produce.

## The Benefits and Constraints of Livestock Keeping Practices

*Explain the benefits and constraints of livestock keeping practices*

Livestock keeping is very important because it provide food, lead to growth of industries, ranching is done in the land which is not conducive for agriculture which make use of unproductive land and it raise income as individual and as well a nation. However the practice face limitations such as inadequacy capital, pests and diseases and low yield breeds which are not adopted to climatic changes.

## Comparison of Livestock Keeping between Australia and Tanzania

*Compare livestock keeping between Australia and Tanzania*

### **LIVESTOCK KEEPING IN AUSTRALIA**

The Australian continent is found in the Southern part of Africa and the Northern part of Antarctica. The continent is famously known as the founder of sheep farming in the world. Sheep are kept for wool or meat. The sheep kept for wool require dry and cool conditions. The sheep kept for meat need wet conditions which encourage a great supply of pasture. Sheep also produce products like skin and milk. Australia has a sheep population of over 135 million. The sheep farms are very large. A single farm can have up to 50,000 sheep. Australia is the world's leading wool producer.

Factors that led to the Development of Sheep Farming in Australia

Factors that led to the development of sheep farming in Australia

- The use of advanced technology like the use of refrigerators
- Availability of pasture supporting large-scale sheep farming as it assures reliable supply of pasture
- Good climate providing reliable rainfall
- Good soil that supports the growth of grass
- Reliable water availability due to precipitation

- Ready market for selling sheep products
- Good agricultural policies
- Availability of capital

## **LIVESTOCK KEEPING IN TANZANIA**

Livestock production is one of the major agricultural activities in Tanzania. This contributes to the natural food supply, converts arable land resources into products suitable for human consumption. Tanzania's Government provides about 30 per cent of the agricultural commercial ranching in Tanzania, which accounts for about 2% of the total cattle herd. The national ranching company is responsible for managing all ranches in the country. Most of the livestock products are for domestic market. This sub-sector needs to be developed particularly in the dairy farming and its products, meat processing to meet the domestic demands and for export market opportunities.

### Advantages of Livestock Keeping

Mentioned below are the general advantages of livestock keeping

1. Livestock keeping can provide manure that is used in gardens and farms.
2. Livestock keeping increases the living standard of people due to fast economic growth from animal products.
3. It ensures the availability of food especially when the animals are so many, example nomadic pastoralism.
4. Sedentary livestock keeping encourages environmental conservation as the animals do not move from one place to another.
5. It facilitates the development of transport and communication systems, example farming in Argentina.

### Disadvantages of livestock keeping

Disadvantages of livestock keeping include:

1. Livestock keeping can lead to soil erosion due to movements from place to place for finding pasture and water. Example: nomadic pastoralism
2. Farmers do not settle for cultivation but move place to place with their animals for finding pasture and water in semi-nomadic pastoralism
3. Expensive in establishing ranches and capital for establishing and maintaining the project
4. Acceleration of deforestation as most ranches result from clearing forestry in order to be established
5. Livestock lead to environmental pollution example the decomposition of dungs leads to the emission of methane gas that pollute the air

#### Conclusion

Livestock keeping in Tanzania has many benefits; it leads to employment, provision of food and other animal resources like skin and dairy products. So the government must provide capital and support to livestock keeping in order to promote development of the nation.

### Livestock Keeping as Practiced in Different Communities in Tanzania

*Describe livestock keeping as practiced in different communities in Tanzania*

Livestock keeping is activity which is also carried by majority of Tanzanians. Animals which are kept includes cattle, goats, sheep, poultry, donkeys and horses. Livestock keeping in Tanzania is carried out more traditional. Pastoralism as done by Massai, Sukuma and Kwavi, sedentary livestock keeping among Chaggas and commercial livestock keeping in highlands and dry areas of the country.

# WATER MANAGEMENT FOR ECONOMIC DEVELOPMENT

## Importance of Water

Water is perhaps the most important commodity on earth. There can be no life on earth without water. Therefore, water plays a very crucial role in the very existence of human beings, other animals and all living things, as well as in their activities.

## Uses and Economic Importance of Water

*Explain uses and economic importance of water*

Economic importance and uses of water

1. Water is used to clean clothes and other fabrics in homes. On commercial basis, it is used by dry cleaners, capital washing firms and domestic and office cleaning companies
2. In manufacturing industries, water is used for various purposes. These include washing raw materials, washing containers and machines, diluting chemicals or ingredients as well as a raw material in industries such as in beverages industries
3. Water is also put in several uses in the agricultural sector. Among other uses, it is used to irrigate crops and given to farm animals to drink
4. Water is a key component of the electricity
5. Water is used for recreational purposes such as swimming. People pay to use facilities such as swimming pools, thus generating income for those who run the facilities
6. Water facilitates the growth and development of the fishing industry. This is because water supports the existence of fish in rivers, lakes, ocean or in fish ponds

7. People who sell water in estates earn income from this activity. Water provision also generates money for supplying water to homes, offices and industries

## **The Relationship between Family Size, Water Supply and Quality of Life**

*Describe the relationship between family size, water supply and quality of life*

Households with many family members will obviously require more water to use for various purposes. If the water supply is so acute as compared to family demand, this will lead to water scarcity. In such a case, water turns to be a limited resource. This then affects the quality of life in a various ways such as shortage of water for drinking, washing, cleaning, cooking, etc.

A large family requires more water and hence its members have to spend much time, energy and money to search for and carry water. In rural areas family members, especially girls and women, spend a lot of time and energy searching for water. In some communities girl children are stopped from attending to schools in order to search for water to be used by the whole family. The family may also be required to spend a lot of money to purchase water from vendors, thus limiting the family's expenditure on other goods and services. This badly affects the quality of life.

For households with a few members, it is easy to manage water resources to make it suffice every member in the household. The quality of life will even be better if that family is well off, in that it can afford to purchase water or even set up water supply infrastructure for own use. A small family on the other hand, does not require very large amounts of water. Because of its low consumption, such a family is also able to use stored water over a long time in case the frequency of water supply in that locality is low.

## **WATER QUALITY AND SUPPLY**

Water supplied to homes, industries, farms, etc must be of high quality so as to avoid the problems associated with water of poor quality. It must also be free of contamination with microorganisms and/or hazardous chemicals.

Contaminants that may be found in untreated water include microorganisms such as viruses, protozoa and bacteria; inorganic contaminants such as salts and metals; organic chemical contaminants from industrial processes and petroleum use; pesticides and herbicides; and

radioactive contaminants. Water quality depends on the local geology and ecosystem, as well as human uses, such as sewage disposal, industrial pollution, use of water bodies as a heat sink, and overuse.

Dissolved minerals may affect suitability of water for a range of industrial and domestic purposes. The most familiar of these is probably the presence of ions of calcium and magnesium which interfere with the cleaning action of soap.

### Water supply

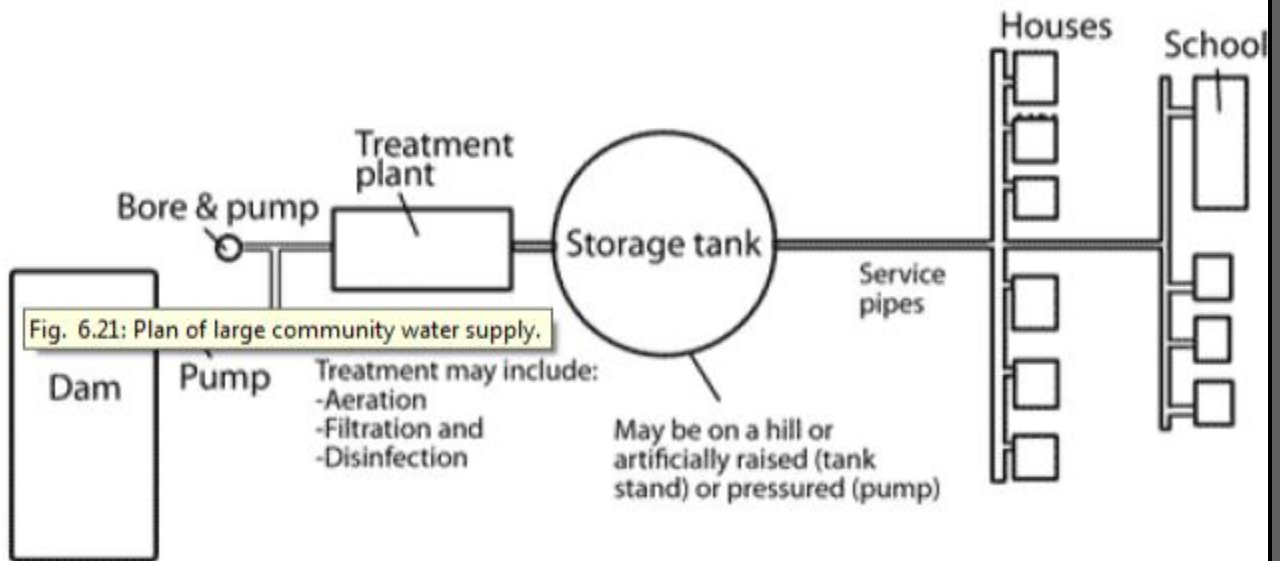
Water supply is the provision of water by the government or local authorities, commercial organisations, community endeavours or by individuals, usually via a system of pumps and pipes.

### Community water supplies

Community water supplies in Tanzania falls into three categories as explained below:

1. **Urban water supply**, The supplier of water to most cities and towns is the local water and sanitation authority. For example, in Dar es Salaam and Coast Regions, the supplier is the Dar es Salaam Water and Sewerage Authority (DAWASA), which is a parastatal organization. Communities which are situated near towns usually get their water from town water supply. In these communities, the water is pumped from its source which is usually a dam or bore. The water is treated for possible contamination and is then stored in large tanks or reservoirs. From these tanks or reservoirs, a complex system of underground pipes takes the water to the community's houses, schools, hospitals and other users.



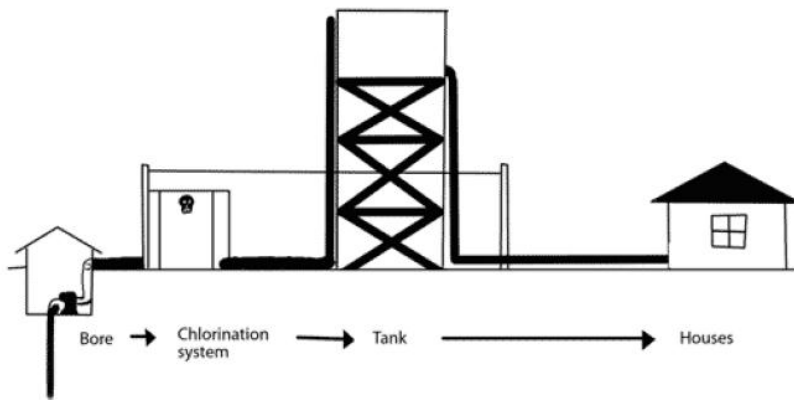


*Plan of a large community water supply*

It is the supplier's responsibility to maintain the water supply equipment. Normally, this will be the water authority. The supplier usually looks after all pipelines to houses and other buildings. Maintenance and repair of water structures in the yard or house is the responsibility of the owner of the house.

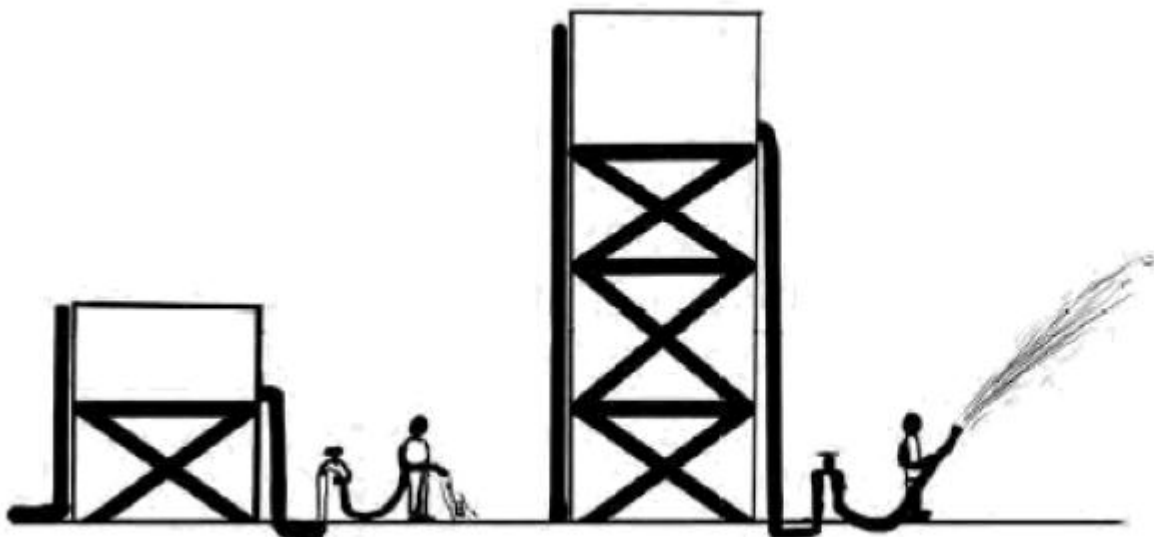
1. **Rural water supply** Most communities that are situated away from towns get their water supply from a bore. The bore is sunk in an area where the water is cleanest and most plentiful. Sometimes, water for a rural community is pumped from a river, pool, lake or dam.

The rural community's water supply is a smaller version of a town water supply. When the water is pumped from the bore it is first treated to make it clean and free of germs. It is then pumped into a storage tank. From the storage tank a network of pipes carries the water to the houses, schools, hospitals, shops, and any other buildings.



*Plan of a small community water supply*

3. The elevated tank Community water tanks can be set on high stands or placed on a nearby hill. The reason is that the elevation (height) of the tank creates the water pressure at the tap. The higher the tank above the taps, the greater is the water pressure at the taps. The maximum (greatest) height for a community water tank is usually 12 metres.



*An elevated water tank*

If water pressure at the taps was not created by elevating the tank, the water from the taps and hoses would dribble out very slowly or no water would come out at all, for example, it might take an hour to fill a 20-litre bucket or it might be impossible to have a proper shower.

- **Continuity of water supply** Continuity of water supply is not a problem in most developed countries, but is a severe problem in many developing countries, where sometimes water is only provided for a few hours every day or a few days a week. It is estimated that about half of the population of developing countries receives water on an intermittent basis.
- **The consequences of water quality and supply** A safe, reliable, affordable, and easily accessible water supply is essential for good health. An inadequate water supply prevents good sanitation and hygiene. Consequently, improvements in water supply enhance public health. An outbreak of diseases like cholera, dysentery, typhoid and diarrhoea often occur during the time when the water supply is very limited such that adequate sanitation cannot be achieved.

Water supply issues have specific adverse effects on women in developing nations such as Tanzania. Women are often the primary family members responsible for providing water as well as collecting it. This makes female members of the community spend most of the time searching for water, thus preventing them from participating in other economic activities. Sometimes girl children are stopped from attending schools so as to fetch water for the family.

In places where the water supply is low, residents have to spend a lot of money on purchasing it, erecting water infrastructures such as storage tanks as well as much effort in searching for water. This deprives people of time to participate in other income-generating activities. Also the money that could otherwise be spent on other life aspects is directed towards solving water scarcity. This may lead to abject poverty for those families with low income.

All these problems indicate that water quality and supply have a lot of negative implications to the community. So provision of ample and quality water by the responsible authorities is inevitable.

## The Relationship between Vegetation and Water Supply

*Explain the relationship between vegetation and water supply*

The availability and quality of water in many regions of the world are more and more threatened by overuse, misuse and pollution. Both water availability and quality are strongly influenced by forests. Moreover, climate change is altering forest's role in regulating water flows and influencing the availability of water resources. Therefore, the relationship between forests and water is a critical issue that must be addressed keenly.

- Areas with dense forests and other thick vegetation serve as water catchments. Many rivers and streams have their sources in forests. Examples of rivers originating from forests are the Congo (Congo forests) and Mara (Mau forest in Kenya). This water is what feeds streams, rivers and lakes from which we get water for domestic and industrial uses.
- Places with abundant vegetation stand a chance of getting reliable water supply compared to those with little or no vegetation. This due to the fact that forests form water catchment areas and they also attract rainfall. Forested lands normally receive high rainfall per year than dry and bare lands.
- Governments and international and local organizations encourage people to plant more trees and conserve natural forests so as to prevent the occurrence of drought and hence limited water supply to the community. It is therefore important to ensure that everybody is involved in forest conservation in one way or another so as to maintain water supply.
- There is a very close relationship between water supply and forests. Forests will only thrive on a land that receives sufficient water. At the same time, places with many thick forests often receive high rainfall. Therefore, to be sure of adequate water supply, forest conservation is a must. Where there is little water available, vegetation is very sparse and poor.

### How Distance to Water Sources from Household Affects the Girl Child

*Explain how distance to water sources from household affects the girl child*

Lack of accessible, sufficient, clean and affordable water supply has adverse impacts specifically related to women in developing nations. In Tanzania, women and girl children are mainly the ones responsible for fetching water from wells, rivers, streams, community water supply, etc. The fetching of water, which may take up to six hours a day to meet the household needs, is a duty often assigned to women and children. This foregone time often prevents children, especially girls, from attending school and women from pursuing small business opportunities.

## **The distance between home and the water source affects the girl child in the following ways:**

1. **When the distance is long**, the girls have to walk long distances, sometimes in harsh weather conditions such as hot sun, rains and coldness. Thus, they get tired and sometimes affected health wise by adverse weather. On the way to and from the water sources, they can also be attacked by dangerous animals such as lions and hyenas, bitten by poisonous snakes or even get molested, raped and abused in various ways. Because they spend much time on the way, this means that they have little time to study, play or socialize with their contemporaries.

2. **If the distance between home and water source is short**, the girl children will take a short time to get the water and have enough time to play or take part in other activities. So they will not get very tired. Those studying will have ample time to study and revise or help their parents to do other activities.

Therefore, it is crucial that the government and local authorities do whatever it takes to improve the water services so that water can be obtained from sources close to households. This will reduce or eliminate all the hardships facing girl children in search of water for their families.



## River Basin Development

River basin development projects are schemes developed for different purposes, also they are called multipurpose schemes because they are aimed at meeting many goals like flood control, water supply in the industries and irrigation schemes. Examples of river basin developments are Rufiji River Basin Development and Kilombero Basin Development found in Tanzania, others examples are Tennessee Valley Project in the U.S and the Amazon Basin Development scheme in Brazil. River basin developments involve processes such as construction of dams for retaining water, dredging of the river so as to remove silt and mud from the river.

- Also clearing of vegetation where economic activities are going to take place.
- Planting of trees on the side of the river so as to prevent soil erosion and check the movement of the surface run-off to prevent flooding.
- Creating some canals and installing the pipes that should be used in irrigation schemes.

## Benefits of Developing River Basins

*State the benefits of developing river basins*

Listed below are the benefits of river basin developments

1. They help in control of floods where they are established hence the danger of destruction through flooding is avoided.
2. They lead to the improvement of navigation in the respective rivers especially when the dams are constructed.
3. Leads to the development of the fishing industry especially after the construction of the dams.
4. Water is provided for industrial use and domestic purposes.
5. River projects encourage environmental conservation like the control of soil erosion by planting trees.
6. Employment is usually created in the river basin development projects, for example fishing and workers in the farms get employment.

7. Silt removed from the river during dredging adds fertility to the soil and hence promotes farming.
8. Water is also provided in the irrigation schemes hence leading to the expansion of farms and increase in agriculture production.
9. They encourage the development of tourism since the dams are used as recreational centers, the gorges and waterfalls for viewing and hence bring foreign currency to the country.

## The Organization, Benefits, Problems and Prospects of Rufiji Basin Development Authority (RUBADA) and Tennessee River Valley Authority

*Explain the organization, benefits, problems faces and prospects of Rufiji Basin Development Authority (RUBADA) and Tennessee River Valley Authority*

### **1. Tennessee River Valley Authority (TVA)**

Tennessee river valley is found in the U.S.A and is a tributary of Ohio river. The government of U.S.A organized the development of the valley with the general aim of solving economic difficulties of the people.

Benefits of the Tennessee Valley Authority (TVA)

Below are the benefits of the Tennessee Valley Authority:

1. There has been an increase in water supply for irrigation, domestic use and industrial use.
2. Navigation in the Tennessee river has improved such as the commercial freight ships operating in the river.
3. Hydropower was made available to many people.
4. The floods have highly been controlled.
5. The project has created job opportunities for many people.
6. Increase on the size of arable land due to soil control.
7. Fishing industry has developed due to the construction of dams.

8. Provision of hydroelectric power has led to the development of different manufacturing and heavy industries.

#### Problems facing Tennessee River Valley

Listed below are some of the problems facing the Tennessee Valley:

1. Soil erosion can also affect the established Tennessee River Valley project.
2. Soil exhaustion due to intensive farming hence poor farming and low yield.
3. Water pollution especially by the industries discourages the utilization of water from the river basins for economic development.
4. Accumulation of silt in the dams leads to the reduction of the volume of water.
5. The outbreak of diseases like cholera due to accumulation of water.
6. Unreliable rainfall and excessive evaporation lead to the drying of the river and other water bodies hence economic activities cannot take place easily due to the dryness.

#### Prospects of the Tennessee River Valley

These are some of the prospects brought by the Tennessee River Valley

1. Constructing more dams for retaining water all year round
2. Maintaining the roads and modifying them to better standards
3. Training the local people on other economic activities like navigation fishing and not to rely on one activity to solve the economic problems of the people

## **2. Rufiji River Basin Development Authority (RUBADA)**

Rufiji basin development is found in Tanzania, the government of Tanzania organized the development to support economic activities of the people.

#### Benefits of Rufiji Basin

Some of the major benefits of RUBADA include:

1. It has promoted the market for the Hydro Electric Power (HEP) from Kidatu power plant.



2. There has been flood control.
3. The scheme has stimulated the development and maintenance of the railway lines and roads.
4. It has lead to the creation of employment opportunities in the valley.
5. It has promoted living standards of people through employment.
6. The development of towns, for example, new towns like Kidatu, Makambako and Mikumi.
7. The authority provides expert advice to the farmers on good farming techniques and solutions to their farming problems.

#### Problems facing the Rufiji Basin Development

Some of the problems facing the Rufiji Basin Development include:

1. Poor labour supply due to rural urban migration.
2. Diseases like cholera and malaria affect the farmers such that they fail to contribute effectively in the development of the scheme.
3. The climate problems like draught have been affecting water availability, sometimes the volume of water in the river decreases.
4. There are transport problems prevailing since the roads and bridges are not well constructed, hence during the wet season the area is not well accessible.
5. Expenses will be high since the process need high capital and the government does not have enough capital.
6. Low technology knowledge among the local people and hence they need intensive training to get the required knowledge and skills.
7. The researches and preliminary plans are taking too long. This will lead to the decline of other small projects because the government is concentrating more on that big project.

#### Prospects of Rufiji Basin Development

Some of the prospects of the Rufiji Basin Development include:

1. More funds have to be solicited from various donors both internally and externally.
2. Private sector should be encouraged to invest in the development of the valley, thus good investment climate has to be created in order to attract private investors.
3. Construction of more dams for retaining water.

## Land Reclamation

### The Major Aims for Land Reclamation

*Explain the major aims for land reclamation*

Land reclamation is the process of creating new land from ocean, riverbeds or lake beds. The main objective is to turn land which was previously unproductive to be productive, to increase the size of arable land for various uses such as: human settlement, establishment of industries and expanding agricultural production.

### The Techniques Used in Land Reclamation

*Describe the techniques used in land reclamation*

Land reclamation can be achieved with a number of different methods. The simplest method involves simply filling the undulating land with large amounts of heavy rock and/or cement until the desired level is attained. The process is called "infilling" and the material used to fill the space is generally called "infill".

Draining of submerged wetlands is often meant to reclaim land for agricultural use. Deep cement mixing is used typically in situations in which the material displaced by either dredging or draining may be contaminated and hence needs to be contained.

Various techniques are employed in land reclamation. The method chosen for reclaiming the land depends on the state of the land in question. The following are some of the techniques that can be used to reclaim the land:

1. **Irrigation:** Irrigation can be used to reclaim arid and semi-arid lands. An arid land may contain sufficient plant nutrients only that these nutrients are not available to plants unless

dissolved in water. Irrigation may be followed by addition of fertiliser if the land does not contain adequate nutrient elements to sustain plant growth. The irrigation can be done on a small or large scale depending on the size of the land and the kind of use into which the land is to be put after reclamation.

2. **Afforestation and reforestation:** Afforestation refers to the act of planting trees on a land that has scant or no vegetation. It is mainly carried out on arid, semi-arid or badly eroded lands. It can also be done to reclaim a swampy land. In such cases, trees that consume a lot of water such as eucalyptus are planted so as to drain the land. Reforestation refers to planting of vegetation on an area whose natural vegetation has become scant or cleared by man.

*A forestation is done for four major reasons, among others:*

1. To create water catchment. As explained early, forests attract rainfall, thus they act as water catchment.
2. To prevent soil erosion. In this case, trees protect soil from the impact of direct rain drops as well as wind, both of which protect the soil from erosion by water and wind respectively. In addition, trees help to bind the soil particles firmly so that they are not easily eroded by agents of erosion such as water, wind and animals.
3. Forests may be established for the purpose of producing timber or poles for sale or logs for manufacture of paper.
4. Forests are known to modify the climate through processes such as evapotranspiration (release of water vapour from plant leaves into the atmosphere). Forests also attract rainfall and hence improve the amount of rainfall that a place receives. Increased rainfall can stimulate crop cultivation and animal husbandry.

Techniques continued

1. **Drainage:** This technique involves digging trenches or channels through which water from swampy lands can drain out, thus helping to dry the land. This makes the land suitable for agriculture or settlement. It may also be used to reclaim land from the sea or lake. In the Zuider Zee project in the Netherlands, dykes were built to block sea water. The water in the enclosure was pumped out using pumps. The land was then rehabilitated by planting reeds to prevent

growth of weeds and to further drain the water. The reclaimed land was ultimately used for agriculture.

2. **Landfill:** This refers to the act of levelling the land by filling soil, vegetation, stones or other material in the holes, depressions, trenches or undulating land surface to make it suitable for various uses. Landfill can also involve adding a layer of a fertile soil on top of a barren or unproductive soil to be used for agricultural production. This technique of land reclamation is practiced by countries which lie in desert or arid belts where addition of a fertile soil is followed by irrigation and fertilisation.

3. **Flushing or acidification:** Sometimes the soil may contain excess salts particularly sodium ions. This makes the soil too basic (saline). To make such a soil fit for agriculture, the salts are flushed by passing water through it. Alternatively, the salts can be neutralised by addition of sulphur or sulphuric acid. However, this technique is very expensive. It should only be practiced when necessary.

4. **Clearing vegetation and controlling pests:** Some places consist of dense vegetation covers. Such places often are infested with tsetse flies. One of the methods of controlling tsetse is through clearing of bushes (their breeding grounds). Once the bushes have been cleared, the tsetse are ultimately killed using chemicals or by biological methods. The reclaimed land can then be used for crop cultivation, livestock keeping or settlement.

## Land Reclamation Process in Tanzania

### *Explain land reclamation process in Tanzania*

Various land reclamation efforts have taken place and are still going on in Tanzania. A number of methods are employed to reclaim wasteland, turning it a useful land.

Some of the land reclamation initiatives in Tanzania include the following:

1. **Irrigation.** This is carried out on dry lands found within the Rufiji basin. Water from river Rufiji and its tributaries are used for this purpose. Irrigation is also carried out in dry regions of Singida, Dodoma and Shinyanga.

2. **Drainage.** The land in some parts of the country has been reclaimed by using this technique. For example, parts of Kunduchi and Msasani were reclaimed through drainage in order to obtain land for settlement and other purposes

3. **Afforestation** and reforestation. This is one of the various methods used to reclaim wastelands in Tanzania. Shinyanga region is the best example of the land reclaimed through afforestation. Under the afforestation programme called Hifadhi Ardhi Shinyanga (HASHI), the government has encouraged planting trees to create forests as well as planting trees in crop farms (agroforestry).<sup>17</sup>The land which was formerly unproductive is now productive again and can be used for agricultural production, settlement and other economic activities. Also in Kondoa district the land has been reclaimed through afforestation campaign, among other techniques.

4. Clearing of vegetation. This was mainly done by colonialists in miombo woodlands. The vegetation was cleared to get rid of tsetse flies which affected livestock production. The cleared land was used for livestock keeping as well as settlement.



*Agroforestry as practised in Shinyanga region*

## Sustainable Use of Water Resources

### The Types of Underground Water and how it can be Tapped for Use at Local and National Levels in Tanzania

*Explain the types of underground water and how it can be tapped for use at local and national levels in Tanzania*

Water can be found both on the surface of the earth and underground. Underground water also called ground water or subterranean water, is the type of water found below the surface of the earth. Underground water include all water that is found below the earth's surface, occupying interstices (pores) or voids of pervious rocks and soil. Like surface water, it is derived principally from precipitation that falls upon the earth's surface and percolates downward under gravity.

### Different Resources Obtained from Water

*Differentiate different resources that are obtained from Water*

Underground water is categorised based on its source as follows

1. **Connate water:** It may also be described as fossil water. This is water trapped in the pores of the rock during the formation of the rock. Connate water can change in composition thought the history of the rock. Connate water is normally saline. Formation water or interstitial water, in contrast, is simply water found in the pore spaces of rock and might not have been present when the rock was formed. This type of water can be found in desert rocks where rainfall does not occur for a long period of time. Connate water generally plays an insignificant role in ground water studies. Agroforestry as practised in Shinyanga region
2. **Meteoric water:** This refers to underground water which originates from rainfall and other forms of precipitation such as hailstorms and snowfall. When the rainfalls or snow melts, a considerable portion of this water gradually infiltrates into the ground. This infiltrating water continues its downward journey to the zone of saturation to become part of the ground water in aquifers (water-bearing rocks).

3. **Juvenile water:**Juvenile water, also described as magnetic water, is water that exists within magma. It is brought close to the earth during vulcanicity. Magnetic water rises from great depth accompanying the magma flow from down the earth's crust.

4. **Oceanic water:**This is underground water that results from the seepage of ocean water into the ground. It is common in coastal areas where ocean water seeps horizontally into the ground from the ocean.

Underground water can be tapped and put into various uses. The water tapped from the ground can be used for domestic and industrial purposes. Domestic uses include cooking, washing, bathing, watering plants, cleaning and many other uses. Industrial uses may include cooling of machinery, dissolution and dilution of chemicals, beverage manufacture, etc.

Underground water can be tapped in a number of ways which include the following:

1. **Drilling boreholes:**These are holes dug deep into the ground to reach the water table. When the water table or underground water is reached, the water seeps up through the hole under pressure. It is then brought above the ground by pumping manually or using a water pump.

2. **Digging wells:**Just like boreholes, a hole is dug into the ground until water is reached. The difference between boreholes and wells is that water from the well is mainly drawn mechanically using containers such as buckets that are raised mechanically or by use of simple pulleys or hand. The walls of wells may be lined with bricks or stones and cement.

3. 3. Where the water occurs very close to the surface, the soil may be scooped to expose the water. The water may then be scooped using cups or other containers. It may be directed to farms for irrigation via channels or trenches. The water may also be pumped and channelled into pipes to provide tap water.

4. Underground water may be naturally exposed to form springs or oases in deserts. This water may be scooped directly using containers. It may also be directed to farms through channels.





*Pumping water at a borehole*

ways to tap underground water





## Methods Used for Extracting Resources from Water

*Describe methods used for extracting resources from water*

### **Resources obtained from water**

There are a number of resources that can be obtained from water. Outlined below are some of the resources that can be extracted from water:

1. **Fish and other edible creatures, such as crabs and prawns:** These resources may be caught either for sale or family consumption.
2. **Building materials:** The building materials obtained from water include sand, coral rock, gravel and clay. Sand can be obtained from beaches of seas or lakes or river valleys and rocks are collected from the sea shore. The rocks and gravel are a result of erosion of the coastal rock by sea waves. Clay can also be obtained from the sea floor or river bed.

3. **Electricity:** Marine wind is used to turn windmills to generate electricity. Hydroelectric power is also a resource from the water since it results from the running water which is used to turn turbines to generate electricity.
4. **Salt** which is used at home and in industries, is mainly obtained from sea water though it can also be extracted from salty rivers and lakes. Brick-lined well<sup>20</sup>
5. **Ornamental items** such as cowrie shells, snail shells, lobster shells, etc are also water resources since they come from animals that inhabit water.
6. **Sea weed** is used in many maritime countries as a source of food, for industrial applications and as a fertiliser. High utilisation of these plants as food is in Asia, particularly Japan, Korea and China, where sea weeds cultivation has become a major industry.
7. **Limestone and gypsum:** Limestone forms from shells of dead marine organisms ranging from molluscs to corals and plants. Limestone can be used directly or converted into cement for construction purposes. Gypsum forms during evaporation of sea water and thus may occur with limestone. The gypsum deposits are mined and generally converted into Plaster of Paris which is mainly used as a building material.



*Fish and prawns*

## **Extraction of resources from water**

Many resources are extracted from water and used by man. The following are the means by which the named resources may be extracted from the water:

Fish and other edible marine creatures

Fish may be obtained from water through use of a hook and line, nets, herbs, spears or traps. In the case of a hook and line, bait (such as worm or meat) is attached to a hook which is joined to a string tied to a long stick or rod. The hook is sunk into the water. When the fish bites the bait, it gets caught by the hook and pulled out. This method is used for small-scale fishing.



*Fishing using hook and line*

Another method of catching fish is through use of certain plants called tephrosia. This plant is poisonous to fish. When the leaves of this pea plant are pounded and mixed with water, the fish are poisoned and they fall unconscious and float on water. They are then picked from the water by hand or use of a spear (harpooning). The fisherman spears fish in water and it is attached to the tip of the spear from which it is detached and put in a container.

The traps are mainly used where there are floods or at the coast where there are tides. These traps are set up at the bank of the river or on the beaches. The fish are washed into the banks or beaches by the water. As the water receded the fish remain trapped behind the traps.



## *A fish trap*

Nets are used to catch a large number of fish. With nets the fish are enclosed in a net with small perforations through which fish cannot penetrate. They are then hauled to the sea shore, removed from the net and put in containers.

## **Sand**

Sand is extracted from the beaches or dredged from the ocean or river beds. This can be done by using scooping machinery or by hand using shovels, pans, hoes, etc. It is then loaded onto truck or lorry using shovels or a grab dredge.



*Harvesting sand from water*

## **Salt**

The process of extraction of salt from water involves evaporation. The salty water is trapped in evaporation ponds. The sun evaporates the water. As the water vapourizes, the salt remains behind. Eventually, enough of the water evaporates to leave behind a layer of salt crystals that can be collected, dried and stored in bags. Another alternative for salt extraction from the water is by means of evaporation tanks. Salty water is pumped into the tanks where the water is evaporated, leaving the salt behind.



*Salt evaporation ponds*

## **Hydroelectricity**

- Hydroelectric power is generated by using turbines that are turned by the fast-flowing river water, where the kinetic energy of the water is transformed into electrical energy.
- Tidal power or marine wind is used to turn windmills to generate electricity. The kinetic energy of wind is converted into electrical energy by windmills (wind turbines).

## **Ornamental items**

These can be obtained from the sea or lake by picking them using hands. This is normally done during low tide and after the water has receded. Ornamental items are brought to the shore from deep sea by the tides or sea waves.



Seaweeds are harvested by hand-picking. The weeds occur naturally or they can be planted. Limestone and gypsum are mined by quarrying.

## The Problems Caused by Extraction of Water Resources

*Explain the problems caused by extraction of water resources*

**Extraction of water resources may cause various problems and disturbance to ecosystem. Below are some of these problems:**

1. **Overfishing**, and indiscriminate fishing whereby even very young fish are caught reduces the availability of fish resources in water. It also causes an imbalance in the ecosystem.
2. **Water pollution** is a problem where dynamites or poisons are used as methods of fishing. Dynamites produce loud sounds which disturb the fish and other aquatic organisms while poison kills fish, aquatic plants, and other marine organisms.
3. **Sand harvesting** may lead to loss of media for growth of plant life. It may also disturb aquatic life, for example, it may interfere with breeding of some marine organisms such as monitor lizards, salt evaporation ponds, snakes, crocodiles, alligators and turtles. These animals normally lay eggs in the sand. Sand extraction from river banks may also lead to flooding since the sand deposited besides a river acts as a levee which prevents water from leaving its channel during floods. It may also accelerate river erosion because the extraction process loosens the soil and makes it easy to erode.
4. **Harnessing hydroelectric power** from river water requires dams to be constructed. This can cause water shortage to the areas downstream. Water trickling from the tank to the nearby areas may also lead to flourishing of disease vectors such as mosquitoes and snails which harbour causative agents for malaria and schistosomiasis respectively.

Some of the solutions to these problems include the following:-

1. Giving guidelines on the kind of nets allowed for fishing certain fish species. To achieve this, the fishermen must be closely monitored to ensure that holes of the nets they use for fishing are not too small to catch even young fish.
2. Restricting fishing in some parts of the water, especially those areas identified as fish breeding grounds, so as to allow fish to breed and increase in number.

3. Encouraging and educating people to practice fish farming so as to reduce fishing pressure on natural water bodies such as rivers, lakes and seas.
4. Restricting or controlling sand harvesting in beaches and shores so as to ensure that aquatic environment is not destroyed and that aquatic life is not disturbed.
5. Banning the use of dynamites or poisons in fishing because this act pollutes the water and is likely to harm fish consumers.
6. Taking stern actions against those people breaching environmental conservation laws. The actions may include fines, jail sentences or both.

## **Water pollution**

Water pollution is the introduction of substances that lower the quality of water bodies such as oceans, rivers, lakes, aquifers and ground water. This makes the water unsafe for use in homes and industries. Water pollution also affects living organisms (plants and animals) living in water.

Water pollution is caused by some or a combination of many factors. The following are some of the major causes of water pollution:

- **Agricultural chemicals;** Agricultural chemicals that are applied to crops and animals drip onto the soil and may eventually run off into the local streams and rivers. They can also seep down to reach ground water. These chemicals contaminate the water and make it unwholesome for human use and can drastically affect the aquatic life.
- **Oil spills;** Oil spills in oceans and seas cause water pollution and big problems for local wildlife, fishermen and aquatic organisms. Oil spilled onto land is also carried into water bodies by surface run off. This includes drips of oil, fuel and fluid from motor vehicles, oil spilled onto the ground at filling stations; and drips of oil from industrial machinery. These sources and many more combine together to form continual petroleum pollution to all of the world's waters.

## **Mining**

Mining causes pollution in a number of ways. They include the following:



1. The mining process exposes heavy metals and sulphur compounds that were previously locked deep in the earth. Rain water leaches these compounds out of the exposed earth, resulting in “acid mine drainage” and heavy metal pollution that can continue long after the mining operations have practically ceased.
2. The action of rain water on piles of mining waste (tailings) transfers harmful chemicals to freshwater supplies.
3. In gold mining, cyanide is intentionally poured on piles of mined rock (a leach heap) to chemically extract the gold from the ore. Some of the cyanide ultimately finds its way into nearby water.
4. Huge pools of mining waste slurry (semi-liquid mixture) are often stored behind containment dams. If a dam leaks or bursts, water pollution is likely to take place.
5. Mining companies in developing countries sometimes dump mining waste directly into rivers or other water bodies as a method of disposal.

Other pollutants:

- ***Sediment:***The act of clearing the forests to get ample land for agriculture, settlement or wood, leaves the land bare and exposed to the agents of denudation. This accelerates soil erosion and the sediment is free to run into nearby streams, rivers and lakes. The increased amount of sediment running off the land into nearby water bodies seriously affects the fish and other aquatic life. Poor farming practices and cultivation along and close to the rivers, exposes the soil to erosion agents. Soil erosion causes water pollution.
- ***Industrial Chemicals:***Most of the water that is used in the production process in industries is eventually discharged into water bodies. This waste water may contain harmful chemicals such as acids, alkalis, salts, toxic chemicals, oil, heavy metals and even harmful bacteria, and other reagents. These substances affect the quality of water and the lives of aquatic organisms.
- In some cases, the waste water discharged into a water body may be hot enough to kill any organism living in that water.

- **Sewage:**In developing countries, about 90% of untreated sewage is discharged directly into rivers and streams. This renders the water unwholesome for domestic and other uses. Untreated sewage harbours a myriad of disease-causing organisms. This is the reason why diseases such as cholera, dysentery, typhoid and bilharzias are very common among African countries. Leaking septic tanks and other sources of sewage can contaminate ground and stream waters as well.
- **Marine debris:** (marine litter) Marine debris is trash in the ocean. This is litter that ends up in ocean, seas or other large water bodies. The debris mainly comes from urban sewers and garbage thrown overboard from ships and boats. Examples of marine debris include plastic bags, water bottles, balloons, shoes, lags etc. It can also include items that wash in from the ocean, such as fishing line, ropes, nets and traps, and items from ship such as lost cargo from container ships.
- **Heat:**Heat is a water pollutant. Increase in water temperature results in deaths of many aquatic organisms. This is because, as water temperature increases, the amount of oxygen that can dissolve in it also decreases. Therefore, warm and shallow water will contain very little oxygen to an extent that the dissolved gas will not sustain aquatic life.
- This increase in temperature is most often caused by discharge of cooling water (which is always hot) by factories and power plants.
- Global warming also contributes significantly to heating of the oceans.

For resources to be sustainable, they must be conserved to ensure continuity and availability to upcoming generations. Water, as a resource, can be conserved through the following ways:

1. **Avoiding wastage:**All people should use water wisely to minimise wastage. All taps should be turned off when they are not used. The used water may be re-used again. For example, water that has been used to rinse clothes can be re-used to mop the floor, soak the dirtiest clothes, rags etc. Do not use water directly from the tap, instead fetch the water in a container and use it wisely.
2. **Controlling polluting:** People should neither throw wastes carelessly nor introduce any chemicals into water. Stern laws should be made and enforced to stop industries from dumping

toxic wastes into the water bodies. Any industry found polluting the water by any means should be heavily punished or even closed down altogether.

3. **Protection of water catchment:**Vegetation in water catchment areas should be protected and cared for. People should not carry out agricultural activities close to water sources. Planting of trees that consume a lot of water, such as eucalyptus, near water sources or rivers should also be avoided. Any activity that destroys the water catchment should be banned. In the past, the government ordered people to cut down all eucalyptus trees planted close to water sources so as to prevent the water sources from drying up.

4. **Education:**People should be educated about the importance of conserving the water resources. This education can be conveyed through mass media and introducing water conservation courses in schools and colleges. The government and other organizations concerned with conservation of water resources should involve local communities so as to get maximum cooperation in their endeavours. The local people must be involved at all levels and should be given freedom to suggest how best these resources can be conserved.

5. **Sewage treatment:**Sewage is water containing waste matter produced by people. Much industrial sewage contains harmful chemicals and other waste materials. Sewage must be treated before it flows from sewerage systems into lakes, rivers, and other bodies of water. Untreated sewage contaminates the water and, in time, can kill fish and aquatic plants. The sewage makes the water unsafe to drink and can also prevent use of the water for swimming, fishing, and other recreation. Most cities and towns have at least one sewage treatment plant. In most rural areas, homeowners must provide their own sewage treatment. Most do so with large underground containers called septic tanks or pit latrines.

6. **Controlled use of agrochemicals:**Farmers should be educated on the correct use of agrochemicals. Also agricultural activities should not be carried out in areas close to water bodies. The use of organic manures and chemicals in place of harmful industrial chemicals for agricultural production should be emphasised.

7. **Recycling of products:**People should be advised to recycle the waste instead of dumping it in water sources. This will help reduce the problem of water pollution.8. Immediate clean upWhen oil is accidentally spilled in water it should be cleaned up immediately before causing any harm to aquatic life or people using that water. This can be done by use of chemicals or special machines called skimmer ships.

## Water Pollution

Many resources are extracted from water and used by man. The following are the means by which thenamed resources may be extracted from the water:

- Fish and other edible marine creatures

Fish may be obtained from water through use of a hook and line, nets, herbs, spears or traps. In thecase of a hook and line, bait (such as worm or meat) is attached to a hook which is joined to a stringtied to a long stick or rod. The hook is sunk into the water. When the fish bites the bait, it gets caughtby the hook and pulled out. This method is used for small-scale fishing.



*Fishing using hook and line*

## Pollution

*Define pollution*

Water pollution is caused by some or a combination of many factors. The following are some of the major causes of water pollution:

- ***Agricultural chemicals:*** Agricultural chemicals that are applied to crops and animals drip onto the soil and may eventually run off into the local streams and rivers. They can also seep down to reach ground water. These chemicals contaminate the water and make it unwholesome for human use and can drastically affect the aquatic life.
- ***Oil spills:*** Oil spills in oceans and seas cause water pollution and big problems for local wildlife, fishermen and aquatic organisms. Oil spilled onto land is also carried into water bodies

by surface run off. This includes drips of oil, fuel and fluid from motor vehicles, oil spilled onto the ground at filling stations; and drips of oil from industrial machinery.

- These sources and many more combine together to form continual petroleum pollution to all of the world's waters.

## **Mining**

- Mining causes pollution in a number of ways. They include the following:
- The mining process exposes heavy metals and sulphur compounds that were previously locked deep in the earth.
- Rain water leaches these compounds out of the exposed earth, resulting in “acid mine drainage” and heavy metal pollution that can continue long after the mining operations have practically ceased.
- The action of rain water on piles of mining waste (tailings) transfers harmful chemicals to freshwater supplies.
- In gold mining, cyanide is intentionally poured on piles of mined rock (a leach heap) to chemically extract the gold from the ore. Some of the cyanide ultimately finds its way into nearby water.
- Huge pools of mining waste slurry (semi-liquid mixture) are often stored behind containment dams. If a dam leaks or bursts, water pollution is likely to take place.
- Mining companies in developing countries sometimes dump mining waste directly into rivers or other water bodies as a method of disposal.
- **Sediment:**The act of clearing the forests to get ample land for agriculture, settlement or wood, leaves the land bare and exposed to the agents of denudation. This accelerates soil erosion and the sediment is free to run into nearby streams, rivers and lakes. The increased amount of sediment running off the land into nearby water bodies seriously affects the fish and other aquatic life. Poor farming practices and cultivation along and close to the rivers, exposes the soil to erosion agents. Soil erosion causes water pollution.

- **Industrial chemicals:** Most of the water that is used in the production process in industries is eventually discharged into water bodies. This waste water may contain harmful chemicals such as acids, alkalis, salts, toxic chemicals, oil, heavy metals and even harmful bacteria, and other reagents. These substances affect the quality of water and the lives of aquatic organisms. In some cases, the waste water discharged into a water body may be hot enough to kill any organism living in that water.
- **Sewage:** In developing countries, about 90% of untreated sewage is discharged directly into rivers and streams. This renders the water unwholesome for domestic and other uses. Untreated sewage harbours a myriad of disease-causing organisms. This is the reason why diseases such as cholera, dysentery, typhoid and bilharzias are very common among African countries. Leaking septic tanks and other sources of sewage can contaminate ground and stream waters as well.
- **Marine debris:** (marine litter) Marine debris is trash in the ocean. This is litter that ends up in ocean, seas or other large water bodies. The debris mainly comes from urban sewers and garbage thrown overboard from ships and boats. Examples of marine debris include plastic bags, water bottles, balloons, shoes, lags etc. It can also include items that wash in from the ocean, such as fishing line, ropes, nets and traps, and items from ship such as lost cargo from container ships.
- **Heat:** Heat is a water pollutant. Increase in water temperature results in deaths of many aquatic organisms. This is because, as water temperature increases, the amount of oxygen that can dissolve in it also decreases. Therefore, warm and shallow water will contain very little oxygen to an extent that the dissolved gas will not sustain aquatic life.
- This increase in temperature is most often caused by discharge of cooling water (which is always hot) by factories and power plants.
- Global warming also contributes significantly to heating of the oceans.

## The Main Sources of Water Pollution

*Differentiate the main sources of water pollution*

There are two major sources of water pollution which are direct and indirect sources. Direct sources includes effluent from factories, refiners and domestic sewage which affect directly water supply systems. Indirect sources include pollution from runoffs, ground water and

contaminated rain water. There are other sources such as oil spills and marine or river dumping of waste.

## Ways of Conserving Water Resources

*Describe various ways of conserving water resources*

For resources to be sustainable, they must be conserved to ensure continuity and availability to upcoming generations. Water, as a resource, can be conserved through the following ways:

1. **Avoiding wastage:** All people should use water wisely to minimise wastage. All taps should be turned off when they are not used. The used water may be re-used again. For example, water that has been used to rinse clothes can be re-used to mop the floor, soak the dirtiest clothes, rags etc. Do not use water directly from the tap, instead fetch the water in a container and use it wisely.
2. **Controlling polluting:** People should neither throw wastes carelessly nor introduce any chemicals into water. Stern laws should be made and enforced to stop industries from dumping toxic wastes into the water bodies. Any industry found polluting the water by any means should be heavily punished or even closed down altogether.
3. **Protection of water catchment:** Vegetation in water catchment areas should be protected and cared for. People should not carry out agricultural activities close to water sources. Planting of trees that consume a lot of water, such as eucalyptus, near water sources or rivers should also be avoided. Any activity that destroys the water catchment should be banned. In the past, the government ordered people to cut down all eucalyptus trees planted close to water sources so as to prevent the water sources from drying up.
4. **Education:** People should be educated about the importance of conserving the water resources. This education can be conveyed through mass media and introducing water conservation courses in schools and colleges. The government and other organisations concerned with conservation of water resources should involve local communities so as to get maximum cooperation in their endeavours. The local people must be involved at all levels and should be given freedom to suggest how best these resources can be conserved.
5. **Sewage treatment:** Sewage is water containing waste matter produced by people. Much industrial sewage contains harmful chemicals and other waste materials. Sewage must be treated before it flows from sewerage systems into lakes, rivers, and other bodies of water. Untreated

sewage contaminates the water and, in time, can kill fish and aquatic plants. The sewage makes the water unsafe to drink and can also prevent use of the water for swimming, fishing, and other recreation.<sup>26</sup> Most cities and towns have at least one sewage treatment plant. In most rural areas, homeowners must provide their own sewage treatment. Most do so with large underground containers called septic tanks or pit latrines.

6. ***Controlled use of agro-chemicals:*** Farmers should be educated on the correct use of agrochemicals. Also agricultural activities should not be carried out in areas close to water bodies. The use of organic manures and chemicals in place of harmful industrial chemicals for agricultural production should be emphasised.

7. ***Recycling of products:*** People should be advised to recycle the waste instead of dumping it in water sources. This will help reduce the problem of water pollution.

8. ***Immediate clean up:*** When oil is accidentally spilled in water it should be cleaned up immediately before causing any harm to aquatic life or people using that water. This can be done by use of chemicals or special machines called skimmer ships.



# SUSTAINABLE USE OF FOREST RESOURCES

## Types of Forestry Resources

### Types of Forests

#### *Identify types of forests*

A forest is a dense growth of trees, plants and undergrowth covering a large area of land. There are two broad types of forests: Natural forests and planted (artificial) forests. Natural forests develop naturally without intervention of man while planted forests are planted and cared for by man.

### **Natural forests**

Some characteristics of natural forests include the following:

1. Trees of different types grow together.
2. Most of the trees are hardwood.
3. The trees in these forests are indigenous to the area.
4. There is dense or thick undergrowth.



*A natural forest*

## Distribution of Forests by Type

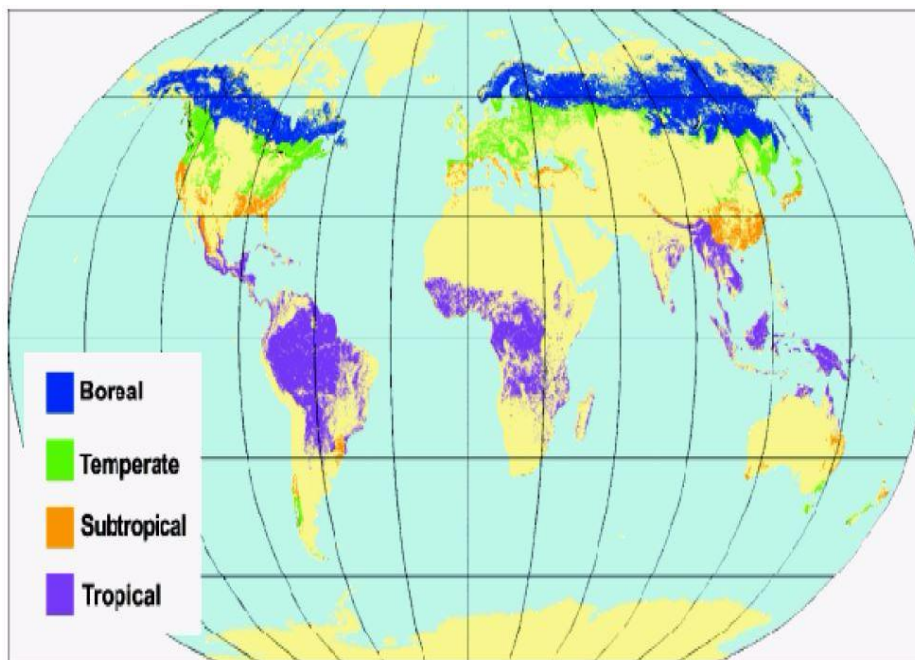
*Locate the distribution of forests by type*

Due to factors such as climate and tree species, natural forests can further be subdivided into the following broad categories.

- **Tropical rainforests:** They are found around the equator, between 23.5°N and 23.5°S. Trees in the tropical rainforests are tall and often take a very long time to mature. They consist of indigenous trees which are typically broad-leaved, and they contain thick undergrowths of shrubs and other vegetation.
- **Temperate forests:** These forests occur in the mid latitudes of both hemispheres. There are four distinct seasons in temperate deciduous forests and precipitation falls throughout the year, as rain in the spring, summer and fall and snow in the winter. The forest floor in temperate forests supports mosses, ferns and wild flowers. Maple, oak and birch trees are some examples of the deciduous trees that dominate these forests. There are also small numbers of evergreen trees such as pines and fir.
- **Coniferous forests:** Coniferous forests are typically found in coastal areas with mild winters and heavy rainfall or in in-land mountainous areas with mild climates with temperature

that fluctuates little throughout the year. Evergreen conifers dominate these forests. They are characterized by evergreen, needle-leaved trees, with little undergrowth and tall trees which take very long time to mature. Dominant tree species found in coniferous forests include cedar, cypress, Douglas fir, pine, spruce and redwood. Some deciduous trees such as maple, and mosses and ferns are common in coniferous forests.

- **Boreal (taiga) forests:** These are the northernmost forest type and are found between 50°N and 60°N. Boreal forests are characterized by long winters and short summers. Most precipitation is in the form of snow. Trees are mostly evergreen and include species such as spruce, fir and pine.



*Distribution of natural forests*

## **Planted forests**

Some characteristics of plant forests include.

- Trees are mainly of one species
- Trees are planted in rows in order to make harvesting work easy.
- Trees are may or may not be indigenous to the area
- Most of the trees are softwood.



*A planted forest*

## Factors for Distribution of Forests

*Explain factors for distribution of forests*

Forest distributions are affected by a number of factors which include the following:

1. **Soil:** Different types of soil offer various types of vegetation. For example, a damp and marshy soil will favour growth of types of trees such as mangroves, which are generally found on the coastal areas of the tropics or subtropics. On the other hand, sandy soils located in dry desert areas will support prickly bushes and cactus where the aim of the plant is to conserve water.
2. **Rainfall:** Water is an essential component of all living organisms. Trees need water for various physiological functions such as photosynthesis and cooling. Hence, it is essential for growth and development of any particular vegetation. Forests thrive well in areas that receive sufficient rainfall which is evenly distributed throughout the year.
3. **Temperature:** The warm and wet equatorial climate supports the growth of mainly huge, tall, deciduous trees. The cooler temperate climate supports needle-leaved trees which are adapted to that particular climate. The moderately hot tropical climate supports a variety of softwood and hardwood trees which thrive best in the tropics.



4. **Relief:** Relief refers to variation in altitude in an area. Differences in altitude along the slope of a mountain bring about differences in the type of forests along a mountain slope. For example, you will always find dense forests on the foot of Mount Kilimanjaro. As you move up from the foot of the mountain, the vegetation type and density changes gradually. At a height ranging between 1800 and 2800 m, there is the tropical rainforest, followed by the temperate forest at around 4000 m. Between 3000 and 3500 m, the forest is dominated by scanty vegetation, with patches of a bamboo forest.

5. **Aspect:** In physical geography, aspect generally refers to the horizontal direction to which a mountain slope faces. The slope of a mountain facing the direction of prevailing winds (windward side) will always receive higher amounts of rainfall than the slope facing the opposite side (leeward side). For this reason, dense forests will always grow on the windward side, due to abundant rainfall, while the leeward side will consist of scanty and poor vegetation.

6. **Drainage:** If the soil has too much water, plants cannot get enough oxygen from the soil. This will affect root respiration and the plants may eventually die. On the other hand, plants cannot grow well if they do not have healthy roots for absorbing water from the soil. So, the proper balance of plant health, water and air is necessary for maximum plant growth and development. Well drained soils support growth of a variety of big trees compared to water-logged and swampy lowland. However, few plants such as mangrove can thrive in shallow sea shores which are more or less permanently covered by water.

7. **Human activities:** Human activities such as clearing the vegetation to get land for agriculture or settlement greatly affect the distribution of forests. Most of the natural forests of the world have been cleared by man. In some parts man has planted forests (artificial forests) on bare lands or in place of natural forests.

## Importance of Forestry Resources

### The Importance and Values of Forests in Social and Economic Life

*Describe the importance and values of forests in social and economic life*

Forests play an important role in our daily lives. A variety of goods and services that we use to simplify our lives are derived from forests. It is not possible to sum up the importance of forests

in a few words. Forests impact our lives in so many ways. They are of great social and ecological significance to mankind.

The following are some of the reasons why forests are very important:

- Forests are of immense economic importance to us. For example, plantation forests provide humans with timber and wood, which is exported and used in all parts of the world. Timber is used in building and construction, making furniture, tool handles and for ship building, among other various uses. Trees also provide tourism income to inhabitants (people living in or close to forests) when people pay a visit to see the beauty of nature (ecotourism).

- 



### *Timber*

- Forest trees are valuable sources of wood and charcoal which are used as fuel in many parts of the world. In many developing countries, Tanzania inclusive, more than 80% of total energy (fuel wood and charcoal) consumed by people and industry is derived from forests.



*Charcoal*

- Wood pulp which is used to make paper is derived from a variety of softwood trees.

## The Importance of Forests in Ecological and Environmental Balance

*Explain the importance of forests in ecological and environmental balance*

The following are the importance of Forests in Ecological and Environmental Balance

1. Forests serve as habitats to a diversity of animal species and they also serve as settlements for many different wild tribes. Certain tribes such as the Hadzabe and Tindiga in Tanzania live and earn their living in forests. They live by gathering fruits from the forests, hunting wild animals for meat, and harvesting honey. They get all their daily needs from the forests.

2. Forests protect the watersheds (water catchments). Many rivers and streams have their sources in dense forests. This is because of the heavy rainfall often experienced in these areas. So forests serve as sources of rivers and springs, the water resources that are needed by man for livelihood. The Amazon is by far the largest watershed and largest river system in the world

occupying over 6million square kilometres. Over two-thirds of all the fresh water found on Earth is in the Amazon Basin's rivers, streams, and tributaries.

3. Forests help in maintaining the water cycle. When the rain falls some of the water is absorbed by plants in the soil through roots. The water absorbed by trees is then released into the atmosphere through plant leaves (transpiration) where it condenses to form a mass of tiny water droplets(clouds). After these water droplets have gained enough size and weight, they fall down as rain under the influence of gravitational pull.

4. A variety of chemical substances are obtained from the forest trees. The barks of mangrove trees that are common along the coast of East and West Africa provide tannin which is used for tanning leather. Chicle, a milky sap obtained from the bark of the zapote tree from the tropical rainforest of Central America is a raw material used for making chewing gum. Wild rubber and balata juices used for making machinery belting are also obtained from tropical forests.

5. Forests play the most important role in environmental conservation. Trees give out moisture via transpiration, a phenomenon which increases the atmospheric moisture content and hence rainfall. The air in and around forests is cold for most of the time, thereby providing a pleasant micro-climate. Acer saccharum (Sugar maple) is best known for being the primary source of maples Forest trees also serve as wind breaks, thus helping to reduce soil erosion by wind. Trees also prevent soil erosion by providing a soil cover that offers protection to the soil against the impact of direct rain drops. In this way, they both protect the soil from water erosion and loss of water via evaporation of moisture from the soil.

<i>Product</i>	<i>Leading countries</i>
Timber and wood fuel	Russia, USA, Brazil, China, Canada, Indonesia, Japan, Sweden, Nigeria, France, Finland, Germany
Timber from hardwoods	Indonesia, Brazil, India, China, USA, Russia, Nigeria, Tanzania, Malaysia, Philippines
Timber from softwoods	Russia, USA, Canada, China, Sweden, Finland, Brazil, Germany, Japan



Wood pulp	USA, Canada, Russia, Japan, Sweden, Finland, France, Germany, China, Brazil, Norway, New Zealand.
Newsprint	Canada, USA, Japan, Russia, Sweden, China, Finland, Germany, Norway, UK
Rubber and gum	Brazil, Nigeria, Borneo (Indonesia) Central America
Resin, pith, tar, turpentine	Southern USA, France, Russia
Cork	USA (California) Portugal, Spain Morocco

6. Climate control and atmospheric purification is crucial for human existence. Trees and soils help regulate atmospheric temperatures through a process called evapotranspiration. This helps to stabilize the climate. Additionally, they enrich the atmosphere by absorbing bad gases (for example, carbon dioxide and other greenhouse gases) and producing oxygen. Trees also help to remove air pollutants.

## Important Areas of Forest Products, their Transport and Use in the World

### Important Countries in Timber Production

*Identify important countries in timber production*

Because forests exist in almost every country, they are equally exploited for their products. Many countries produce, use and export a variety of forest products. The following are the world's leading countries in production of forest products.

There are many forest products which include the following:

- Tannin, which is obtained from the hemlock tree of North America and Europe, oak and chestnut of the temperate hardwoods, quebracho of Southern Brazil, Paraguay and Northern Argentina, wattle tress of East, Central and South Africa and mangrove from the tropical coastlands.

- Palm and creeper products, such as:(i) palm oil; (ii) coconuts; (iii) mat and basket weaving materials from many varieties of palms such as pandanus and raffia; and (iv) furniture, basketry and weaving materials from bamboo and creepers like rattan.
- Medicinal materials, such as:(i) quinine from cinchona tree;(ii) cocaine from coca plant; and(iii) camphor from the camphor tree.
- Fruits and spices

## The Means of Transportation and Problems of Timber Transportation in the World

*Explain the means of transportation and problems of timber transportation in the world*

Harvesting and transportation of timber faces many challenges in many ways. The movement of logs and timber from the forests to sawmills or market faces many challenges.

The logs are pulled by tractors or lorries out of dense forests to saw mills or markets. Where sawmills are located far away from the forests, they are loaded and transported to sawmills by lorries. The sawn timber is then transported to local markets for sale or exported overseas.

In Tanzania, timber and logs are transported by lorries from production areas (mostly Iringa, Mbeya, Mtwara, Lindi and Ruvuma regions) to Dar es Salaam where they are sold or shipped to overseas markets.

Within the tropics, the major problem is moving logs from deep in the heart of the forest to the mills. The areas where valuable trees are found are undeveloped, impenetrable, and remote and they often lack access roads. The valuable tree species are also scattered within the forests. This means covering large areas of the forest harvesting the desired tree species, a situation which makes transportation of logs very difficult. Many tropical trees have big trunks and are heavy. This makes it impossible to transport them by floating on rivers. Bad enough, some rivers that could be used to transport the logs are interrupted with waterfalls and rapids, and are covered with dense floating vegetations such as water hyacinth.

Timber transportation in temperate forests is much easier. The tree species grow in pure stands. This means that one area is covered by one species of trees all of which are almost of the same

age. The tree trunks are smaller and lighter than their tropical counterparts. So the logs can easily be floated downstream to the saw mills which are located along rivers. In comparison to tropical forests, transportation problems are minimal. The logs are pulled along the partly frozen ground in winter by tractors and caterpillars onto the rivers. Also, there is little undergrowth in the forests. So transportation is not hindered as it is the case in the tropical forests.

## Problems Associated with Forestry Resources Harvesting

### The Problems Facing Forestry Resources Harvesting

*Describe the problems facing forestry resources harvesting*

Over the last fifty years about half the world's original forest cover has been lost. The most notorious cause for this loss is unsystematic use of forest resources by man. When we take away the forest it is not just the trees that go. The entire ecosystem begins to fall apart with dire consequences for all of us. The following are some of the problems (effects) associated with harvesting of forest resources:

1. Cutting down trees indiscriminately exposes the soil to agents of erosion. If corrective measures are not taken in time, the soil may get eroded badly to such an extent that it can turn into badlands or even semi-arid.
2. Many forests form water catchments. Clearing the forests from such places can lead to destruction of water sources, a fact which can cause drought and hence water shortage and eventually aridity.
3. Cutting down trees carelessly, without taking actions to replant the new ones, can eventually lead to change in climatic conditions leading to drought and famine. It also deprives the animals of the habitat.
4. Trees also help to absorb carbon dioxide gas from the atmosphere. So reduction of the forest cover through deforestation can cause accumulation of carbon dioxide in the atmosphere and result in greenhouse effect, which causes global warming.

5. Uncontrolled harvesting of forest resources eventually leads to scarcity of forest resources. This may, in turn, lead to extinction of some forest species.

6. Forests are a habitat to a variety of animal species ranging from crawling insects to flying birds; and extremely small organisms to very big animals. Uncontrolled tree harvesting interferes with the ecological balance of the forest flora and fauna. In time, some of the animals migrate to other regions where the habitat is unfavourable or die leading to species extinction.

7. Some tree species are very rare and unique to the region. If tree harvesting is not done with care, some of the rare plant species would become extinct, a fact that would negatively affect the ecosystem balance.

## Ways to Address Problems Facing Forests in the World

*Describe ways to address problems facing forests in the world*

The problems facing forests in the world can be addressed through sound management and conservation of forest resources. There are a number of measures that be taken effectively to manage forests, which include the following:

1. Carrying out researches to determine the growth requirement of certain tree species so that correct species are planted in the correct soil and climatic conditions for optimum growth. This can also involve the development of tree species that withstand harsh conditions and which take a short time to mature.

2. Educating the people on the importance of conserving forests and how the destruction of the forest cover can have negative impacts on their livelihood. This can be done via mass media, posters, seminars and introduction of forest conservation education in school and college curricula.

3. Encouraging the use of alternative energy sources instead of relying heavily on charcoal and firewood as the major sources of fuel for homes and industries. The alternative and clean energy sources include solar power, hydroelectric power, wind energy, biomass energy (biogas), oil kerosene and natural gas.

4. Encouraging the use of energy-efficient devices which consume a little amount of energy. Examples of these devices include energy-saving bulbs and stoves which can be purchased from

local shops. Use of devices that consume less energy not only help to conserve energy but also lowers electricity bills.

5. Enacting and enforcing laws that govern conservation of forest resources. This can involve setting rules and guidelines about selective felling of trees, that is, rare species such as the mninga should only be harvested after getting a permit from forest officer.

6. Where new forests are established, trees should be planted in blocks. Planting should be done in phases such that trees in different blocks mature and are harvested at different periods. When trees in a given block mature, they are cut down and the new ones are planted to replace them. This will ensure continuity in supply of timber as well as conserving the soil. The forestry department should supply seed and or seedling to people to encourage them to plant more trees. Also people should be encouraged to plant indigenous tree species so that the trees do not become extinct.

7. The forestry department should be very keen in detection and control of pests and diseases that attack the planted and natural forests to ensure constant supply of timber and other forest resources.

8. Planting trees where other trees have been cut down (reforestation) and planting trees where there never existed any tree before (afforestation). People should be encourage to take part in tree planting through campaigns such as “Kata Panda Mti”, a campaign aiming at planting trees to replace those cut down. The forestry department should provide seedlings and seeds to people and everybody must participate to plant trees on the Environment Day (1st April each year), a day which is celebrated in Tanzania by planting trees countrywide.

9. The government should enact and enforce laws in order to manage forests and protect them against destruction. This may be done by setting aside some forests and declaring them as protected areas. Anyone caught harvesting trees from the protected forests should be heavily fined, jailed or both. Forest guards should be deployed to patrol the forests.

10. Population control should be encouraged in the countries to reduce pressure on the forest resources and the land in general. The ever growing human population is becoming a threat to forest resources as people’s requirement of timber, firewood and other forest resources is in on the increase.

Forest conservation involves the following measures:

1. *Afforestation.* This is the planting of new trees in areas where trees never existed before. Arid and semi arid regions should be planted with trees to control soil erosion. Countries like Israel have managed to make the desert land productive by planting trees.
2. *Reforestation.* This refers to planting of trees in an area previously occupied by a forest but which has been cleared off. This will help to replace the trees that have been cut so as to conserve the soil and the environment in general.
3. Involving the local communities in forest conservation is very crucial. This will make them support forest conservation initiatives. People may be allowed to plant crops in areas close to forests and at the same time serve as guards who take care of the forests. This practice has two benefits: helping to clean the forests and preventing illegal forest resource harvesters. Farmers should be encouraged to plant trees along with crop cultivation (agroforestry). It is important to note that measures that aim at management of forests are also the measures that aim at forest conservation, such as legislation and creation of forest reserves (protected areas).



*Afforestation*

# SUSTAINABLE MINING

Mining is the process of extracting valuable minerals or other geological materials from the earth. Sustainable mining refers to controlled extraction of minerals such that the minerals do not run out so fast and by ensuring mining activities do not cause environmental pollution. In geology, a mineral can be defined as "an element or chemical compound that is normally crystalline and that has been formed as a result of geological processes." Therefore, a mineral is a solid matter having a crystalline atomic or molecular structure. It is a homogeneous, naturally occurring substance with a clearly defined chemical composition.

## Types of Mining Industries

### Different Types of Mining Industries

*Name different types of mining industries*

The mining industry can be divided into two main types, namely:

1. Metal mining industry; and
2. Non-metal mining industry.

### **Metal mining industry**

This industry involves the mining of metallic minerals such as gold, manganese, aluminium, etc. It can be further subdivided into more categories of the mining industry. For example, we have the gold mining industry, the copper mining industry, and the aluminium mining industry.

### **Non-metal mining industry**

This industry involves the mining of non-metallic minerals such as salt, phosphate, potash, nitrates, sulphur, diamond, mineral oil, coal, natural gas, limestone, etc. It can also be subdivided into several categories such as the salt mining industry, the coal industry, and the oil mining industry, among others.

## Types and Distribution of Mining Regions in the World

### Major Types of Minerals Found in the World

*Explain major types of minerals found in the world*

So far over 4600 minerals have been found and every year new ones are discovered. Only 100 of these are common, while the rest are either encountered occasionally, or are very rare. With such a large number of minerals, it is difficult to identify and classify them separately. However, mineralogists identify minerals based on a number of characteristics which include streak, lustre, sheen, hardness, cleavage, crystal system, colour, specific gravity, clarity or transparency.

All minerals are formed from one or more of eight main elements. These are: oxygen, silicon, potassium, sodium, calcium, magnesium, iron and aluminium. Minerals are divided into two broad groups, based on their composition, as either silicate or no-silicate minerals.

### Silicate Minerals

Mineral	Chemical formula	Type of rocks that they are commonly found within	How People Use Them
Olivine	$(\text{Mg}, \text{Fe})_2\text{SiO}_4$	Ultramafic igneous rocks	A gemstone!
Pyroxene group	$(\text{Mg}, \text{Fe})\text{SiO}_2$	Basaltic igneous rocks	-
Amphibole group (example: hornblende)	$(\text{Ca}_2\text{Mg}_5)\text{Si}_8\text{O}_{22}(\text{OH})_2$	Andesitic igneous rocks	-
Micas	Biotite: $\text{K}(\text{Mg}, \text{Fe})_3\text{Si}_3\text{O}_{10}(\text{OH})_2$ Muscovite: $\text{KAl}_3\text{Si}_3\text{O}_{10}(\text{OH})_2$	Andesitic igneous rocks	Colonial Americans used sheets of mica as window glass.



Feldspars	Orthoclase: $\text{KAlSi}_3\text{O}_8$ Plagioclase: $(\text{Ca}, \text{Na})\text{AlSi}_3\text{O}_8$	Granitic igneous rocks	Important for making ceramics and glass
Quartz	$\text{SiO}_2$	Granitic igneous rocks	Quartz is the raw material for glass and helps clocks keep time.

The most commonly found group of minerals in the Earth's crust is the silicate group. Almost all silicate minerals have silicon and oxygen as their basic units. Most silicate minerals are formed by the cooling of molten rocks. As the molten rocks come closer to the surface inside the Earth's crust, they start cooling very fast and combine with the most abundant element in the Earth's crust—silicon. Silicate minerals constitute approximately 90% of the Earth's crust. Mica, quartz, amazonite, olivine, and biotite are some examples of silicate minerals.

Examples of silicate minerals are as shown in the table below.

## Non-silicate Minerals

There is a complete range of non-silicate minerals. Some of these are formed when there is cooling of magma, while others are formed when water in them evaporates, or due to mineral decomposition. The non-silicates can be further classified into different groups which are:

**Native elements:** Many pure elements that are found with a distinct mineral structure and occur naturally in an uncombined form fall under this category. For example, uncombined carbon is often found in its pure state in the form of graphite or more rarely as diamond. Gold, silver, and sulphur are other elements, which are also found in their pure state. Even though these are pure elements, they qualify to be known as minerals, but no further chemical process is required on them.

**Sulphides:** This class of minerals have sulphide ( $\text{S}^{2-}$ ) as their basic unit. These inorganic compounds are sometimes as economically important as other ores. Some examples include Nickeline ( $\text{NiAs}$ ), Pyrite ( $\text{FeS}_2$ ) and Molybdenite ( $\text{MoS}_2$ ).

**Oxides:** When an ore is found in which one or more elements are combined with oxygen, it is an oxide mineral. These may have chemical formulas of the type  $\text{XO}$  ( $\text{MgO}$ ,  $\text{ZnO}$ ,  $\text{CuO}$ , etc.),  $\text{X}_2\text{O}$

(Cu<sub>2</sub>O), X<sub>2</sub>O<sub>3</sub> (Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>), XO<sub>2</sub> (MnO<sub>2</sub>, SnO<sub>2</sub>) and XY<sub>2</sub>O<sub>4</sub> (MgAl<sub>2</sub>O<sub>4</sub>, FeCr<sub>2</sub>O<sub>4</sub>). The oxide minerals are mostly of metallic elements. Example: haematite, magnetite, and cuprite. Silicates and oxides are the most common types of minerals in volcanoes, especially after an eruption.

**Carbonates:** This particular type is formed when a single carbonate ion (CO<sub>3</sub><sup>2-</sup>) reacts with a metal ion of complementing polarity. Example: siderite (FeCO<sub>3</sub>), smithsonite (ZnCO<sub>3</sub>), calcite (CaCO<sub>3</sub>). Carbonate minerals are used in making cement and other bonding material.

**Sulfates:** The mineral class which includes the sulphate ion (SO<sub>4</sub><sup>2-</sup>) within its molecular structure is categorized as a sulphate mineral. Minerals like Gypsum (CaSO<sub>4</sub>·2H<sub>2</sub>O) and Barite (BaSO<sub>4</sub>) are examples of sulphate minerals.

**Organic Minerals:** This class of minerals includes biogenic substances, genesis, or origin of which can be attributed to a geological process. Organic minerals include all types of oxalates, mellitates, citrates, cyanates, acetates, formates, hydrocarbons, etc

Apart from these, there are many more non-silicate minerals, like nitrates, sulphides, phosphates, etc., but most of the 4,000-odd listed minerals are grouped in the above categories. Make sure you do not get confused between minerals and rocks. A rock is a combination of a number of minerals, which may also include organic remains and mineraloids, i.e., non-crystalline minerals

Specific examples of non-silicate minerals are shown in the table below.

*Common Non-silicate Mineral Groups*

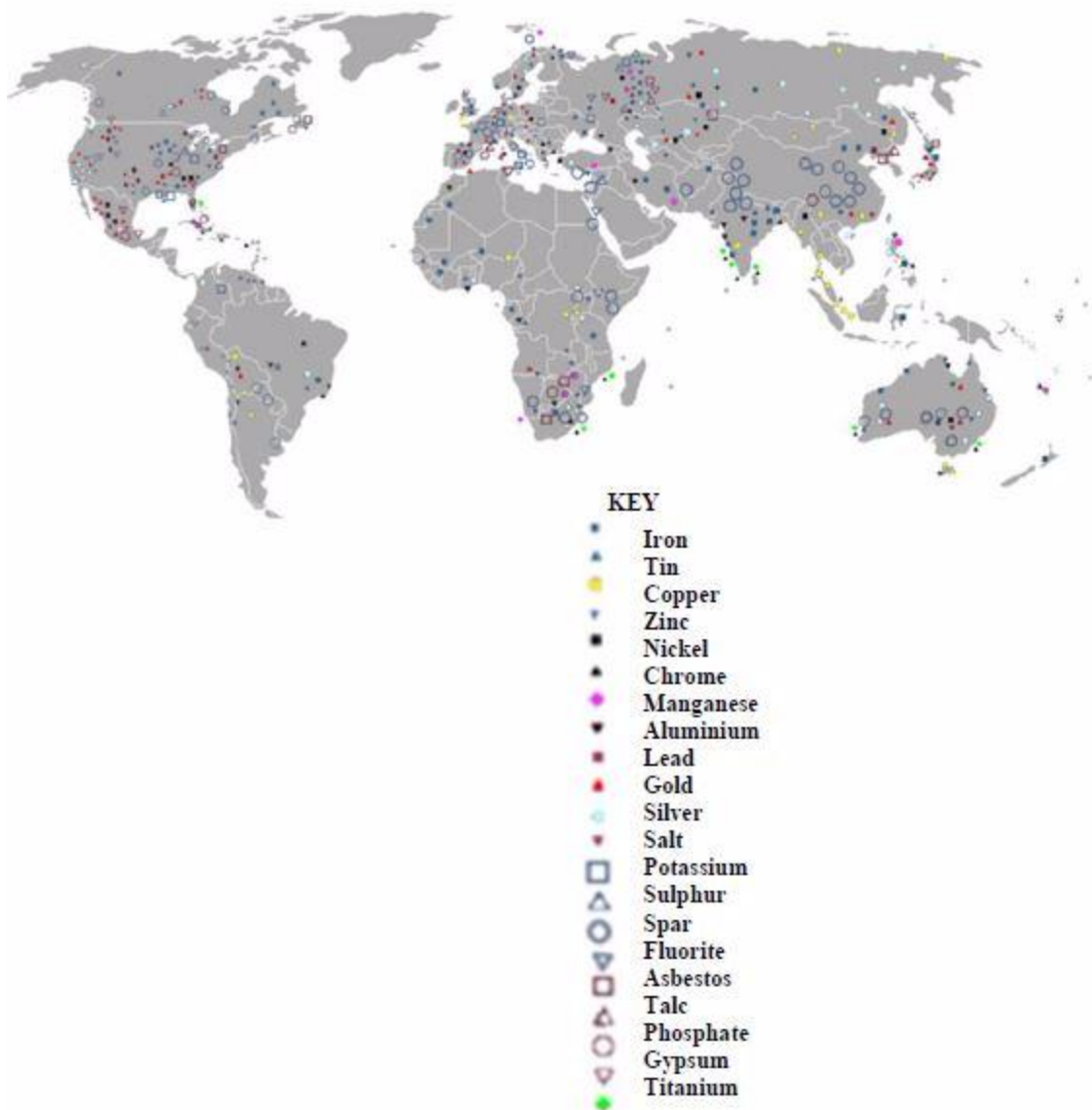
Mineral Group	Example of Mineral	How People Use Them
Oxides	Hematite (Fe <sub>2</sub> O <sub>3</sub> ) (Magnetite is another type of oxide!)	Ore of iron
Sulphides	Pyrite (FeS <sub>2</sub> )	An ore of iron. Also known as fool's gold.
Sulphates	Gypsum (CaSO <sub>4</sub> (+2H <sub>2</sub> O))	Used to make plaster
Halides	Halite (NaCl)	Table salt

Carbonates	Calcite ( $\text{CaCO}_3$ )	Used to make cement
Native Elements	Sulphur (S)	An ingredient of drugs and chemicals

## Mining Regions in the World Map and the Type of Minerals Extracted

*Locate mining regions in the world map and the type of minerals extracted*

A world map showing distribution of major minerals

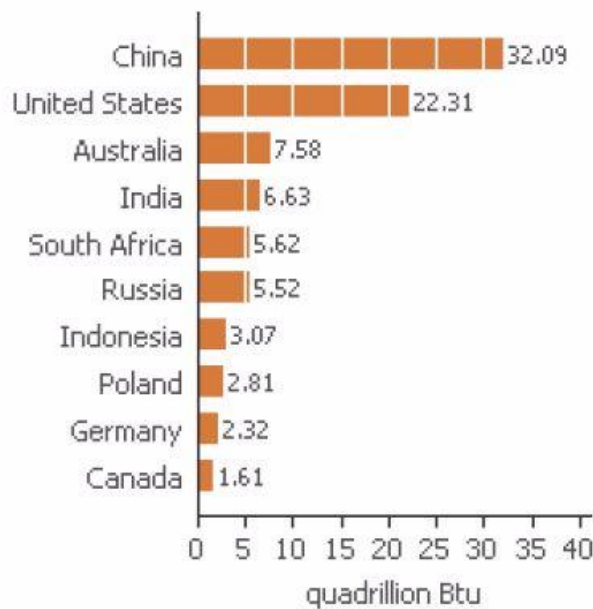


**Coal**

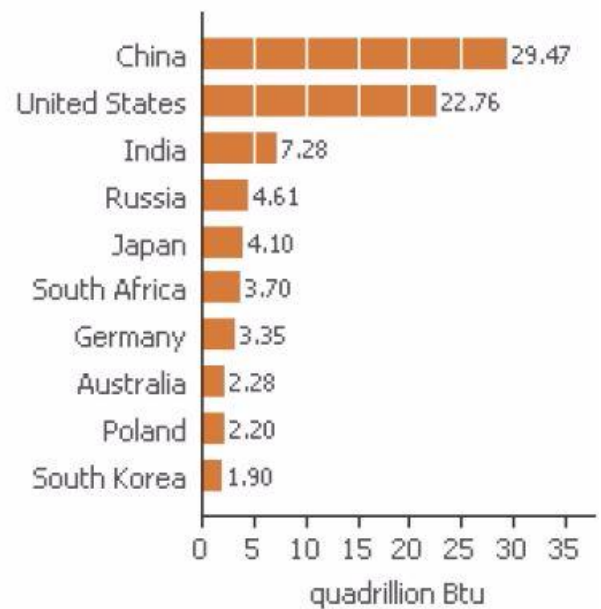
Throughout history, coal has been used as an energy resource, primarily burned for the production of electricity or heat. It is also used for industrial purposes such as refining of metals. Coal is the largest source of energy for the generation of electricity worldwide, as well as the largest worldwide source of carbon dioxide release into the atmosphere.

Coal is today used to heat furnaces, for domestic heating and for the generation of thermal electricity. China is the largest producer of coal in the world. The USA contains the world's largest coal reserves, followed by Pakistan, Russia, China and India. China and the USA are also among the largest consumers of coal.

Top Ten Producing Countries



Top Ten Consuming Countries



### *World coal production and consumption*

In USA, the states with largest coal reserves are, in descending order, Wyoming, West Virginia, Illinois, and Montana. The largest single mine in USA is the North Antelope Rachele, which produces over 100 million tons coal annually.

The Ruhr coalfield in Germany is one of the largest coal reserves. In Tanzania, there are coal deposits at Mchuchuma (Njombe region) and Kiwira (Mbeya region).

## **Petroleum**

Petroleum is mainly used as fuel to power machines such as vehicles. It is also used as a source of heat and heating. Petroleum occurs as crude oil which is then refined to obtain fractions with varied uses. These fractions include diesel, petrol, paraffin (kerosene), jet fuel and lubricants.

Some of the leading petroleum producers are Saudi Arabia, Russia, Iran, Iraq, Nigeria, United Arab Emirates, Angola, Venezuela, Kuwait and Libya.

In Saudi Arabia the oilfields are located in such areas as Abqaiq, Ghawar, Khurais, Qatif, Safaniya and Shaybah. In Nigeria, oil wells are found in the Niger Delta.

## **Diamond**

Diamond is the hardest and most coveted of all the precious stones. Due to its extreme hardness, it is used to make glass cutters, drilling devices, rock borers, and as an abrasive for smoothing very hard materials. Polished diamond is used to make jewellery such as necklaces, rings and bracelets.

The major world producers of diamond include Russia, Botswana, DRC, Australia, South Africa, Canada, Angola, Namibia, Ghana and Brazil. In Tanzania, diamond is mined at Mwadui in Shinyanga region.

## **Copper**

Copper is a major metal and an essential element used by man. It is found in ore deposits around the world. It is also the oldest metal known to man and was used many years ago. Today, the functions of copper have expanded to include heating, cooling and refrigeration, electrical wiring, generation and transmission of electrical power, automotive applications, and many more. Some of the major copper-producing countries in the world are Chile, USA, Peru, China, Australia and Zambia.

In Zambia, copper is mined at Kitwe and Konkola. Zambia is internationally recognised as a major producer of copper and cobalt. It is ranked the world's seventh producer of copper and the world's second-largest producer of cobalt after the DRC.

## **Gold**

Gold is the most popular and well known mineral, known for its value and special properties since the earliest time. Gold has its use in jewellery, electronics and computers, dentistry and medicine, aerospace, and medals and awards. Some of the leading producers of gold in the world are China, Australia, USA, Russia, South Africa and Ghana.

Tanzania has become one of the fastest-emerging gold producers in Africa, and is now the continent's third largest producer after South Africa and Ghana. Of late there are nine gold mines in Tanzania namely, Bulyanhulu, Buckreef, Geita, Golden Pride, Golden Ridge, North Mara, Tulawaka and Kitongo.

## **Iron ores**

Iron ores are rocks and minerals from which metallic iron can be economically extracted. The ores are usually rich in iron oxides. The iron itself is found in the magnetite (72.4% iron), haematite (69.9% iron), goethite, (62.9% iron), siderite (48.2% iron) and limonite ores.

Ores carrying very high quantities of iron, haematite or magnetite (greater than 60% iron) are known as "natural ores". The leading iron producers in the world are China, Australia, Brazil, India, Russia, Ukraine, South Africa and USA.

## **Bauxite**

Bauxite, an aluminium ore, is the world's main source of aluminium. The ore contains about 98% of aluminium oxide.

Australia is the top producer of bauxite with almost one-third of the world's production, followed by China, Brazil, Indonesia, India, Guinea and Jamaica. Although aluminium demand is rapidly increasing, known reserves of its bauxite ore are sufficient to meet the worldwide demands for aluminium for many centuries.

## **Methods of Mining**

### **Various Ways of Mining**

### *Categories of various ways of mining*

Mining methods have drastically transformed over many years. Technological advances have seen improvement in efficiency, safety and health of miners. Also the impacts of mining operations to the environment have been greatly minimized.

To gain access to mineral deposits within an area, it is often necessary to mine through or remove the waste material (overburden) which is not of immediate interest to the miner. The total movement of ore and waste constitutes the mining process.

There are several methods of mining which depend on the type of a mineral and whether the mineral is located close or deep in the earth's crust.

The following are the main mining methods:

## **Surface mining**

This is done by removing (stripping) surface vegetation, dirt, and if necessary, layers of bed rock in order to reach buried ore deposits. Techniques of surface mining include the following:

- ***Open pit mining:*** This method is also known as *opencast mining* or *open cut mining*. It involves extracting rock or minerals from an open pit or burrow.
- ***Quarrying:*** This is the process which involves excavating stone, rock, construction aggregate, riprap, sand, gravel or slate from the ground. Continuous excavation of these minerals from the earth results to an open pit called a quarry. **Note:** A quarry is the same thing as an open pit mine from which minerals are excavated. The only trivial difference between the two is that open pit mines that produce building materials and stones are commonly referred to as quarries.
- ***Stripping:*** This consists of removing surface layers off to reveal ores or seams underneath.
- ***Mountaintop removal:*** This technique, commonly associated with coal mining involves taking the top of a mountain off to reach ore deposits at depth.
- ***Landfill mining:*** A process whereby solid wastes which have previously been land-filled are excavated and processed.





*Mountaintop Removal Mining*

## **Underground (sub-surface) mining**

Underground mining consist of digging tunnels or shafts into the earth to reach buried deposits. The ore, for processing, and waste rock, for disposal, are brought to the surface through the tunnels and shafts. Techniques of underground mining include the following:

***Drift mining*** – This technique utilizes horizontal access tunnels. Sometimes the mineral occurs in the side of a hill or valley. In such cases, a horizontal or nearly horizontal tunnel is dug into the side of a hill or valley until the mineral is reached. This horizontal tunnel is called an adit.



The adit serves as an entrance to an underground mine by which the mine can be entered, drained of water, ventilated and mineral extracted.



*Horse level Adit in the abandoned lead mine, Nenthead, County Durham, UK*

If the mineral is petroleum or natural gas, the deposit is reached by sinking wells. Pumping or own pressure brings the gas or petroleum to the surface.

Other minerals are extracted by digging shafts to reach the mineral-containing layer. Hot water is then pumped in to dissolve the mineral and the mixture is pumped out. The water is ultimately evaporated, leaving the mineral behind. Sulphur is one of the minerals extracted by this method.

**Slope mining:** This technique, unlike drift mining, uses diagonally-sloping access shafts (tunnels).

**Shaft mining:** This one utilises vertical access shafts.

## **Alluvial or placer mining**

Placer mining is the mining of alluvial deposits for minerals. This may be done by open pit (open-cast) mining or other means. The placer mining is frequently used for precious metal deposits (particularly gold) and gemstones, both of which are often found in alluvial deposits

(deposits of sand and gravel in stream beds or glacial deposits). Since gems and heavy metals, like gold, are denser than sand, they tend to accumulate at the base of placer deposits.

The placer mining technique involves digging out the alluvial deposit from the river bed, mixing it with water, and then swirling (rotating) the mixture around with water in a shallow pan. During swirling, the pan is tilted in such a way that the lighter sand or gravel is washed over the side, leaving Horse level Adit in the abandoned lead mine, Nenthead, County Durham, UK the heavier mineral at the bottom of the pan. This technique is used in gold mining by small scale gold miners in Tanzania and South Africa.

## Ways of Processing Different Types of Minerals

*Explain ways of processing different types of minerals*

Once the mineral ore has been excavated from the ground it has to be treated in various ways to separate the required mineral from the waste material and impurities. The process of treating crude ores and mineral products in order to separate the valuable minerals from the waste rock or gangue is called mineral processing.

Depending on the chemical composition of the ore, mineral processing can involve the following general operations:

### **Comminution**

Comminution is particle size reduction of materials. Comminution may be carried out on either dry materials or slurries. Crushing and grinding are the two primary comminution processes. Crushing is normally carried out on the raw ore, while grinding (normally carried out after crushing) may be conducted on dry or slurried material.

### **Sizing**

Sizing is the general term for separation of particles according to their size. The simplest sizing process is screening, or passing the particles to be sized through a screen or number of screens. The screening equipment can include various types of screens or wire mesh. Screens can be static (typically the case for very coarse material), or they can incorporate mechanisms to shake or vibrate the screen.

## **Concentration**

In chemistry, concentration is defined as the number of moles of a solute in a volume of the solution. In case of mineral processing, concentration means the increase of the percentage of the valuable mineral in the concentrate (mixture of gangue and valuable mineral). There are a number of ways to increase the concentration of the wanted minerals, which include:

### **Gravity concentration**

Gravity separation is the separation of two or more minerals of different specific gravity by their relative movement in response to the force of gravity and one or more other forces (such as centrifugal forces, magnetic forces, buoyant forces), one of which is resistance to motion (drag force) by a viscous medium such as heavy media, water or, less commonly, air.

Gravity separation is one of the oldest techniques in mineral processing but has seen a decline in its use since the introduction of methods like flotation, classification, magnetic separation and leaching.

### **Froth flotation**

Froth flotation is an important concentration process. The froth flotation is used with sulphide ores (e.g. CuS or ZnS). The ore is powdered, fed into water tanks and made into slurry with water. Then “frothing” chemicals (suitable oils) are added. Sulphides are attracted to these chemicals. When air is blown through the slurry, froth rises to the top of the tank carrying the metal sulphides with it. Then they are skimmed off and dried. The gangue sinks.

### **Electrostatic separation**

This kind of concentration process involves passing a stream of particles past a charged anode plate. The particles that are conductors lose electrons to the plate and are pulled away from the other particles due to the induced attraction to the anode and are removed from the mixture. For efficient separation to occur the particles must be extremely small (between 75 and 250 micron), the particles need to be dry, have a close size distribution and uniform in shape. Of these considerations, one of the most important is the water content of the particles. This is important

as a layer of moisture on the particles will render the non-conductors as conductors as the layer of the water is conductive.

## **Magnetic separation**

Magnetic separation is a process in which magnetically susceptible material is extracted from a mixture using a magnetic force. This separation technique can be useful in mining iron as it is attracted to a magnet. This process of separating magnetic substances from the non-magnetic substances in a mixture with the help of a magnet is called magnetic separation.

## **Automated ore sorting**

Modern, automated sorting applies optical sensors (visible spectrum, near infrared, X-ray, ultraviolet), that can be coupled with electrical conductivity and magnetic susceptibility sensors, to control the mechanical separation of ore into two or more categories on an individual rock by rock basis. Also new sensors have been developed which exploit material properties such as electrical conductivity, magnetization, molecular structure and thermal conductivity. Sensor based sorting has found application in the processing of nickel, gold, copper, coal and diamonds.

## **Dewatering**

Dewatering is an important process in mineral processing. The purpose of dewatering is to remove water absorbed by the particles. This is done for a number of reasons, specifically, to enable ore handling and concentrates to be transported easily, allow further processing to occur and to dispose of the gangue. The water extracted from the ore by dewatering is reused for plant operations after being sent to a water treatment plant.

After learning about general processes of mineral extraction, let us now turn to specific processing of individual minerals. The following are the descriptions of the ways in which various, named minerals are processed:

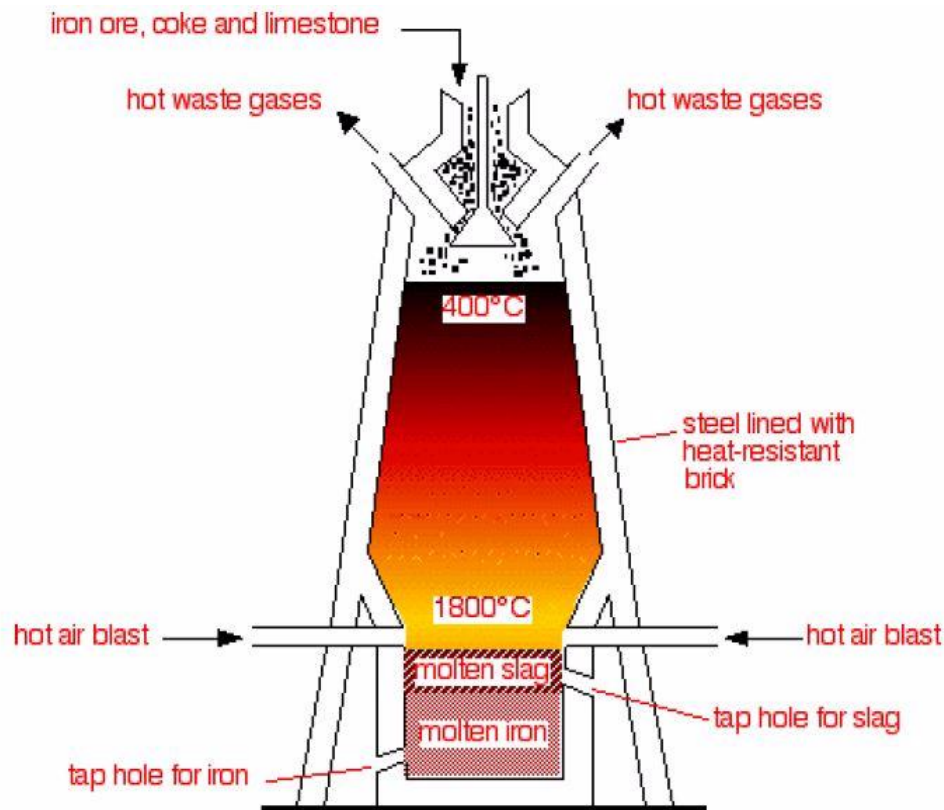
## **Iron processing**

The process of iron extraction is carried out by the following steps:

- **Concentration of ore:** In this metallurgical operation, the ore is concentrated by removing impurities like soil etc. The process involves the crushing and washing of ore.
- **Calcination or roasting of ore:** The concentrated ore is now heated in the presence of air. The process of roasting is performed to convert the iron to iron (III) oxide,  $\text{Fe}_2\text{O}_3$ . Before being introduced into the blast furnace, all forms of iron ore must be converted into the oxide.
- **Reduction of ore:** The process of reduction is carried out in a blast furnace. The blast furnace is a cylindrical tower in which the ore is reduced to iron metal. Iron ore, coke and limestone are mixed together to give a mixture called **charge**. The charge is introduced into the blast furnace.

In the blast furnace, carbon is oxidized to carbon monoxide gas. The carbon monoxide gas reduces the iron (III) oxide to molten iron, which is removed as either pig iron or cast iron. This is the raw material for production of iron, steel and other products. Pig iron is made into steel by melting it to remove all its impurities, after which small amounts of other metals are added to make different types of steel.

The impurities in the ore, mainly silicon oxide (silica) reacts with limestone to form calcium silicate (slag) which is tapped off from the furnace and put into various uses.



### *Iron processing*

## **Copper processing**

Copper ore is mined in open pits and below ground. The mined ore is ground, concentrated and slurried with water and chemical reagents. Air is blown through the mixture and attaches to the copper, causing it to float to the top of the slurry. The copper is then removed with skimmer (a machine that separates a liquid from particles floating on it or from another liquid). The tailings (materials left over after the mineral has been separated from the gangue of an ore) remain and are dewatered and disposed off in tailing ponds. The water is recovered and recycled.

The concentrated copper recovered through floatation is dried and then smelted in copper smelters. The smelters reduce the concentrate to copper blisters. The copper blisters contain 97–98% of pure copper. To get pure copper, which must have a purity of 99% to be effective for electrical wiring and other purposes, the copper blisters are purified by electrolysis. This purification process is called copper refining.

## Gold processing

The ore is crushed and dissolved in a solution of sodium cyanide. The chemical dissolves the gold particles leaving behind stone and other mineral waste. The sodium cyanide solution containing gold particles is drained off and mixed with zinc dust which causes the gold particles to solidify. The particles are then separated, dried, melted and moulded into bars called ingots.

## Aluminium processing

Aluminium is processed by the following three steps:

- **Concentration of the ore:** Aluminium ore, bauxite, is mined from the ground by open-cast mining. The ore is then sorted, crushed, grinded and fed into large grinding mills where it is mixed with sodium hydroxide solution at high temperatures and pressure. The grinding mill grinds the ore to an even finer size. The material finally discharged from the mill is called *slurry*. The resulting liquor contains a solution of sodium aluminate and undissolved bauxite residues containing *iron*, *silicon* and *titanium*. These residues, commonly referred to as “red mud”, gradually sink to the bottom of the tank and are removed.
- **Purification of the ore:** The sodium aluminate obtained in the above stage is purified through a number of industrial processes to get aluminium oxide (alumina).
- **Electrolysis:** The purified aluminium oxide is then electrolysed to get pure aluminium metal. Because aluminium oxide has a high melting point, it dissolved in molten *cryolite* to lower its melting point because it is too expensive to carry out electrolysis at very high temperatures. During electrolysis the molten metal falls to the bottom of the electrolytic cell and is tapped off.

## Contribution of Mining Industry to the Economy of Tanzania

### The Economic Importance of Mining to the Economy of Tanzania

*Explain the economic importance of mining to the economy of Tanzania*

Contribution of the mining industry to the economy of Tanzania include:

1. ***Creation of employment opportunities:***The mining sector has led to creation of employment opportunities to local Tanzanians. Many people are employed as mine workers and in mineral processing industries. A good number of people are also engaged in mineral trade which consists of purchasing and selling of minerals such as gold, tanzanite, diamond and other gemstones. Many people are also employed in industries that emerge due to mining, for instance, people are employed to run shops and hotels that serve workers and their families.
2. ***Urbanization:***Mining activities attract settlement which, in turn, attracts delivery of social services and amenities. This leads to development of towns. For example, Nyamongo village in Tarime District was once undeveloped but, after gold discovery and establishment of a mine, the village has now grown into a township.
3. ***Development of other sectors:***The mining industry has led to the development of other sectors such as agriculture, trade and transport and communication. For example, the road from Tarime Town to North Mara Gold Mine at Nyamongo village has been improved by mine owners, a fact that has led to improvement of transport and communication between Tarime and the village. Also, transmission of electricity from Tarime to Nyamongo and adjacent villages, such as Kemakorere, Nyarero, Nyamwaga and Geisangora, was made possible because of the presence of a mine.
4. ***Provision of raw materials:***The minerals obtained from the mining industry provide raw materials for other industries. For example, tanzanite and gold are sources of raw materials for making jewellery. Gypsum is the raw material for cement making industries.
5. ***Foreign exchange:***The mining industry provides foreign exchange to the country through export of minerals and mineral ores. The contribution of the mining sector to the country's GDP has risen in recent years following increased production of minerals, such as gold, diamond, tanzanite and other gemstones.
6. ***Improvement of social services:***Mining companies improve service delivery to local communities through investment in community projects, such as construction of social infrastructures which include schools, hospitals, boreholes, roads and many others. Many mining companies have managed to provide these services to local communities, thereby improving the living standard of the local people. This has, in turn, helped a great deal to improve the public relation between mine owners and the host communities.



## The effects of the Mining Industry in the Environment

### The Effects of Mining to the Environment

*Describe the effects of mining to the environment*

Mining activities can cause a great harm to the environment if common sense is not observed during mining operation. The following are some effects of the mining industry to the environment:

1. **Land subsidence (sagging):** Holes created due to underground mining cause land to sink (or subside). This is because the holes underneath the ground cause imbalance in weight of the soil above the ground. This may result to severe damage to buildings and other infrastructures such as roads, railway trucks and so forth.
2. **Poisonous substances:** Poisonous compounds (for example of lead, cadmium and arsenic) are found in many ores. These may be washed into the soil and streams because of the mining process. If they happen to reach the water, they can kill fish and plant life, and can end up in your food as well.
3. **Large volume of waste:** Large-scale mining operations inevitably produce a great deal of waste. This waste not only comprises of earth from the soil and gangue but also includes the toxic chemicals added to the ore to aid mineral extraction. The waste material gets washed into streams and rivers. The *sediment* that builds up, blocks rivers and alters their routes. This serves as a source of pollutants to natural water systems.
4. **Air pollution:** Large-scale mineral extraction results to production of gases such as sulphur dioxide, carbon dioxide and other bad gases which are emitted to the atmosphere. These gases may bring about a green house effects and even cause acid rains.
5. **Noise and dust:** Mining activities produce a lot of noise and dust. Noise and dust can be due to haulage trucks, rock blasting and crushing, drilling operations, and heavy traffic. Everything for miles around the mine may get covered with dust. The loud sound due to blasting of rocks is likely to destroy the adjacent buildings due to earth tremor.
6. **Big holes in the ground:** Mineral extraction leads to boring of deep holes through the ground in the course of searching for rich ores. Huge amounts of rock are dug up to get a small amount of ore. For example, 1000 tonnes of rock may produce just 5 tonnes of copper. This

leaves huge scars on the landscape (if it is opencast method) or huge holes underground (if it is underground mining).

7. **Great heaps of earth material:** Unwanted rock material, after the metal has been extracted from the ore, gets heaped up in tips. These are unsightly. They can be unstable and therefore dangerous. During heavy rains, a landslide is likely to occur, a catastrophe that often results to loss of life and destruction of property.

8. **Soil erosion:** Before mining operations are carried out, the natural vegetation on and around the mining site is usually cleared up in order to give enough room to mining activities. The consequent removal of vegetation cover leaves the soil bare and, therefore, susceptible to erosion. Prolonged soil may, in turn, lead to aridity and loss of biodiversity.

## Ways of Minimizing Effects of Mining to the Environment

*Propose ways of minimizing effects of mining to the environment*

Measures should be taken to minimize the effect of the mining industry to the environment. Some of these measures are being practiced in many areas affected by mining activities. The measures include the following:

1. Cleaning up the existing and abandoned mines. The following are some of the ways through which water pollution by mines can be controlled: Mining companies should clean up abandoned mines which continue to release pollutants to the environment; New mines should not be established in areas where they are likely to cause water pollution problems; Mining practices which cause water pollution should be banned.

2. Enacting and enforcing the laws that govern environmental conservation. The laws and regulation should be put in place that direct how the mining companies should carry out their operations and activities without causing environmental pollution. Stern measures should be imposed against any mining company that pollutes the environment. Punishments may include fines, jail sentences or even closure of the mining activities.

3. Stern controls apply to the production of wastes that may be toxic or may cause environmental damage. Safety regulations and practices must be maintained to avoid the risk of accidental release of harmful materials. Governments are getting ever tougher with mining

companies about damage to the environment. Sadly, in developing countries like Tanzania where much mining takes place, laws may be less strict.

4. Rehabilitation of the land after mining has practically ceased following exhaustion of minerals. Rehabilitation involves reclaiming the abandoned mine and re-using the land for other economic activities. Land rehabilitation activities can include levelling of the heaps of rock, replacement of the top soil with a fertile one, filling up the holes, and planting trees in the mined out areas. Care must be taken to relocate streams, wildlife and other valuable resources. Quarries and opencast workings can be reclaimed by the process of filling the holes with solid wastes. The eroded bare soil can be conserved by planting trees and grasses to serve as a soil cover, which would counteract the impacts of wind, running water, rain and animals to the soil. Reclaimed land can have many uses such as agriculture, forestry, wildlife, settlement and recreation.

5. Carrying out Environmental Impact Assessment before starting the mining operations in an area will help establish the environmental effects the mining activities are likely to cause to the environment. This should be carried out before mining companies are licensed to undertake their activities. When the negative effects far outweigh the benefits, then such activities should never be allowed to proceed.

6. Dust levels can be controlled by spraying water on roads, stockpiles and conveyors. Other steps can also be taken including filling of drills with dust collection systems, and purchasing additional land surrounding the mine to act as a buffer zone. Trees planted in these buffer zones can also minimize the visual impact of dust from the mining operations to local communities.

7. Noise can be controlled through careful selection of equipment and insulation and enclosures around machinery.

8. The poisonous and toxic substances used in metal extraction must be treated properly before being directed into rivers and streams. Alternatively, these materials may be drained into reservoirs where they can gradually percolate deep into the soil and evaporate into the air without causing much harm to the surrounding ecosystems. In some mines, absorbent carpets are spread on the surface of the ground to trap the toxic substances contained in liquid chemicals, hence preventing these chemicals from finding their way into water bodies.

## FOCAL STUDIES

### Oil Production in the Middle East

#### *Oil production in the Middle East*

The Middle East is the largest oil-producing region in the world. It accounts for over one third of the total world production. The major producers of oil in this region include Saudi Arabia, Iraq, Kuwait, Iran and the United Arab Emirates. Others include Bahrain, Qatar and Yemen.

Most of these countries are members of the Organization of Petroleum Producing countries (OPEC), an intergovernmental organization which plays key role in managing and overseeing the oil industry, including fixing of the oil price and regulation of oil production among member states, among other functions.

The prospection, drilling, refining and transportation of petroleum are mainly carried out by international companies from Europe and America.

A portion of the oil is refined in oil refineries within the Middle East while the rest is exported overseas as crude oil.



## Natural Gas Production in Tanzania

### *Natural gas production in Tanzania*

Natural gas is a fossil fuel formed when layers of buried organic matter are exposed to intense heat and pressure over thousands of years. It is used for various purposes such as generation of electricity, fuelling machines, cooking, heating, etc.

Tanzania has recently managed to exploit this mineral at Songosongo in Kilwa, Lindi region. The gas is processed at Songosongo and then transported via pipeline to Dar es Salaam where plans are under way to use the resource to generate electricity. It will also be supplied to homes and industries for heating and other operations.

The country has so far four natural gas fields, namely Songosongo, Mnazi Bay, Mkuranga and Kiliwani North. Of these, only two gas fields – Songosongo and Mnazi Bay – are producing. The rest are still being developed.

## Advantages of Oil Production in the Middle East and Natural Gas Production in Tanzania

*Describe advantages of oil production in the Middle East and natural gas production in Tanzania*

### **Advantages of oil production in the Middle East**

1. ***Source of foreign currency:***Most of the oil used in many parts of the world comes from the Middle East. A large amount of oil is exported from this region, so the countries earn the much needed foreign exchange which is, in turn, invested in others sectors such as manufacturing industries, commerce and trade.
2. ***Creation of employment opportunities:***Most of the Middle East countries lie entirely in the heart of the desert. So it is hard to undertake other economic activities such as agriculture. Most people are solely employed in the oil production industry, which provides them with income that they spend on their basic needs. People are employed to work in oil extraction, transportation, or sale of petroleum products.
3. ***Improvement of social services:***The money earned from the oil industry is invested in other sectors of economy. It is also used to established or improve social services and other amenities. The governments spend huge sums of money to set up social services such as schools, hospitals, games and sports, etc.
4. ***Improvement of transport and communication:***The income generated by the oil industry is used to develop roads railways, harbours, and airports. This has consequently led to improvement of transportation and communication infrastructures in the region.

5. **Generation of energy and power:**The oil produced provides the Middle East countries with energy and power that is used for various purposes, including running vehicles and other machinery.

## **Advantages of natural gas production in Tanzania**

1. The industry is a source of employment opportunities to Tanzanians since many people are directly employed in the gas sector as prospectors, engineers, miners, transporters, etc. This helps to curb the problem of unemployment as well as improving the living standards of the people.

2. Discovery of natural gas in remote areas of Lindi, Coast and other parts has helped to solve the problem of rural–urban migration since people now can stay in the rural areas and engage in gas production. This has greatly helped reduce the population pressure in urban areas as well as minimize the problems associated with overpopulation.

3. One of the major uses of natural gas is the production of cost-effective electricity. It is expected that when more electricity generated from natural gas will be available to consumers, the cost of electricity will drop significantly. This will, in turn, reduce the burden of high living costs to Tanzanians.

4. Cheap electricity generated from natural gas will soon be supplied to industries. The cost of production of goods and services will thus be cut short. Hence, the goods and services will be available to people cheaply. This will lower the cost of living and hence improve the living standards of the people.

5. Exportation of natural gas and sale of electricity will increase the government revenue. The revenue collected will then be used to improve public services to people around the gas fields and the entire country in general.

6. Due to availability of cheap electricity people will no longer cut down trees for firewood and charcoal. This will help conserve the forest and the environment.

## **Disadvantage of natural gas production in Tanzania**

1. Even though people are compensated when they give their lands for construction and expansion of gas projects, the compensation is very small. The houses and other infrastructure

belonging to poor people are demolished carelessly before they are compensated or relocated, a fact that bothers these citizens a great deal.

2. The natural gas is a highly explosive substance. It can cause great loss of life and property to the people living or undertaking their activities close to gas pipelines in case the gas in the pipeline explodes and catches fire spontaneously.

3. Because the gas is a non-renewable resource, it can be exhausted or get used up. This could destabilize the activities and sectors whose existence relies upon the availability of natural gas.



# TOURISM

## Concept of Tourism

### Tourism

#### *Define tourism*

Tourism refers to the travel for recreation, leisure, religious, family, or business purposes, usually of a limited duration. Tourism is commonly associated with trans-national travel, but may also refer to travel to another location within the same country.

Tourism has become a popular global leisure activity. Today, tourism is a major source of income for many countries, and affects the economy of both the source and host countries. So tourism is very important for economic growth.

There are two categories of tourism, namely, domestic and international tourism. Domestic tourism involves travel within the same country. For example, when someone sets out from Dar es Salaam to Mikumi National Park to view wild animals, he or she is practising domestic tourism.

International tourism involves travelling from one country to another for leisure, business, education, etc. For example, many people travel from Europe and America to Tanzania to climb Mount Kilimanjaro, view wild game in national parks, or visit cultural places such as the Amboni Caves, Kilwa ruins, and other interesting sites for leisure and refreshment. International tourism has both incoming and outgoing implications on a country's economy.

## Factors for the Development and Growth of the Tourism Industry in the World

### Factors Which have Contributed to the Development and Growth of Tourism in the World

*Describe factors which have contributed to the development and growth of tourism in the world*

## Physical factors

- **Good climate:** Good climate is one of the most important features of attraction for any tourist place. Pleasant climate with warmth and ample sunshine attracts tourists who come from the temperate and colder regions. For example, most tourists from temperate countries visit Tanzania when it is winter in their home countries in order to enjoy the warm and favourable climate found in Tanzania. On the other hand, people from summer areas migrate to cooler regions to seek pleasure of coldness and fresh environment. Other countries such as Switzerland, Sweden, etc have a cooler climate that attracts tropical tourists.
- **Beautiful scenery:** This refers to the beautiful features that are attractive to look at. Tourism booms at picnic spots with beautiful sceneries. For example, sunrise and sunset points, long sea beaches, mountains, craters, lakes, canyons, deserts, waterfalls, etc., often attract large numbers of tourists.

## Socio-economic factors

1. **Accessibility:** Of all socio-economic factors, accessibility is the most important one. All tourist centres must be easily accessible by various modes of transportation like roads, railways, air and water. To enjoy seeing nature's beautiful sites, travelling by roads and railways is a better option. If a tourist plans to reach a remote tour-destination in the quickest possible time, then airway is the most suitable choice. Generally, waterways are seldom selected unless a tourist decides to enjoy a luxury travel experience in sea and/or interested to visit an isolated group of islands.
2. **Accommodation:** Places of tourists' interest must be able to provide good accommodation and catering facilities. A type of accommodation required by tourists depends on their lifestyles, standard of living, capacity to spend money, nature of services expected, etc. Classification of accommodation centres (i.e. various hotels, motels, dormitories, lodges, cottages, etc.) on basis of rating, like five stars and below, is essential so that tourists can make a proper choice and plan their trips appropriately. Generally, tourism mostly prospers in those areas where good lodging and food facilities are available at reasonable prices.
3. **Amenities:** Growth of tourism at a particular place is also influenced by crucial factors such as how well the site is maintained for touring activities like skiing, roping, paragliding,

rowing, fishing, surfing, safari adventure, etc and whether emergency facilities are available or not, and so forth.

4. ***Ancillary services***: If a tour destination is equipped by ancillary (supplementary) services like banking and finance, the internet and telecom connectivity, hospitals, insurance, so on, then such a place succeeds to hold (retain) more tourists for a longer time. This helps to boost the local economy to some extent.

## **Political factors**

People like to travel around the world if there is peace, harmony and stability like Tanzania. They normally avoid areas with political problems such as civil wars. In case of instability, due to war or terror attacks, people travel less to countries affected with such chaos. Often, some countries warn their citizens about visiting countries with political instability like tribal wars, terror attacks, political unrest, etc. For example, after September 11 terror attack on the US, her citizens were warned not to travel to certain destinations.

Also the government policy can encourage the development of the tourism industry by financing or giving favourable conditions which are not restrictive to visitors touring the country

## **Historical and cultural factors**

Many tourists are attracted to places of historical significance and which have a legacy of rich cultural heritage. People love and enjoy exploring destinations where there are famous ancient monuments, marvellous forts, castles and palaces ruled by kings and queens in historical times, etc. Examples of places that are famous throughout the world for their historical and cultural accounts are Kilwa ruins in Tanzania, Fort Jesus in Kenya, Taj Mahal in India, Nazca lines and Machu Picchu in Peru, Pyramid of Giza in Egypt, Great Wall of China and Stonehenge in England.

## **Religious factors**

People often make pilgrims to places of religious importance to seek inner peace, get blessing of their favourite gods and spiritual leaders, attain salvation before death, etc. Here, faiths, beliefs and sentiments of people contribute in booming tourism at holy places. Examples of places that

are well known for their religious significance are Jerusalem in Israel, Mecca and Medina in Saudi Arabia, Varanasi and Amritsar in India, etc.

## Other factors

- **Adventures:** Research activities and adventures of deep seas and caves, geological studies of hot-water springs and geysers, seismic analysis of active volcanoes, investigation of paranormal activities in abandoned spiritual towns, etc also contribute in developing tourism on some scale.
- **Marketing:** Tourism is nowadays being advertised via various mass media so as to alert the potential tourists about the presence of tourists' attractions present in a given country. Various adverts are made via TV, radio, posters, documentaries, etc. In this way, the organizations and individuals involved in the tourism industry are able to attract many visitors. This leads to development of the tourism industry.
- **Trained manpower:** Availability of trained manpower encourages development and expansion of the industry. People are trained about hospitality and how to care for the tourists. Training is based on languages and communication skills, hotel management, tour guide, and any knowledge on handling of tourists. Decent hospitality in destination countries normally encourages the tourists to visit them frequently.

## Importance of Tourism in the World

### Importance of Tourism in the World

*Explain the importance of tourism in the world*

Tourism has become one of the most important sectors in the world economy. Tourism is important in a number of ways which include the following:

1. **Source of employment:** Tourism creates jobs through direct employment within the tourism industry, and indirectly in sectors such as retail and transportation, tour guiding, tour operation, hotel management, pottery, etc. When tourists spend their wages on goods and services, it leads to what is known as “multiplier effect”, creating more jobs. The tourism industry also provides opportunities for small scale business enterprises which is especially

important in rural communities, and generates extra tax revenues such as airport and hotel taxes which can be used to improve social services such as education, health, and housing.

2. **Source of foreign exchange:** Tourists pay for their services in foreign currency, which adds to the country's foreign currency, thus helping to stabilise the economy.

3. **Improvement of infrastructure:** The improvement of infrastructure and new leisure amenities that result from tourism also benefit the local communities. These infrastructures may include renovation of existing roads and construction of new ones, development of air strips and air ports, and improvement of communication facilities. All of these benefit the visitors as well as the local people.

4. **Promotes international relations:** Tourism often involves the movement of people from one country to another. This movement of people promotes political, economic, and social relations between the countries.

5. **Source of government revenue:** Tourism earns the countries of destination the revenue from various sources which include fees into game parks and reserves, taxes charged on various tourism services offered, and visa fees among others. This income can be invested in improvement of different social services.

6. **Conservation of wildlife and environment and protection of historical sites:** Tourism contributes to conservation of wildlife and natural vegetation which leads to conservation of soil and catchment areas. If this was not done some animal and plant species would have been extinct and historical sites ruined.

7. **Economic use of marginal lands:** Tourism enables the marginal unproductive land to be used for economic development rather than staying idle. For example national parks with wildlife which serve as tourist attractions occupy unproductive lands.

8. **Preservation of culture:** Tourism encourages the preservation of traditional customs, handicraft, and festivals that might otherwise have been allowed to wane and it creates civic pride. Interchanges between hosts and guests create a better cultural understanding and can help promote global awareness of issues such as poverty and human rights abuses.

## Impact of Tourism in the World

*Identify impact of tourism in the world*

Tourism can bring many economic and social benefits, particularly in developing countries. However, mass tourism is also associated with negative impacts. Tourism can only be sustainable if it is carefully managed so that potential negative effects on the host community and the environment are not permitted to outweigh the financial benefits.

### ***Positive impacts of tourism***

1. As explained early, tourism has led to creation of job opportunities. Many people have been employed in the tourist sector, a fact which has helped improve their quality of life.
2. It has led to development of infrastructure in host countries. In Tanzania, for example, roads to national parks such as Serengeti National Park have been improved. And also airstrips have been constructed in many national parks so as to facilitate the transport of tourists to and from the parks.
3. It brings together people of different colours, cultures and religions. This leads to interaction of cultures, especially the awareness of other people's values and belief which may be different from others. The outcome is realization of peace and harmony among different religions and culture.
4. It leads to job creation in rural areas, thereby reducing rural-urban migration. This has led to reduction of population pressure and its associated effects in urban areas. In some cases, people move from urban to rural areas to engage in tourism activities.
5. It has led to diversification of economies of countries involved in the sector. For example, tourism is now earning more revenue than agriculture and other sectors of the economy in Tanzania.
6. Tourism has enabled sustainable conservation of wildlife and the environment and preservation of cultural heritage and historical sites.
7. It earns the destination countries the much needed foreign exchange. For example, Tanzania's economic growth is highly boosted by her flourishing tourism industry.

### ***Negative impact of tourism***

1. Visitor behaviour can have adverse effects on the quality of life of the host community. For example, overcrowding and congestion, drug and alcohol problems, prostitution, and increased levels of crime can occur in areas where tourism takes place. There has been a marked increase in crime in areas frequently visited by tourists as these areas attract thieves who steal tourists' and hosts' properties as well as engaging in their illicit drug and other illegal businesses.
2. Tourism can even infringe on human rights with locals being displaced from their land to make way for new hotels or barred from beaches. Interaction with tourists can also lead to erosion of traditional cultures and values.
3. Tourism poses a threat to natural and cultural resources such as water supply, beaches, coral reefs and heritage sites through overuse. It also causes increased pollution through traffic emissions, littering, increased sewage production and noise.
4. Successful tourism relies on establishing basic infrastructures such as roads, visitor centres and hotels. The cost of this usually falls on the government, so it has to come out of tax revenues that could otherwise be directed towards improvement of social services.
5. Jobs created by tourism are often seasonal and poorly paid, yet tourism can push up local property prices and the cost of goods and services. Much as this has benefited the traders, the goods have become unaffordable to the locals.
6. Money generated by tourism does not always benefit the local community as some of it leaks out to huge international companies such as hotel chains.
7. Destinations depending on tourism can be adversely affected by events such as terrorism, natural disasters and economic recession. This may become a problem if the tourism sector is negatively affected. The governments and the local communities will be deprived of the foreign exchange leading to a drop in economic growth and hence the quality of life.

## Ways of Addressing the Negative Impact of Tourism

*State ways of addressing the negative impact of tourism*

Ways of addressing negative impact of tourism include:

1. Laws and policies should be put in place that ensures the revenue accrued from tourism benefits the local community and the government in general.

2. Tourists should be directed to obey the culture and traditions of the host communities. For example, they should be ordered to dress in a manner acceptable to the host communities.
3. The countries and local communities that depend heavily on tourism industry should diversify their revenue sources such that when the tourism industry collapses they do not suffer economic difficulties.
4. In order to conserve and preserve the environment, tourists should be required to dispose off their litter in a proper way. Those who disobey the rules should be heavily fined. Also there should be restrictions on the number of vehicles allowed in a certain area so as to prevent air pollution caused by exhaust fumes.
5. The laws, rules and regulations should be enacted and enforced to combat criminal incidences, child labour, drug abuse, and prostitution. This should be accompanied by stern punishments for those who fail to comply with the law.
6. New tourist attractions should be established and developed so as to reduce pressure exerted to already established attractions. This will check congestion in the existing tourist centres.
7. The local people should be involved in tourism activities so that they benefit in conserving the tourist attractions like wildlife conservation areas, etc.
8. There should be integration of tourist activities with the protection of the environmental condition through the eco-tourism approach.

## Focal Studies on Tourism Industry

### Factors for the Development of Tourism in Switzerland, Namibia and Tanzania

*Describe factors for the development of tourism in Switzerland, Namibia and Tanzania*

This section deals with tourism industries of selected countries around the world. In this case we shall study the tourism industries in Switzerland (Europe) and Namibia (Africa) as well as our own tourism industry in Tanzania.



## Tourism in Switzerland

Switzerland is located in Central Europe, bordered on the North by France and Germany, on the East by Austria and Liechtenstein, on the South by Italy, and on the West and South-West by France. This land locked alpine country has an area covering 41,290 km<sup>2</sup>, making it slightly less than twenty three times the size of Tanzania.

Tourists are drawn to Switzerland's Alpine climate and landscape, in particular for mountaineering (sport of mountain climbing, including skiing, hiking, skating, etc). As of 2011, tourism accounted for an estimated 2.9% of Switzerland's Gross Domestic Product (GDP).

### Factors favouring the development of tourism in Switzerland

1. **Geographical factors:**Switzerland is located in the centre of Europe, making it close to rich industrialised countries which are a major source of her tourists. These industrialised countries include France, Germany, Italy and Britain. In addition, the excellent transport network ensures easy and cheap movement of tourists.
2. **Beautiful scenery:**Switzerland is a land of intense natural beauty, dominated by mountain peaks. Most travellers visit the country to experience the scenery and are also pleasantly surprised by the cultural treasures found in the cities and tourism centres.Places such as Zurich, Geneva, Basel and Lausanne offer world-class museums, lively arts scenes, lovely old architecture, fine dining and all the luxuries that come with great cities. There are also many smaller towns and resorts that can serve as a base for tourists looking to enjoy the landscape.
3. **Favourable climate:**The climate is moderate, with no excessive heat, coldness or humidity. The snow during winter, encourage winter sports such as skiing and ice skating. Warm and sunny summers facilitate viewing of the beautiful scenery as well as swimming and sunbathing.
4. **Good transport system:**Switzerland has a well development transport system, ranging from trains to ferries to cable cars that easily take visitors to tops of the mountains. Some means of transport include cars, buses, electric trains, cable cars and aerial lifts access mountain resorts. And because Switzerland is a small country its attractions are close together, so most of them can be reached quite easily.

5. **Accommodation:**Switzerland has a great number of first-class hotels to suit the needs of its tourists. There are also cottages, camping sites, taverns and guest houses.
6. **Hospitality:**The Swiss hospitality standard and methods have traditionally been regarded as the best in the world. The Swiss people are hospitable and the personnel handling tourists are well trained and efficient. The Swiss people speak a number of different languages, making it easy to communicate with visitors from a number of different countries.
7. **Political stability and neutrality:**Switzerland has been and continues to be neutral in world affairs such as the world wars. As such, tourists from different parts of the world feel free and safe to visit the country since it has no enemies to endanger its security. With a low crime rate, Switzerland is very safe for tourism.
8. **Package tours:**The organisation of package tours, in which all tour arrangements, including hotel bookings and travel are done by a company, has increased the number of tourists visiting Switzerland. These kinds of tours are affordable to many people in the society.
9. **Centre for international meetings:**The headquarters of many international organisations such as WHO, ILO, FIFA, UNHCR and many others are based in Switzerland, particularly in the cities of Zurich and Geneva. Many meetings and conventions are held in Switzerland. People attending these meetings and conventions also take time off to tour the country, thus contributing to the country's leisure business and tourism industry.
10. **Industrialization:**Switzerland produces a variety of manufactured goods, some of which are used in the tourism industry. Because the country is highly industrialised, the employees earn good income and are able to save for holidays. Domestic tourism accounts for more than 25% of the tourist population.



*Double-decker cable car: the first such cars in the world, able to carry 180 passengers*

## The Importance of Tourism in Switzerland, Namibia and Tanzania

*Explain the importance of tourism in Switzerland, Namibia and Tanzania*

### **The significance of tourism in Switzerland**

1. **Source of employment:** Many Swiss are employed in the tourism sector. About 5% of the workforce is employed in the sector, although this share is higher in mountain regions than it is

in urban areas. This has enabled the people to improve their incomes and hence their standards of living.

2. **Source of foreign exchange:** Tourism is an important source of foreign exchange. It is the third largest foreign exchange earner, thus contributing significantly to the country's economy.

3. **International relations:** The tourists visiting Switzerland from different countries help strengthen the relationship between Switzerland and the tourists' countries of origin.

4. **Source of revenue:** Tourism is a major source of Switzerland's revenue. It accounts for about 3% of the total GDP.

5. **Environmental conservation:** To ensure constant visit by tourists, the Swiss have taken much efforts to conserve their environment. Some measures have been taken to reduce emission of green house gases which can cause global warming and hence melt the snow on the Alps, thus destroying tourist attractions.

## **Importance of tourism in Namibia**

1. The revenue obtained from tourism industry is invested in the development of infrastructure such as transport and communication as well as improving other public services.

2. Tourism contributes significantly to the country's economy. It is the third contributor to the GDP after mining and agriculture respectively.

3. The people of Namibia are employed directly and indirectly by the tourism sector. Employment in tourism amounts to about 20% of all formal jobs in Namibia. This has helped to reduce the level of unemployment in the country and has improved the living standards of Namibians significantly.

4. Tourism has had a positive impact on resource conservation and rural development. It has ensured preservation of tourism attractions like national parks, game reserves, forest reserves and cultural centres. Some fifty commercial conservancies have been established across the country, covering 11.8 million hectares of land, resulting in enhanced land management while providing thousands of Namibians with much needed income.

5. Social services have improved in the country especially with the introduction of community-based tourism.

6. Namibia is highly respected by other stakeholders in the tourism industry especially in ecotourism. This promotes cooperation between Namibia and other countries of the world.

## **The importance of tourism in Tanzania**

1. **Source of revenue:**The government of Tanzania receives the highly needed revenue from the tourism industry. Revenue is collected on visa and gate fees at national parks and other sources. Also wildlife hunting companies pay money for the game hunting blocks and licences. The money obtained is invested in development projects and other social services.

2. **Improvement in the standard of living:**The money gained by people engaged in the tourism industry improves their livelihood. This has also improved their purchasing power, enabling them to contribute to the development of other sectors such as manufacturing and agriculture.

3. **Source of employment:**Many Tanzanians are employed directly and indirectly in the tourism industry. People are employed to work in tourist hotels; as porters who carry tourist luggage; tour guides and agents; and as owners of tourist companies. This has somewhat helped to solve the problem of unemployment in the country.

4. **Improvement of infrastructure:**For successful tourism business, good infrastructure is inevitable. The improved transport and communication infrastructures not only benefit the tourists, but it also benefits the local communities.

5. **Market for locally produced goods and services:**The goods and services provided locally are sold to tourists or people engaged in tourism. Tourism, therefore, provides a ready market for agricultural produce and locally manufactured goods, such as sugar, cooking oil, and artefacts. This promotes trade as well as the development of local industries.

6. **Environmental conservation:**Involvement of the local communities in the tourism industry has made it possible for these communities to participate in environmental conservation activities. The conserved environment benefits all people residing around and away from these tourist attractions. For example, forest conservation reduces the problem of green house effect and global warming, an act that is beneficial to the general community.

7. **Strengthening of international relations:**Tourism helps to strengthen the relationship between Tanzania and the mother countries of the visitors. This improves understanding and cooperation.

8. **Source of foreign exchange:**It is estimated that tourism generates 25% of Tanzania's foreign exchange. With increased promotion and establishment of new tourist sites, the figure may increase in future. This, in turn, improves the country's economy and hence the living standards of her people

## Problems Facing Tourism Industry in Tanzania

*Identify problems facing tourism industry in Tanzania*

**Problems facing the tourism industry in Tanzania include:**

1. **Poor transport and communication:**Transport and communication infrastructures are still in a very poor state. Many tourist attractions are in remote areas but the roads connecting them from major urban centres are very poor. This makes the attraction sites accessible only in some months of the year. The roads are very uncomfortable to drive on. Access to communication services, such as internet is also difficult and expensive wherever available. This tends to discourage the tourists to visit attractions located in remote areas.
2. **Poor marketing:**The tourist attractions in the country have not been well advertised to local and international tourists, hence most of them are unknown. Very little effort has been put to market the industry worldwide via mass media and forums.
3. **Human encroachment:**The ever increasing human population has led to encroachment on national parks and game reserves. This threatens the wildlife in their natural habitats.
4. **Limited capital:**Tanzania is a very poor country with a very poor economy. Much of her revenue is directed towards provision of social services such that very little capital is left to be invested in other sectors of the economy including the development of tourism industry.
5. **Poor coordination policies:**There is poor coordination on matters concerning tourism between the government and stakeholders in the industry. The lack of proper coordination on polices and marketing, among other issues, hinders the development of the industry.
6. **Crime:**High crime rates in tourist attraction areas discourage tourists from visiting these areas. This makes the industry lack the much needed income, thereby hampering its development.
7. **Poaching:**Poaching in Tanzania is at alarming levels. This is one of the major problems affecting wildlife conservation. Many animals are killed by armed poachers each year for trophies, especially elephant tusks. The problem has led to extinction of some animals such as

the white rhinoceros, some birds and animals. The number of elephants in the parks has drastically reduced in recent years following poaching.

8. **Competition:** There is a stiff competition from other countries with the same attractions, which are more developed and have a good set up of tourist facilities in terms of transport and infrastructure, more comfortable and cheap hotels, favourable climate and ample communication facilities.

9. **Language:** Very few people employed in the tourist industry can speak many of a range of foreign languages apart from English and French. Therefore, failure to master different languages creates a communication barrier between the locals and the tourists.

## Methods Used to Increase the Income of Tourism Industry in Tanzania

*Explain methods used to increase the income of tourism industry in Tanzania*

**Ways of increasing income from the tourism industry include:**

1. **Marketing and publicity:** The government and other stakeholders must put more efforts in advertising tourist attractions found in the country so as to attract many tourists to visit them. This will, in turn, increase the government revenue and the money obtained from the tourism industry will be invested in tourism development and improvement of social services.

2. **Promotion of domestic tourism:** In spite of the government's efforts to promote domestic tourism, participation of the locals in visiting tourist attractions is still very low. The government through the Ministry of Tourism and Natural Resources has an obligation to further advertise and promote domestic tourism so as to encourage more locals to visit tourist attractions. This undertaking can be achieved through reducing the gate fees into game parks, game reserves and other attractions for local tourists.

3. **Package tours:** Package tour or **package holiday** consists of transport and communication advertised and sold together by a vendor known as **tour operator**. Other services may be provided such as a rental car, activities or outings during the holiday. Package holidays are organised by a tour operator and sold to a consumer by a **travel agent**. Some travel agents are employees of tour operators, others are independent. Package tours are affordable and less taxing to the tourists. Organising such tours will encourage more people to visit since they are cheap and most of the organising is done by a company.

4. **Expanding tourist industry:** New tourist attractions like coastal areas and lakes should be opened and developed so as to attract more visitors to visit the country. Tanzania has already started developing the coastal areas into tourist centres. Also archaeological and cultural centres should be developed. There are many of such centres in Tanzania but they have not yet been fully developed and advertised to potential tourists.
5. **Training of tourism personnel:** Tourism is a service industry and the tourists must get the quality service for the money they spend. When they get better services they are more likely to visit again. It is therefore important to have trained personnel who are capable of offering the best services. Tourism courses are offered at universities and colleges.
6. **Improvement of infrastructures:** The existing transport and communication infrastructures are not yet sufficiently developed to offer the quality services to tourists. There is need to improve the existing infrastructures, together with construction of the new ones. Improved and quality infrastructures will encourage more tourists to visit the country and hence increase the revenue gained from the industry.
7. **Improvement of safety and security:** Safety and security to tourists is a very important aspect in development of tourism. Measures should be taken to prevent any sort of crime around tourist centres and in the whole country. This will influence the tourists to visit Tanzania as they will be sure of their personal and property safety.
8. **Controlling poaching:** Poaching reduces the number of game and may lead to extinction of some wildlife species. Because wildlife is the major attraction to tourists visiting the country, more game wardens, rangers, and guards should be deployed to combat poaching activities in game parks and reserves. The government should employ more game protection personnel and equip them with appropriate weapons to fight against poachers.

## Lessons to Promote Tourism Industry in Tanzania

*Discuss the lessons that can be drawn to promote tourism industry in Tanzania*

### **How to promote tourism in Tanzania**

1. The ministry of Natural Resources and Tourism, through Tanzania Tourist Board (TTB), must promote Tanzania's tourist attractions through conducting publicity campaigns, preparation and publication of destination brochures and provision of tourist information.



2. Improvement and development of transport and communication infrastructures, particularly in areas with tourist attractions, in order to make these attractions accessible from the town centres.
3. Tourism resources such as national parks and game reserves should be protected from human encroachment. Also the environment on which the animals thrive, such as natural vegetation and water resources should be conserved.
4. There is need to identify and develop tourist attractions and improve the existing ones so as to diversify the tourist activities. Special emphasis should be put on improvement of pre-historical and archaeological sites, most of which are in very poor states.
5. The level of hospitality to tourists must be improved through training of the tourism personnel so as to meet the world's standards.
6. Attracting both local and foreign investors to put up facilities such as hotels, motels, lodges, etc. for tourists.
7. The political stability, peace and tranquillity should be maintained to ensure maximum security to tourists.

# MANUFACTURING INDUSTRY

## Concept and Importance of Manufacturing Industries

### Manufacturing Industry

*Define manufacturing industry*

Manufacturing is the production of goods for consumption or sale using labour, machines, tools, chemical and biological processes or formulation.

The term may refer to a range of human activity but is not commonly applied to industrial production, in which **raw materials** are transformed into **finished goods** on a large scale. Such finished products may be used for manufacturing other more complex products, such as aircraft, household appliances, automobiles, or sold to **wholesalers**, who in turn sell them to **retailers**, who finally sell them to end users – the **consumers**.

Therefore, a manufacturing industry is an industry that is involved in the large scale manufacturing, processing, fabrication, or preparation of goods from raw material or commodities

### The Importance of Manufacturing Industry

*Explain the importance of manufacturing industry*

The manufacturing industry plays a vital role in the economy of many countries. It contributes to growth and strengthening of the country's economy. The wealthiest countries in the world are heavily industrialised.

The manufacturing industry is important in the following ways:

1. **Source of employment:** Operations in any industry require manpower or labour. People are employed to undertake various activities carried out in a manufacturing industry. This helps lessen the problem of unemployment in the respective country.
2. **Diversification of economy:** Whereby the economy of a country depends mainly on other sectors such tourism, mining, fishing, and lumbering, for example, the establishment of

manufacturing industries help to diversify the country's economy. In this way, if one sector collapses the economy will still remain stable.

3. **Source of foreign exchange:**The finished goods from manufacturing industries are often exported overseas. The sale of such goods earns the country the much needed foreign currency and hence helps to improve the country's economy.

4. **Increased agricultural production:**Most of the agricultural produces are processed into finished products by the manufacturing industries. So long as there is demand for agricultural produces by the industries, farmers will produce more to meet the demand of the industries. Hence agricultural production will increase because the surplus from farmers finds a ready market, that is, the manufacturing industries.

5. **It stimulates the development of infrastructure:**Industries require a good network of roads and railways linking them to areas where raw materials are produced. Industries, therefore, lead to improvement of transport infrastructure between their locations and the sources of raw materials. Industries also need power and water infrastructure set in place. Thus, they also lead to improvement of public services which could have otherwise not been developed.

6. **Improvement of international relations:**The exchange of goods and services for money between countries help to improve the diplomatic relationship between the trade partners. This happens through interaction of traders and business people between two or more trade partners.

7. **Higher earning:**Processing of raw material adds value to a commodity, enabling the country earn more by exporting processed goods than when exporting the unprocessed raw materials.

8. **Reducing dependency on imports:**Manufacturing industries enable the countries to become self-sufficient in the goods they produce. This means that the country can only import the goods and services that are not manufactured within its borders. This reduces dependency on imported goods, hence saving the government revenue and foreign currency that could be spent on imported products. The revenue is consequently directed towards improvement of social services in the country.

## Types of Manufacturing Industries

### Types of Manufacturing Industries in East Africa

*Describe the types of manufacturing industries in East Africa*

Manufacturing industries are the industries concerned with processing and changing the raw materials into semi-processed or finished products or goods. There are two broad types of manufacturing industries as outlined below:

### ***Processing industries***

These are primary industries which convert the raw materials into products that can be used as raw materials for other industries which then process or convert them into finished goods. Examples of processing industries include coffee pulping plants, decorticators, cashew nut hullers and sisal processing factories.

### ***Fabrication industries***

#### Products of Each Type of Manufacturing Industry

*Identify products of each type of manufacturing industry*

Type of industry and product manufactured.

- ***Heavy industries:*** These are capital-intensive and large scale industries involved in the manufacture of bulky and heavy products. The products are made by using raw materials like iron and steel. Examples of heavy industries are those involved in the manufacture of heavy machinery such as ships, cars, cranes, aeroplanes, bulldozers and rockets.
- ***Light industries:*** These are less capital-intensive industries involved in the manufacture of consumer goods, such as cosmetics, plastics, textiles, paper, shoes, consumer electronics and home appliances. These industries require only a small amount of raw materials, area, and power. The goods they manufacture are often small but of relatively high value per unit weight.
- ***High-tech industries:*** High technology industries, often abbreviated as **high tech** or **hi-tech** industries are the type of industries involved in the manufacture of high technology products, such as electronic goods. Examples of electronic devices include computers, phones, telephones, calculators, audio equipment, digital cameras, electrical equipment, etc. The high-tech industry is capital-intensive and reliant on research and development.

## Factors for Location of Industries

### Factors Necessary for Location of Industries

#### *Name factors necessary for location of industries*

Generally, location of industries is influenced by economic considerations though certain non-economic considerations also might influence the location of some industries. Maximisation of profit which also implies cost minimisation is the most important goal in the choice of particular places for the location of industries. There are several factors which pull the industry to a particular place. Some of the major factors are discussed below:

#### ***Raw materials***

The significance of raw materials in manufacturing industry is so fundamental that it needs no emphasising. Indeed, the location of industrial enterprises is sometimes determined simply by location of the raw materials.

Some raw materials are bulky and heavy and transporting them over long distances may be very costly. For this reason, industries which use heavy and bulky raw materials in their primary stage in large quantities are usually located near the source of the raw materials. For example, iron and steel industries in Germany are located in the iron mining areas of the Ruhr region.

It is also true in the case of raw materials which lose weight in the process of manufacture or whose transport cost cannot be afforded or cannot be transported over long distances because of their perishable nature. For instance, vegetable and fruit processing industries are often located in areas close to the source of these raw materials.

The same case applies to those industries which depend on imported raw materials. They are normally located close to the points of arrivals e.g. the sea ports or along the coasts. For example, industries in Japan are concentrated close to the coast because they use imported raw materials.

#### ***Power***

Regular supply of power is a pre-requisite for the location of industries. Coal, mineral oil and hydro-electricity are the three important conventional sources of power. Most industries tend to concentrate at the source of power.

The iron and steel industries which mainly depend on large quantities of coking coal as source of power are frequently tied to coal fields. Others like the electro-metallurgical and electro-chemical industries, which are great users of cheap hydro-electric power, are generally found in the areas of hydro-power production, for instance, aluminium industry. Therefore, large and heavy industries are quite often established at a point which has the best economic advantage in obtaining power and raw materials.

However, as petroleum can be easily piped and electricity can be transmitted over long distances by wires, it is possible to disperse the industries over a larger area if need be.

### ***Labour***

Adequate supply of cheap and skilled labour is necessary for an industry. The attraction of an industry towards labour centres depends on the ratio of labour cost to the total cost of production. Labour supply is important in two respects: (a) workers in large numbers are often required; (b) people with skill or technical expertise are needed

The nature and amount of labour required will depend on the type of an industry and the kind of goods and/or services produced. Labour-intensive industries such as automobile industries require a large workforce. So, such industries are located in places with abundant labour. Some industries require skilled while others need semi-skilled or unskilled labour

Industries requiring semi-skilled and unskilled labour are often located in urban centres where the availability of such labour is not a problem. However, unskilled labour force is also abundant in urban centres, which mainly consists of unskilled job seekers who move from the countryside to seek for greener pastures in urban centres.

### ***Transport and communication***

Transport by land or water is necessary for the movement of raw materials and for the marketing of the finished products. A good transport and communication infrastructure is important for

carrying raw materials to the industry and transporting finished goods from the industry to consumers. It is also required for moving workers, machinery, chemicals and other materials.

Communication is important in connecting with buyers and suppliers. Communication links are facilitated by phones and computers. Manufacturers can easily market and advertise their products via the internet. This also enables the buyers to make their order online, a fact that lowers their trading costs significantly.

The entire process of manufacturing is useless until the finished goods reach the market. Nearness to market is essential for quick transport of manufactured goods. It helps in reducing the transport cost and enables the consumer to get things at cheaper rates.

A ready market is most essential for perishable and heavy products. Perishable products are such as vegetables, breads and milk. Industries producing heavy products should be located close to potential markets so as to reduce the transportation costs and eliminate the problems encountered in transportation of such products.

Water is another important requirement for industries. Many industries are established near rivers, canals, and lakes because of this reason. Iron and steel, textile, coffee pulping, sugar cane processing, paper mills, brewing, soft drink and chemical industries require large quantities of water for their proper functioning

### ***Market***

The entire process of manufacturing is useless until the finished goods reach the market. Nearness to market is essential for quick transport of manufactured goods. It helps in reducing the transport cost and enables the consumer to get things at cheaper rates.

A ready market is most essential for perishable and heavy products. Perishable products are such as vegetables, breads and milk. Industries producing heavy products should be located close to potential markets so as to reduce the transportation costs and eliminate the problems encountered in transportation of such products.

### ***Water***

Water is another important requirement for industries. Many industries are established near rivers, canals, and lakes because of this reason. Iron and steel, textile, coffee pulping, sugar cane processing, paper mills, brewing, soft drink and chemical industries require large quantities of water for their proper functioning.

### ***Site***

Site requirement for location of an industry is of utmost significance. An industry can only be located in an area if there is enough land space to build it. Sites, generally, should be flat and well served by adequate transport facilities. A large piece of land is required to build factories. Now, there is a tendency to set up industries in rural areas because the cost of land in urban centres has shot up.

### ***Climate***

Climate plays an important role in the establishment of industries at a place. Harsh climate is not much suitable for the establishment of industries. There can be no industrial development in extremely hot, humid, dry or cold climate. Cotton fabric industries require humid climate because cotton threads tend to break in dry climate.

### ***Capital***

Modern industries are capital-intensive and require huge investments. A lot of money is needed in the establishment of infrastructure and transportation of raw materials, goods and other requirements. Capital is also required to set up industrial machinery. However, capital does not influence the location of an industry to a large extent. It is only a problem in case the cost of land and rent rates, especially in urban areas, are extremely high.

### ***Government policies***

Government policy in planning the future distribution of industries, for reducing regional disparities, elimination of pollution of air and water, and for avoiding their heavy clustering in big cities, is an important factor in location of industries. The government may discourage the concentration of industries in one place due to a number of reasons as outlined below:



1. ***Economic reasons:*** Industries should be distributed equitably in the country to ensure equitable development of all regions of the country. This will lead to job creation and hence solve the problem of rural-urban migration. For example, the location of many industries in different regions of Tanzania soon after independence was due to this reason.
2. ***Political reasons:*** This is a case whereby political leaders dictate the location of an industry in a certain area for mere political gain.
3. ***Environmental reasons:*** Industries produce much smoke and harmful waste. So they are always located away from residential areas, arable land or community water sources. This is done in order to avoid environmental pollution.
4. ***Security reasons:*** All industries are not concentrated in just one area to avoid great loss in case of any sabotage or attack by terrors. It is, therefore, important to establish industries in different locations.

## ***Industrial location***

Industries tend to develop at the place of their original establishment, though the original cause for their location may no longer exist. This phenomenon is referred to as inertia. It is sometimes termed as *geographical inertia* or *industrial inertia*. Such industries may continue to exist in their previous locations due reasons such as:

1. The availability of skilled and experienced labour.
2. The presence of well developed transport and communication network.
3. Avoiding the expenses that may be incurred in moving to a new place.

## **How Pollutants affect the Environment, Industrial Employees and the Communities around the Plant**

*Explain how each pollutant affects the environment, industrial employees and the communities around the plant*

During operation, manufacturing industries produce various pollutants which can pollute the environment and affect employees and the community in the vicinity of an industry. These pollutants are likely to pollute the environment (land, water, air and organisms) if proper

measures are not taken to control the release of pollutants to the environment. There are many pollutants resulting from manufacturing industries.

## **Types of industrial pollutants**

Industries release a diversity of pollutants which include gases, liquid waste, noise and particulate matter. The effects of these pollutants are as outlined below:

### ***Gases***

Industries are the main sources of gaseous pollutants especially in heavily industrialized countries. These pollutants include carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), sulphur dioxide (SO<sub>2</sub>) and chlorofluorocarbons (CFCs).

- ***Effects on employees:***The gases may be inhaled by the employees and cause serious health problems. For example, carbon monoxide is a poisonous gas which combines with haemoglobin in the blood and stops the haemoglobin carrying oxygen from the lungs to body tissue and vital organs (most notably the heart and the brain). Inhaling high levels of the gas can cause vision problems, physical or mental impairment and even death.
- ***Effects on the environment:***The effects of industrial gases on the environment are many and have far-reaching consequences. The most notorious and notable effects include global warming, ozone layer depletion, acid rain, ocean acidification and soil pollution.
- ***Effects on the surrounding community:***The gases may also affect the community living close to the industry. The effects include health problems, blurred visibility, coughing, and aggravation or complication of medical conditions of individuals with asthma, lung and heart diseases, and respiratory allergies. Some gases, particularly sulphur dioxide, are the main cause of acid rain which destroys the buildings, the soil and harms the animals. This can lead to low agricultural production and hence famine to the surrounding community.

### ***Particulate matter***

- ***Effects on employees:***The PM can cause serious health problems to employees which include aggravating asthma, acute respiratory symptoms such as coughing and difficult or

painful breathing, chronic bronchitis and decreased lung function that can be experienced as shortness in breathing.

- ***Effects on the environment:***The main effects of PM to the environment include reduced visibility (haze), soiling, and damage to materials. Solid particles, especially dust, can cover the plant leaves and hence interfere with the process of photosynthesis. The particles may be carried over long distances by wind and then settle on the ground or water. The effects of this settling include making the lakes and stream acidic, changing the nutrient balance in coastal waters and large river basins, depleting nutrients in the soil, damaging plants and crops, and affecting the diversity of ecosystem.
- ***Effects on the surrounding community:***The PM can deplete the nutrients in the soil and hence affected agricultural production, leading to a drop in food production and hence famine. Particle pollution can also stain and damage buildings and other materials, including culturally important objects such as statues and monuments.

### ***Liquid waste***

Industries produce the liquid wastes that contain toxic and poisonous chemicals. These wastes are often dumped in water bodies and sometimes on land. The chemicals contained in industrial wastes may include lead, mercury, sulphur, asbestos, nitrates and many other harmful substances.

- ***Effects on employees:***The harmful liquid waste may cause skin diseases or burns if they come in contact with the skin. When they are accidentally ingested or if they get into the body through wounded skin, they may poison the body and can even cause death.
- ***Effects on the environment:***Untreated liquid industrial waste may pollute water bodies and the land, and harm living organisms. When damped in water, they can poison fish and other marine flora and fauna. The chemicals can also pollute the soil and consequently destroy soil properties, kill beneficial soil microorganisms, and poison the crops.
- ***Effects on the surrounding community:***The industrial chemicals can pollute the soil and make it unproductive, so this can limit or stop agricultural production. The crops grown on a soil polluted with chemicals can absorb the chemicals, which may get incorporated in plant bodies. When man eats such crops, the chemicals can pass into his body and affect him adversely. The chemicals can pollute drinking water sources, thus rendering the water unwholesome for

community consumption and commercial uses. If people use the water from polluted water bodies the chemical in water may harm their health in one way or another. It can also kill fish and other marine life due to chemicals dumped in water.

## **Noise**

Industries produce a lot of noise which can have adverse effects on the environment and the community.

- **Effects on employees:** Prolonged exposure of employees to loud noise may cause loss of hearing and give rise to rapid ear damage. Noise can not only cause hearing impairment but it also acts as a causal factor for stress and headache. It is also known to cause blood pressure. Additionally, it can be a causal factor in employee accidents both by masking hazards and warning signs, and by hindering concentration.
- **Effects on the environment:** Loud noise may cause migration of animals from a certain area and hence result in the imbalance of ecosystem. Intense vibrations caused by a loud noise may loosen the soil, making it vulnerable to soil erosion agents.
- **Effects on the surrounding community:** Noise can cause loss of concentration and hearing to people living close to industries. The loud noise also interferes with people's sleep making them less productive. It also makes it difficult for people to hold talks as they have to use a lot of energy to shout so as to hear and understand each other. It may also lead to poor health in young children by interfering with their normal sleeping routines.

## **Ways of reducing industrial pollution**

1. Industries should be located far away from residential areas.
2. All industrial wastes must be thoroughly treated before being dumped into water bodies. Doing so will reduce or even eliminate the possibility of harming aquatic life, people or polluting the soil.
3. Recycling of industrial wastes should be emphasized.
4. Using energy-efficient combustion engines so as to minimize the release of harmful gases to the environment.

5. Lubrication of moving parts of machinery should be done timely and effectively in order to reduce the amount of noise produced. Employees should use ear plugs (ear muffs) to protect their ears from damage by extreme noise during work.
6. The government should formulate policies that govern sustainable industrial production without causing environmental pollution, and any industry violating the rules should be fined heavily or even get closed altogether.
7. Developing and using alternative energy sources such as solar energy and wind power which do not pollute the environment.

## Focal Studies

### The Production of Cars in Japan, Electronic Equipment in South Korea and Textiles in Tanzania

*Explain the production of cars in Japan, electronic equipment in South Korea and textiles in Tanzania*

Japan is a chain of islands located in eastern Asia between North Pacific Ocean and the Sea of Japan. Its major islands are Hokkaido, Honshu (the largest and most populous), Kyushu and Shikoku

Japan is one of the world's industrialized countries. It is one of the leading countries in car manufacturing in the world. The Japanese automobile industry is one of the most prominent and largest industries in the world. Japan has been in the top three among the most car manufacturing countries in the world since 1960, surpassing Germany.

The country is the home to a number of companies that produce cars, construction vehicles, motorcycles, all-terrain vehicles (ATVs), and engines. Japan automobile manufacturers include Toyota, Honda, Daihatsu, Nissan, Suzuki, Mazda, Mitsubishi, Subaru, Isuzu, Kawasaki, Yamaha and Mitsouka.

The automobile manufacturing process involves making car parts and then assembling the parts to form a complete car (unit). The manufacturing of car parts is done by other companies using designs provided to them by the car manufacturer.

After assembling the parts, the car engines are tested, followed by painting of the complete cars. Most of these activities are performed by robots and other machines under the supervision of humans.

A number of factors have contributed to growth of car manufacturing in Japan. The factors include the following:

- ***Adequate capital:*** Car manufacturing companies have been conducting this business over a long period of time, so they have grown big financially and have attracted many financial institutions to lend them the capital they require to expand and extend their business. By the way, Japan is a rich country with a very stable economy. This has enabled it to finance the automobile industry adequately.
- ***Advanced technology:*** Japan has an advanced technology in car manufacturing and this technology has been advancing with time. Computerisation and use of robots has improved production efficiency. Research in automobile technology is being conducted in order to come up with better methods of production and new car models.
- ***Accessibility:*** Japan's location makes it accessible from all directions by sea. As such, ships that bringing in raw materials and ships transporting finished products from the car manufacturing industries anchor and set sail from Japan's ports.
- ***Market availability:*** Japan's manufactures produce very durable, reliable, and popular cars. Thus, their cars are sold in many countries due to their relatively low cost of purchase and maintenance. This has provided car manufactures with a wide market. However, its car market has decreased slightly in recent years, particularly due to old and new competition from South Korea, China and India. Still, automobile export remains one of the country's most profitable exports.
- ***Availability of labour:*** Japan has a large number of qualified and skilled personnel to work in the automobile industry. Though robots and other machines are also used in production, humans still remain the main workforce. Availability of considerably cheap labour tends to lower

the cost of production and maximise profit. This is the reason cars made in Japan are affordable to many buyers, including the very poor African and Asian countries.

- ***Good infrastructure:***Japan has very advanced and well maintained infrastructures, which undergoes regular upgrading and expansion. These include roads, modern railways systems, canals, seaports, and airports.
- ***Adequate energy resources:***Car manufacturing industries need a lot of power. Japan has got numerous hydroelectric power stations, coal, and nuclear energy reactors, among other sources, that provide the energy required to operate its industries.
- ***Commitment and hard-working spirit:***The Japanese are hard working people; they are committed in their jobs and the development of their country. This spirit has boosted their car manufacturing industry as well as other industries

## **The electronic equipment industry in South Korea**

South Korea is located in East Asia, on the southern half of the Korean Peninsula. The only country with a land border to South Korea is North Korea. South Korea is mostly surrounded by water. To the West is the Yellow Sea, to the South is the East China Sea, and to the East is the Sea of Japan.

Although South Korea's political scene has experienced a lot of instability, its economy has grown rapidly to become one of the best in the world. This has been geared (spearheaded) by its giant electronic industry, a light industry that produces products such as television sets, radiocassette recorders, microwave ovens, radios, watches, computers, video tapes, calculators and memory cards, among many others. The leading manufacturers of electronics in South Korea include Samsung and LG.

A number of factors have led to growth and development of South Korea's electronics industry. These factors include the following:

- ***Adequate labour:***South Korea has a large population of skilled and experienced labourers who work in the electronic industry. Because the industry is based on research and development, students are encouraged to take science subjects in schools and colleges, ensuring the modelling of future engineers, scientists and technical traders.

- ***Availability of capital:***The giant electronic companies in South Korea have so far accumulated much wealth to invest in research and development of the electronic industry. Furthermore, the companies are trusted by big financial institutions which are ready and willing to borrow them whenever they need capital. The government's financial support is also at the maximum.
- ***Advanced technology:***South Korea has kept up with the changing trends in electronics technology. Indeed, in some areas, South Korea has set the standards in new technology. This has given its electronic industry an edged over other electronic manufacturers.
- ***Improved research:***Research in electronics industry to come up with improved and modern products is very crucial in the development of the electronic industry in South Korea. A lot of the fund is injected into research to design high quality products to meet the changing market demands as well as liaise with stiff competition from other countries like China, Japan and North Korea.
- ***Availability of market:***South Korea is one of the most populous countries in the world. So there is a wide internal market for some of the products while a big portion is exported. Electronic products are always on high and persistent demand due the dynamic nature of electronics technology.
- ***Affordability of the products:***The electronic products from South Korea are of high quality but affordable. This makes them popular around the world, hence highly marketable.
- ***Government support:***The government of South Korea is very supportive to the electronics industry through laying down policies and business-friendly environment, which has promoted the growth and development of the industry. The government also provides financial support in areas like research and development. This has encouraged investment in the industry.
- ***International relations:***South Korea has a good relationship with many countries in the world. This has attracted many countries to become trade partners with South Korea, hence expanding markets for its electronic goods.
- ***Well developed infrastructure:***South Korea has well development transport and communication infrastructures which include an extensive network of railways, roads, seaways and airways that criss-cross the country. Thus, the raw materials and finished goods are transported easily. This makes the export of raw materials cost-effective.



- *Availability of energy:* South Korea generates power through various means. These include nuclear power, which accounts for 45% of the total power production. The other energy sources are thermal and hydroelectric powers. Energy for use in electronics industry is abundantly available and affordable.

## **The textile industry in Tanzania**

The Tanzania textile industry was developed in 1970s as part of the government's efforts to industrialize the economy. More than thirty textile mills, most of them owned by the government, were established and were operational throughout the 1980s.

Prior to economic reforms of early 1990s, the textile sector was thriving well. But faced with the withdrawal of government support, removal of trade barriers, and international competition, it soon the textile industry collapsed. Industries such as Mbeya Textiles, Musoma Textiles, and Mwanza Textiles went out of operation.

Manufacturing plants were sold off by the government to private investors, who have rebuilt the industry since the early 2000s. Much of the equipment bought at this stage was antiquated and inefficient, making it difficult for these companies to be internationally competitive; a major constraint they face up to the present.

Indeed, where companies have upgraded or replaced their equipment, it has inevitably been second- or third-hand, and for the most part globally uncompetitive, leaving the industry under great pressure and at considerable risk.

The collapse of the textile industry was due to inadequate supply of cotton lint, lack of power/power interruptions, high power tariffs, unfair competition from imports, and devaluation of Tanzania shilling, hence making it difficult to buy spare parts for the machines.

Today the textile industry is owned and operated by the private textile companies. Currently, there are 59 industries located in different parts of the country, 36 of which are based in Dar es Salaam. A few of these industries are those that were privatized by the government.

The government of Tanzania is trying hard to create a favourable investment climate for the textile industry, but the sector is still performing poorly and hence not contributing significantly

to the country's economy. Homemade textiles are of poor quality but very expensive as compared to those imported from other countries. As a result, most buyers have turned their attention towards purchase and use of second-hand clothes (*mitumba*) which are durable but affordable.

## **Problems facing the textile industry in Tanzania**

- ***Outdated machinery:***The machinery in most of the textile-manufacturing industries is old. Therefore, the final products manufactured by these industries are of low quality and thus not competitive in the market, both locally and internationally. These machines also have limited capacity which, in turn, limits production.
- ***High cost of power:***The cost of power in Tanzania is considerably higher compared to other countries. This leads to high production costs and, consequently, high prices for textile products. Given that the products are generally poor, they are hence hardly sellable. Through power is very costly, it is also not supplied adequately and persistently mainly because of obsolete transmission system, drought and high oil prices, among others. This problem discourages many investors who would like to invest in the textile industry.
- ***High cost of spare parts:***The cost of spare parts for textile machinery is very high. Sometimes these spare parts are not available in the market because the technology is old and outdated. Most manufactures have stopped manufacturing such spare parts. In addition, carrying out repairs for textile machinery is a very expensive task.
- ***Lack of skilled labour:***The lack of skilled labour in Tanzania prompts dependency on imported labour and skills which are very expensive. Sometimes when machinery breakdown occurs, the operation has to be halted until the imported skilled labour is available to fix it. This leads to stoppage of production and hence, financial losses.
- ***Competition:***The industry faces tough competition from second-hand clothes, known as *mitumba*, and high quality clothes imported from other countries. Due to this reason, the existing small market has considerably diminished the textile market even further.
- ***High taxes:***Tanzania is one of the countries with many meaningless taxes. The high taxes levied on the textile industry by the government leads to low profits, a heart-breaking challenge to investors.

- **High cost of chemicals:** The chemicals used in the textile industry, such as sulphuric acid, are imported from abroad using the foreign currency. This, plus other reasons, makes the textile industry unprofitable and thus a difficult business to operate. Imports add highly to operation costs in the textile sector.
- **Low capital:** Many textile industries operate with limited capital which greatly curtails their abilities to increase production capacity, improve their machinery, or purchase raw materials and industrial chemicals.
- **Poor infrastructures:** Tanzania is among the countries with very poor transport and communication infrastructures. The poor state of infrastructures means increased transport cost of raw materials from production areas and finished goods from industries to consumers. High production costs lowers the profit margin and hence the capability of industries to operate in a sustainable manner.
- **Poor management:** The development of the manufacturing industry was previously hampered by poor and horrible management practices. The rate of corruption and poor management is still rampant in this country, a fact that makes it hard for companies with big financial muscles to come and invest in Tanzania in various sectors of the economy.

## **Ways of encouraging the development of the textile industry in Tanzania**

1. The government should support the industry financially, which can be done by offering soft loans to companies that are involved or interested to invest in the textile sector, or through buying shares in these companies. The government could also fund researches on the development of the textile industry.
2. The government should come up with favourable policies which encourage the growth and development of the textile industry. This may include reviewing tax rates and power tariffs, as well as reviewing policies on importation of second-hand clothes from abroad. It should also consider the possibility of exempting taxes on materials imported for textile manufacturing.
3. There is need to improve the production technology to enable production of quality textile products which will be easily marketable. Alternatively, the outdated industrial machinery

should be replaced by the new modern machinery that produces high quality and up-to date textile products.

4. Market researches should be conducted tirelessly, aiming at development of new products and finding alternative and cheap means of production. The new products will help boost and push the industry forward.

5. Labour should be trained well about textile technology and production. This can be achieved through introducing textile production courses in vocational colleges and in schools and universities.

6. The government and other stakeholders should improve transport and communication infrastructures so as to reduce the production costs incurred for transporting the textile products and raw materials.

7. The government has relaxed the regulations on importation of raw materials and exportation of goods abroad. This has enabled stakeholders in the textile industry to export their products timely and without incurring high costs.

8. Tanzania is a member of regional organizations, such as the East African community (EAC), and the Southern Africa Development Community (SADC). Therefore, Tanzania's textile industry benefits significantly from this combined market of about 150 million people. Market availability will automatically boost the textile industry.

## Lessons from Japan and South Korea Industries for Tanzania

*Identify lessons from Japan and South Korea industries for Tanzania*

Lessons for Tanzania

1. The various industries in South Korea and Japan are well managed. For this reason, they perform well and make profits. The management set objectives that they work hard to achieve. They are not involved in corruption scandals, extravagance or misuse of company resources. Likewise, for Tanzania's textile industry to develop and grow, good management practices must be encouraged.

2. The well developed transport and communication infrastructure in South Korea and Japan play a big role in the development of industries. Thus, well developed infrastructures are

necessary for industrial development. This is because it facilitates the movement of goods and raw materials efficiently. To boost the textile industry in Tanzania, the government should also put more efforts on the improvement and development of infrastructure so as to hasten the movement of raw materials and finished products. This will help to minimize the production costs and hence encourage more people to invest in the industry.

3. Japan and South Korea industries put more emphasis on research and development of products and technology. Tanzania should likewise, invest more on research and come up with new and advanced products that will attract the market.

4. South Korea and Japan have invested a lot in training and development of labour, so Tanzania should do the same. This will ensure constant supply of skilled labour to support the growth and expansion of industries in the country.

5. The Koreans and Japanese are very hard-working people and they are seriously committed to their jobs. This is the reason why their industries produce more products of high quality. Tanzanians should adopt this working spirit. There is no short-cut or miracles to success except hard work and commitment. Tanzanians should also work hard and in a committed way, if at all, they want to achieve their goals in industrial growth and development.

6. Just like Japan and South Korea, the government of Tanzania should also formulate policies that favour growth and development of industries. The government may also fund technical activities such as research as well as negotiating favourable trade agreements with other countries to provide a market for its industrial products.

7. The industrial products from both South Korea and Japan are of high quality and can be sold in any country in the world. Industries in Tanzania should follow in similar steps by producing goods that meet international standards. This can be achieved by producing quality and affordable products.

8. Japan's and South Korea's industries keep up-to-date with development and technology. That is, they produce goods that match with changes in technological advancements and customers' demands. They produce advanced and competitive goods. Tanzania's industries should do the same.

9. Japan and South Korea exploit different energy resources which include nuclear energy, thermal energy, coal and hydroelectricity. Tanzania should also harness different energy resources instead of depending heavily on hydroelectricity which is unreliable and yet expensive. The government should invest on generation of electricity from coal (at Kiwira) and natural gas (at SongoSongo). This will make energy more cheap and available to industries cheaply.

# SUSTAINABLE USE OF POWER AND ENERGY RESOURCES

## Power and Energy

### Power and Energy

*Define power and energy*

Energy is the capacity for doing work. You must have energy to accomplish work. Power is the rate of doing work or the rate of using energy. Therefore, you need energy to produce power. Without energy there is no power that can be produced.

## Major Sources of Power

### The Major Sources of Power and Energy

*Identify the major sources of power and energy*

Energy sources can be sub-divided into two broad categories. These are renewable and non-renewable energy sources. **Renewable sources** are those that do not get finished or used up since they are naturally replenished. These include sunlight, water, geothermal steam, wind and biomass.

**Non-renewable sources** are those that can get finished or used up through use, that is, they cannot be replaced once used up. They include coal, petroleum, natural gas, groundwater aquifers, and nuclear energy sources such as uranium and plutonium.

### The Origin of Different Types of Energy and Power Sources

*Describe the origin of different types of energy and power sources*

Some of these energy and power sources are discussed in details below:

- **Coal:** Coal is a fossil fuel that forms when dead plant matter is converted into **peat**, which in turn is converted into **lignite**, then **sub-bituminous coal**, after that **bituminous coal**, and lastly **anthracite**. This involves biological and geological processes that take place over a long

period of time. Coal is black or brown in colour. Throughout history coal has been used as an energy resource, primarily burned for the production of electricity and/or heat, and is also used for industrial purposes such as refining metals.

- **Sunlight:** The sun is a source of sunlight and all forms of energy on earth. Sunlight can be harnessed to generate electricity (solar power). This is achieved by using solar panels which absorb the solar energy, convert it into electrical energy and store it for later or immediate use.
- **Waves and tides:** Waves are generated by wind passing over the surface of the sea, ocean or lake. As long as the waves propagate slower than the wind speed (just above the waves), there is an energy transfer from the wind to the waves. Tides are the rise and fall of sea levels caused by the combined effects of the gravitational force exerted by the moon and the sun and the rotation of the earth. Tides also contain substantial amounts of energy. The energy in the ocean waves and tides can be captured (trapped) to produce mechanical power which is in turn used to generate electricity.
- **Wind:** Wind is air in motion from low to high pressure region. Wind possesses energy which can be converted by appropriate devices, into mechanical energy, which in turn can be used to generate electricity or do any useful work.
- **Water:** Water in motion, such as waterfall or cataract, can be harnessed to generate hydroelectricity. First, the kinetic energy in running water is converted into mechanical and then electrical power.
- **Biomass:** The term “biomass” refers to organic matter that has stored energy through the process of photosynthesis. This can be transferred through the food chain to the animal’s bodies and their wastes, all of which can be converted into energy for everyday human use through processes such as combustion.
- **Petroleum (crude oil):** Petroleum is a fossil fuel formed from fossilised remains of plants and animals. When refined, it produces various petroleum fractions, which are put to various uses of energy generation. It can be used to power cars and many machines, and burned to produce heat and light or generate electricity.
- **Natural gas:** Natural gas occurs alongside petroleum. The gas can be burned to generate light and/or heat and harnessed to generate electricity. For example, the natural gas from SongoSongo Island in Kilwa is expected to be piped to Dar es Salaam where it will be used to generate electricity and supplied to homes as liquefied gas to be used for heating and lighting.



- **Uranium:** This is a radioactive element which produces tremendous amounts of energy upon disintegration (fission) or combination (fusion) of the nuclei of its atoms. This energy (nuclear energy) can be used and is being used by many countries in the world to generate electricity.

## Methods of Acquiring or Extracting Power and Energy

### Methods of Acquiring/Extracting Power and Energy

*Explain methods of acquiring/extracting power and energy*

Energy and power can be extracted from their sources and put into various uses. Outlined below are different energy and power resources and the methods used to extract energy and power from these resources:

- **Coal:** Coal is a combustive black or brownish-black sedimentary rock, usually occurring in rock strata in layers or veins called beds or coal seams. Coal is considered as a non-renewable resource because it cannot be replenished on a human timeframe. The activities involved in generating electricity from coal include mining, transport to power plants, and burning the coal in power plants. At the power plant, coal is commonly burned in a boiler to produce steam. The resulting steam is run through a turbine to generate electricity. Apart from generating electricity, coal is also burned to produce heat which is used for various purposes such as domestic heating and in industrial furnaces. During the Industrial Revolution, coal was mainly used to raise steam which was used to power machinery, steam ships and locomotives.
- **Petroleum:** Petroleum is a naturally occurring liquid found in rock deep in the ground. This liquid consists of a complex mixture of hydrocarbons of various molecular weights, plus other organic compounds. It is generally accepted that oil is formed mostly from the carbon-rich remains of ancient plankton after exposure to heat and pressure in the earth's crust over hundreds of millions of years. Overtime, the decayed residue was covered by layers of mud and silt, sinking further down into the earth's crust and preserved there between hot and pressured layers, gradually transforming into oil reservoirs. After mining, petroleum is transported to a petroleum refinery where the mixtures of hydrocarbons that constitute the petroleum are separated and put into various uses. Some of these hydrocarbons (fractions or products) include petrol, diesel, fuel oil, kerosene, refinery gas (jet oil), etc. The energy from petroleum products is tapped mainly by

burning. The burning produces heat energy that is used for heating, lighting or doing some mechanical work (such as powering machinery, vehicles, etc). For example, fuel is burned in a furnace or boiler for generation of heat that is used in an engine for generation of power. Petroleum products can also be burned to generate electricity.

- **Natural gas:** Natural gas is fossil fuel formed when layers of buried plants, gases and animals are exposed to intense heat and pressure over thousands of years. The gas is often found in close proximity to and with petroleum. Natural gas is a hydrocarbon gas mixture consisting primarily of methane, but commonly includes varying amounts of other higher alkanes and even a lesser percentage of carbon dioxide, nitrogen, and hydrogen sulphide. Natural gas is mined from deposits deep underground and brought to the surface. Before the gas can be used as a fuel, it must be processed to remove impurities, including water, to meet the standard of a marketable natural gas. Energy from the natural gas is extracted through burning of the gas. This burning produces heat energy which is used for heating, cooking and electricity generation. The gas is also used as fuel for vehicles and as a raw material in the manufacture of plastics and other commercially important organic chemicals.

- **Water:** The potential energy of dammed or flowing water can be converted into storable electrical energy. Harnessing the flowing water to power machines and mechanical processes is one of the oldest methods of power generation that is used until today. The energy in water may be tapped naturally or artificially. Naturally, flowing water at waterfalls runs through turbines, which generate electricity. River water may also be used to run milling machines. Artificially, water may be lifted to higher points such as tanks or dams where it drops in mass, turning the turbines to generate electricity.

- **Biomass:** Biomass is biological material derived from living things, or recently living organisms. It mostly refers to plants or plant-based materials. As an energy source, biomass can either be used directly via combustion to produce heat or indirectly after converting it to various forms of biofuel. The biofuel can then be burned to release heat energy that is used to power machines or for heating purposes. Wood is burned directly to produce heat and/or light. Wood remains the best biomass energy source to date. Examples of wood include forest residues (such as braches, dead trees and stumps), yard clippings, wood chips, and even municipal solid wastes. Biomass also includes plant or animal matter that can be converted into fibres, or other industrial chemicals, including biofuels. For example, gasohol is a biofuel derived from a

mixture of alcohol (from sugar cane) and petrol. This is used as a fuel to run cars and machines. Rotten garbage and agricultural and human waste under controlled conditions can release biogas that can be used for heating, cooking and lighting.

- ***Uranium:*** Uranium is a radioactive element. The energy from uranium is extracted through nuclear fission or fusion. Nuclear fission involves splitting of an atom while nuclear fusion involves combining two light atoms. The most commercially exploited process is nuclear fission, when the atoms and nuclei of this radioactive element split in nuclear reactors. The process releases a large amount of energy in the form of heat. The heat released is used to boil water into steam, which is, in turn used to turn turbines to generate electricity.
- ***Solar energy:*** Solar energy refers to energy from the sun. This energy can be tapped and used for different purposes. Solar energy is tapped by devices called solar panels. The energy is absorbed by the panels and converted into electrical energy that can be used immediately or stored for later use. The trapped energy can be used to light homes and power gadgets such as phones and calculators. The heat from the sun can also be tapped directly like when it is used to dry crops or clothes.
- ***Geothermal steam:*** The geothermal power from geothermal steam is extracted by directing it to run machines that produce electricity. Its heat can also be tapped by placing the material to be heated over the hot steam.
- ***Wind energy:*** The kinetic energy of wind is harnessed by turning windmills, which generate electricity. Each of the several wind mills is supplied with a cable which is used to supply electricity to the main cable which then directs electricity to homes, industries etc. The electricity generated can be used for cooking, lighting and running machines. Wind energy may also be tapped by putting up sails to propel water vessels such as dhows.



*Wind mill*

## Importance and Use of Power and Energy Resources

### The Use and Importance of these types of Power Resources

*Explain the use and importance of these types of power resources*

Power and energy resources are important in two ways. First, it is through the energy and power they produce and secondly, due to their own economic value.

1. **Industry:**The power and energy resources generate energy and power that is used to generate electricity to run machines and produce heat for heating, cooking, lighting, welding etc. This leads to industrial development and hence economic growth.
2. **Agriculture:**Power and energy resources produce energy and power that is used to run agricultural machinery such as tractors and harvesters. These machines are mainly powered by petrol which is a product of petroleum. The use of machines in agriculture increases agricultural production and hence the living standards of the farmers.

3. **Environmental conservation:** The use of solar, wind, biogas and energy helps to conserve the environment because the extraction and use of these power and energy resources is not associated with environmental pollution. This helps to keep our environment clean and also prevents the occurrence of negative effects brought about by environmental pollution. Also the use of wastes such as municipal wastes for generation of biogas helps to clean the environment directly. Furthermore, the use of this clean form of energy instead of cutting down trees to get firewood help conserve the environment.

4. **Transportation:** Transportation sector involves the use of motor vehicles, ships, aircrafts, etc, all of which are powered by petroleum products. Transportation, apart from facilitating the movement of people, goods and services from one place to another, also helps in economic growth and development.

5. **Mining:** Most forms and kinds of machinery that are used in mineral prospection, extraction, and processing use power and energy generated from fossil fuel. Therefore, the fuel energy helps in the development of the mining industry.

6. **Social services and amenities:** Most social services and amenities are facilitated by energy and power. For example, sports, games, schools, healthcare, and homes depend on power and energy in different ways. People use energy to cook, heat, light homes, and power electronic devices that they use daily. This helps to simplify work and create joy and refreshment, hence making life easy, pleasurable and enjoyable. The availability and constant supply of energy and power, therefore, plays a vital role in improvement of the living standards.

Energy and power sources have the following direct economic and social importance:

1. **Source of employment:** Many people are employed directly in the extraction, harnessing, transmission and sale of energy and power. All of these activities involve a great deal of manpower. Some of the people employed in the industry include miners, researchers and scientists, solar equipment installation technicians, electricians, and many others.

2. **Source of foreign exchange:** The extraction and sale of energy resources or energy and power earns countries the foreign exchange. This includes sale of technology or expertise and equipment to the needy countries, all of which are paid for in foreign currency. For instance, countries that export energy resources such as coal and petroleum or energy like electricity, earn

foreign exchange. This increases their foreign exchange reserves and enables them to participate competitively in international trade.

3. **Source of government revenue:**The taxes that are charged on energy-related export earn revenue to respective governments. Some governments are also directly involved in the energy and power business, thereby directly earning revenue from these resources.

4. **Improvement of transport and communication infrastructure:**The movement of energy and power resources or their products (power and energy) requires laying infrastructures such as roads, railways, ports and airports in order to fully exploit these resources. This helps to improve the infrastructures which also benefit the general community.

5. **Promotion of trade and other industries:**The industries that rely on energy and power or resources are sure of continuing with their production so long as the energy and power are available. Therefore, this promotes industrial development as well as sale of goods and services produced by the respective countries. For instance, the industries that manufacture solar panels and electrical equipment benefit a lot from the power and energy industries which are the main users of their products.

## Problems Facing Power and Energy Production

### The Problems Facing the Process of Power and Energy Harnessing

*Discuss the problems facing the process of power and energy harnessing*

Power and energy production endeavour is faced by a number of problems which include the following:

1. **Changing climatic conditions:**Drought leads to rainfall scarcity and hence a drop in the volume of water in rivers. This problem affects the production of hydroelectric power and is one of the factors leading to low energy production in most parts of the world, especially in the least developed countries.

2. **Lack of capital:**Energy and power production needs heavy investments in infrastructure, manpower and technology. All these investments require a great deal of capital. Inadequate capital leads to low investment and, therefore, low production of power and energy. This problem especially affects developing countries which fail to meet enormous costs involved in setting up

energy and power generation facilities. These poor countries normally depend on unreliable hydroelectric power as they lack adequate innovation and technology to establish different energy generation projects.

3. ***Lack of diverse energy sources in respective countries:***Most countries have very few energy resources from which to extract power and energy. Worse still, some do not have a single energy resource, so they have to import the resources or power. For instance, uranium and geothermal steam are not found in many countries. Such countries extract power from only a few available resources such as water, wind or solar energy.

4. ***Poor technology and lack of skilled personnel:***Many developing countries lack the technology required to establish energy extraction infrastructures and the skilled personnel needed to perform that function. Most of the power and energy exploitation technology used in developing countries is very old and less efficient and productive. There are also very few people with the necessary skills for setting up and operating equipment as well as conducting research on power and energy production methods, facilities and technologies.

5. ***High prices:***High prices for energy resources hinder energy and power output in most countries that have to import these resources from other countries. Oil is used for energy production. We have recently seen escalating oil prices worldwide. This leads to low purchase and hence low energy and power production. Also the equipment needed for production of energy and power is very expensive and can thus not be afforded by many poor countries. As a result, they resort to inefficient and less productive obsolete technology which cannot produce sufficient power and energy to meet the ever-increasing demand for energy and power.

6. ***Environment pollution:***Energy and power exploitation is sometimes accompanied with the emission of harmful gases that pollute the environment. Coal burning, for example, releases tremendous quantities of carbon dioxide gas into the atmosphere. As such, many countries are either phasing out such energy generation technologies or spending a lot of capital to clean the coal so as to prevent environmental pollution. The power and energy production sector is, therefore, in great pressure to adopt technologies that minimize or cause no environmental pollution.

7. ***Siltation:***Accumulation of silt in dams used for generation of hydroelectric power reduces the volume of water in dams, hence resulting to low power generation. On the other

hand, removal of the silt from dams adds to the cost of energy and power production and these costs are pushed on to consumers of energy and power.

8. ***Scramble for resources:*** River water is also used for irrigation of crops, domestic and industrial uses, fishing or preservation of flora or fauna. For example, river Nile is used for irrigation in Ethiopia (Gezira Irrigation Scheme) and, at the same time, required for production of hydroelectric power at Aswan High Dam, in Egypt. If too much water is used for irrigation, little will be available for hydropower generation. This competition on the same resource can lead to international conflicts and even wars. Another example is coal which is used for domestic heating as well as for generation of electricity. This can curtail the generation of power and energy from coal if too much of it is used for domestic heating. In Tanzania, peculiar species of toads are found at Kihanzi power generation station in Kihanzi River. Use of water for generation of hydroelectricity affects the lives of these organisms. This has caused a big concern from environmentalists and wildlife conservation groups.

## Ways of Addressing Power and Energy Harnessing

*Suggest ways of addressing power and energy harnessing*

**Ways to address the problems facing power and energy production include the following:**

1. The silt accumulating in dams should be dredged regularly in order to keep the volume of water constant. This will maintain the capacity of energy and power generation.
2. Any form of environmental pollution likely to cause global warming and reduction in amount of rainfall should be avoided. People should not cut down trees indiscriminately as this can lead to drought and hence reduction in volumes of rivers needed for generation of hydroelectricity.
3. Countries should diversify their energy generation sources in order to escape the effects caused by such problems as escalating oil prices and climate change.
4. Developing countries should phase out the old energy and power generation technologies and instead adopt the new ones so as to cope with technological advancements to ensure that their energy generation is efficient and highly productive.



5. Research should be carried out often in order to improve energy and power production, as well as come up with new production methods. Research will also help in finding power and energy production methods that cause less or no environmental pollution.

6. The governments should train their people the courses related to energy and power generation at schools, colleges, and universities so as to make them professionally competent in the field of energy and power generation.

7. Countries should set aside enough funds to be used for energy and power generation because success in this sector can boost the growth and development of other sectors. Dormancy in energy and power sector can hinder industrial development and cause the country's economy to drop down.

## Focal Studies; Solar and Wind Power in U.S.A Hydroelectric Power and Biogas in Tanzania

### The Importance of Power and Energy Resources in the Focal Countries

*Evaluate the importance of power and energy resources in the focal countries*

The USA is a technologically advanced country with a huge and very stable economy. It is a developed and heavily industrialized country with a great demand for power and energy required by its industries and its large population

These and other factors have contributed to development of various power production resources. Solar and wind are among the diverse power resources in the USA.

### **Solar Power**

The U.S. is among the top countries in the world in electricity generated by the sun and several of the world's largest small-scale installations are located in the desert Southwest. Solar power includes small-scale solar power plants as well as local distributed generation, mostly from rooftop solar panels. The United States conducted much early research in solar devices and concentrated solar power. There are plans to build many other large solar plants in the United

States. Many states have set individual renewable energy goals with solar power being included in various proportions.

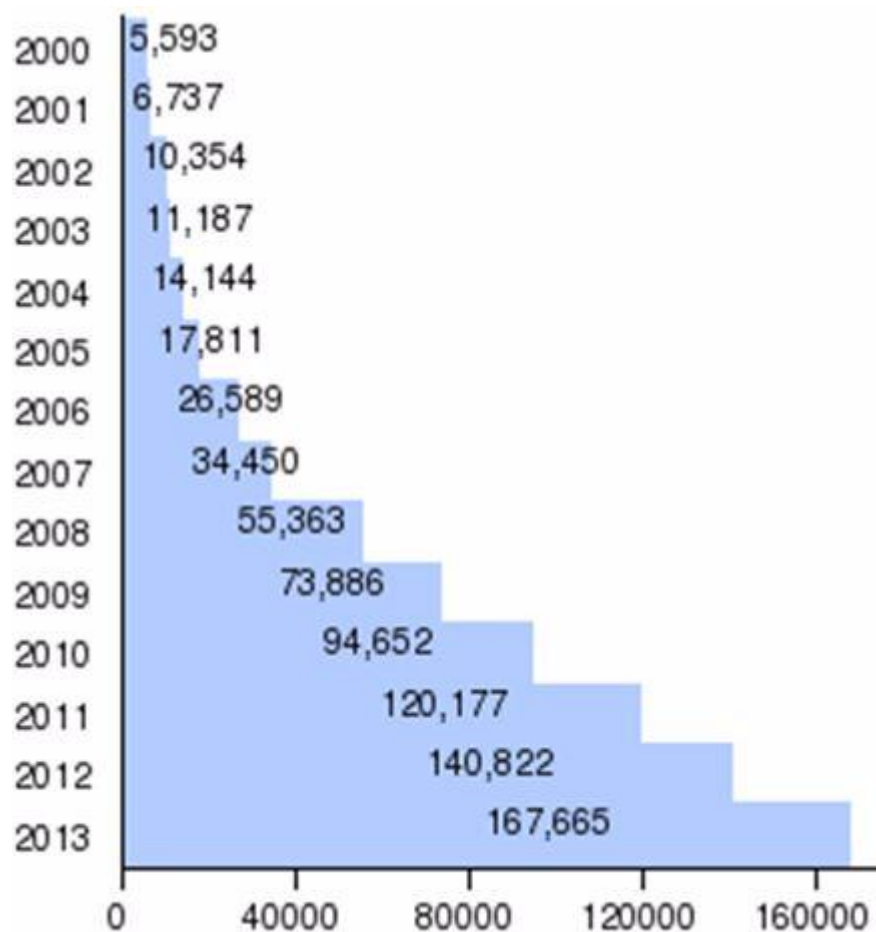
Solar power accounts for about 1% of the total national generation capacity. It is mainly exploited in the sunny areas of the country which include Nevada and California states.



*Rooftop solar panels*

## ***Wind power***

Wind power is a branch of the energy industry expanding quickly over the last several years.



*U.S. Wind Generation (KW) by Year*

Wind power accounts for 4% the total energy produced in the USA. Texas is firmly established as the leader in wind power development, followed by Iowa and California. Wind power is used to run farms, industries and for generating electricity that is fed to the national grid.

## **The importance of solar and wind power in the USA**

1. **Source of employment:** Solar and wind energy industry is more labour-intensive. The industry supports thousands of people in the USA. The wind energy industry employs many Americans in a variety of capacities, including manufacturing, project development, construction and wind mill installation, operations and maintenance, transportation and logistics; and financial, legal and consulting services. The solar energy industry employs people in jobs including solar panel installation, manufacturing and sales.

2. ***Industrial development:***The energy and power generated from resources such as coal, uranium, petroleum and water are very expensive compared to wind and solar energy. The abundance and availability of cheap energy from wind and sunlight promotes industrial development.
3. ***Agricultural development:***Wind and solar power is commonly used in large farms to supply electricity required for such activities as pumping water, lighting and heating. This has, in turn, promoted large-scale agriculture in the country.
4. ***Conservation of non-renewable energy resources:***Depending on renewable energy sources such as wind, solar and hydroelectricity for power and energy generation helps to conserve the non-renewable energy sources such as gas, coal and petroleum. This ensures that these non-renewable energy resources do not run out or become exhausted soon. They are conserved for future uses instead.
5. ***Reduced environmental pollution:***Exploitation of non-renewable energy resources, such as petroleum, coal, and wood, releases harmful gases to the atmosphere which pollutes the environment. Harnessing and use of wind and solar energy do not pollute the environment. Thus, generating sufficient power and energy from these resources will help reduce environmental pollution that could otherwise result due to dependence on non-renewable resources.
6. ***Improved standard of living:***People employed directly and indirectly in the wind and energy industry earn cash which they spend on their daily needs as well as other amenities.Solar and wind energy is cheap and hence affordable to many Americans. So, people who had no access to the costly hydroelectricity and thermal electricity are now able to use this cheap power and energy. This has helped improve their living standards.
7. ***Development of other sectors of economy:***Growth in power and solar industry creates positive multiplier effects. For example, industries in the renewable energy supply chain, such as those manufacturing windmills and solar panels, will benefit. The growth of industries involved in the manufacture of wind and solar energy equipment depends on the growth and existence of the solar and wind generation industry.Also local businesses will benefit from increased household and business incomes.
8. ***Generation of revenue:***Local governments collect property and income taxes and other payments from energy project owners. These revenues can help support public services, especially in rural communities, where projects are often located. Owners of the land on which

wind projects are built also receive lease payments as well as payments for the rights to transmit electricity through their land. Also they may earn royalties based on projects' annual revenues.

9. ***Stabilisation of energy prices in future:*** Wind and solar energy is providing affordable electricity across the country right now, and can help stabilize energy prices in future. The costs of solar and wind energy technologies have declined steadily, and are projected to drop even more. For example, the average price of a solar panel has dropped significantly. The cost of generating electricity from wind is also declining gradually. The wind and solar energy projects require initial investments to build but once established they operate at very low costs and to most technologies the fuel is free. As a result renewable energy prices are relatively stable over time.

10. ***Diversification of energy supplies:*** Using more wind and solar energy can lower the prices and demand for natural gas and coal by increasing competition and diversification of energy supplies. Generation of energy from different resources ensure that the supply is not interrupted in case one resource is finished or exhausted. This ensures constant availability of power and energy. Therefore, wind and solar energy helps to diversify the energy supply in the country.

11. ***Reliability and flexibility:*** Wind and solar energy supplies are less prone to large-scale failure because they are distributed and modular. Distributed systems are spread out over a large geographical area, so a severe weather event in one location will not cut off power to an entire region. Modular systems are composed of numerous wind mills or solar panels. Even if one of the equipment is damaged the rest can typically continue to operate.

12. ***Sustainability:*** For as long as the sun shines and the wind blows, the energy produced can be harnessed to send power across the grid.

## The Problems Facing Power and Energy Harnessing in Focal Countries

*Summarize problems facing power and energy harnessing in focal countries*

### **Problems facing solar and wind power in the USA**

1. Generation of wind and solar power depends on prevailing weather conditions. In case of little or no sunshine due to prolonged cloud cover or if there is very low wind speed, then very little power will be generated. This, in turn, leads to generation of little amount of electricity which cannot meet the demand of all consumers.

2. People are still reluctant to change from dependency on the traditional energy sources, such as hydroelectricity. They are, therefore, slow in adopting the use of solar and wind power, thus hindering fast development and growth of the industry.
3. The cost of installation of equipment for generating wind and solar power on a large-scale is very high. This has led to limited investment in the industry.
4. The cost of leasing land for building wind energy projects is very high. The problem has made many companies reluctant to establish wind power projects.
5. The industry is facing stiff competition from other sectors of energy and power, such as coal power, hydroelectric power, and geothermal power.
6. Unequal government subsidies and taxes. Nuclear and fossil fuel technologies enjoy a considerable advantage in government subsidies for research and development, compared with wind and solar energy counterpart which do not get any government subsidies. In addition to receiving subsidies, conventional generation technologies have a lower tax burden.
7. Wind and solar power developers may have difficulty obtaining financing at rates as low as may be available for conventional energy facilities.
8. Good wind sites are often located in remote areas, far from the cities where electricity is needed most. Transmission lines must be built to bring the electricity from the wind farm to the city. This increases the cost of generating and providing electricity.
9. Wind resource development may not be the most profitable use of the land. Land suitable for wind mill installation must compete with alternative uses for land, which may be more highly valued than electricity generation.

## **HEP and biogas in Tanzania**

### ***Hydroelectric power (HEP)***

Hydroelectric power contributes about 57% of the total power generated in Tanzania. The electricity supply industry is dominated by Tanzania Electric Supply Company (TANESCO). The company operates hydropower generation stations which include Kidatu, Kihansi, Mtera, Pangani, Hale, Nyumba ya Mungu and Uwemba, totalling 561 MW of electricity.

TANESCO also generates thermal electricity using gas and diesel by plants located in various parts of the country. There are also independent power plants (IPPs) which produce thermal electricity from gas and diesel and then sell the generated power to TANESCO who feeds it to the national grid.

### ***Biogas***

Due to increasing demand for power and dwindling energy resources, there is need to develop alternative energy sources in Tanzania. One of such sources is biogas, which is used for heating, lighting, and cooking at homes, schools, hospitals, etc.

Biogas is produced by anaerobic digestion with anaerobic bacteria or fermentation of biodegradable materials such as manure, sewage, municipal waste, plant material, and crops.

Biogas technology in Tanzania was introduced in 1975. But it was not until late 2000s when a study of the biogas sector and how to improve it was conducted. Then the sector saw improved progress in domestic biogas uptake.

The government is collaborating with different development partners to improve on existing technologies and to construct new biogas plants for particularly rural communities. It is estimated that about 700 biogas plants have been constructed in Tanzania. Most of these are in rural areas where raw materials such as livestock and poultry wastes and crop residues are easily and abundantly available.

## **Importance of HEP and biogas production in Tanzania**

Hydroelectricity and biogas are very important power resources in Tanzania. Outlined below are some of the importances of producing these resources:

1. Hydroelectricity and biogas industry employs people who carry out energy production activities. The sector, therefore, serves as the source of employment opportunities to some Tanzanians. This helps to improve their income and hence the standard of living.
2. The hydroelectricity generated in Tanzania is used to power other industries and sectors of economy. It, therefore, leads to industrial development as well as other economic sectors in the country.

3. Biogas generation in rural areas has greatly helped to improve the living standard of the rural people. Studies have revealed that now women and girls with access to biogas do not spend much time looking for firewood and hence they can instead direct their efforts towards participating in other economic activities to improve family income. It thus saves women and children from drudgery of collection and carrying of firewood, exposure to smoke in the kitchen, and time spent for cooking and cleaning of utensils.

4. The use of biogas and hydroelectricity has greatly reduced the problem of cutting down trees for firewood. This has consequently helped to prevent deforestation, hence ensuring environmental conservation. Conversely, biogas combustion has no effect to environmental pollution since it produces negligibly very little pollutants into the atmosphere compared to wood, coal and petroleum. The use of municipal waste to generate biogas directly assists in cleaning of the environment and prevention of pollution that could result by dumping of these wastes on land or into water bodies.

5. Most of the biogas projects are undertaken by development partners from abroad. This has helped to improve the relationship between Tanzania and the partners' mother countries.

6. The residue of the organic matter left back after biogas has been generated is used as enriched organic manure, which can supplement or even replace chemical fertilizers.

## **Problems facing HEP and biogas production in Tanzania**

1. ***Unreliable climatic conditions:*** Hydroelectric power generation relies on rain-fed rivers and dams. There has recently been occurring long dry spells which lower the volumes of rivers and dams, thus curtailing hydroelectricity generation. This leads to power rationing and hence interruption in economic production.

2. ***Lack of adequate capital:*** Generation of HEP and biogas requires investment in installation of hydropower and biogas plants, respectively, all of which are hampered by availability of capital. Due to the country's sluggish economy, investment in the power and energy sector has not been successfully implemented. There is lack of enough funds to finance the establishment of more biogas plants in rural areas. The country relies heavily on donors and foreign investors to finance the projects.



3. **Siltation:**The continuous accumulation of silt in the dams leads to reduction in water volume and hence low hydroelectricity generation. The problem also leads to increased operation costs because the silt has to be dredged periodically.

4. **Lack of skilled personnel:**The establishment and operation of hydroelectric and biogas plants require skilled personnel. There are very few locals with the required expertise and professional skills to operate the projects. This has hindered the construction of hydroelectric and biogas plants in the country. The production of energy and power from these two sources is thus minimal.

5. **Reluctance by the people:**People are still reluctant in adopting the biogas technology. Many people depend on use of wood as their major source of fuel. This has led to low investment in the industry and hence low production of the biogas.

### **Solutions to problems facing power production**

1. The silt in dams should be removed frequently so as to prevent reduction in water volume and the consequent drop in production.

2. The government should invest in other forms of energy generation such as geothermal and coal power in order to reduce overdependence on hydroelectricity.

3. Establishment of training institutions to train manpower on energy production technology. This will help produce skilled manpower to manage the power sector.

4. Power generation must be liberalized in order to attract investors with sufficient capital to invest in the industry.

5. Conducting mass education to educate people to adopt the production and use of biogas. These can be done through seminars, trade shows and mass media, among other means. People benefiting from the use of biogas may be invited to convey the message to those individuals reluctant in adopting the technology.

### **Solutions to Problems Facing Power and Energy Harnessing in Focal Countries**

*Propose solutions to problems facing power and energy harnessing in focal countries*

### **Solutions to problems facing solar and wind power in the USA**

1. Alternative sources of energy have been developed to supplement solar and wind power.
2. People must be taught about the benefit of wind and solar power in order to persuade them to switch from traditional to modern energy sources.
3. Government support as well as partnerships has enabled the setting up of power stations for wind and solar energy exploitation.
4. The government must provide subsidies to solar and wind research and development as it is doing to conventional technologies.

### Lessons from Countries for Better Harnessing of Power and Energy Resources in Tanzania

*Draw successful lessons from countries for better harnessing of power and energy resources in Tanzania*

As far as energy production is concerned, Tanzania has a lot to learn from the USA. The following are some of the lessons that can be adopted and implemented:

1. In USA, the energy sector is liberalized, so many private companies are allowed to generate and sell energy and power. Tanzania should also copy USA's example by allowing more private investors to participate in energy and power generation rather than allowing TANESCO to monopolize the energy production.
2. The USA has diversified its energy and power industry very well. The country generates power from different sources, ranging from nuclear to biogas plants. Tanzania can do the same by using natural gas, coal and uranium discovered in various parts of the country to produce the highly demanded power to boost her economy.
3. The government should form agencies to address the generation of solar and wind energy. There is great potential of wind and solar energy in Tanzania because of the presence of suitable conditions for harnessing these power recourses. There is plenty of wind and sunlight in the country to allow sustainable production of wind and solar energy, which can then be fed to the national grid to help solve the problem of energy in the country.

4. The government should support the development of various energy sources by providing funds to local companies as well as creating favourable investment conditions to multi-million energy production companies to invest in the energy generation sector.

5. The USA uses her own experts to develop the energy industry. Tanzania should also train her own people so that they can take active part in building energy generation projects rather than depending on skilled personnel from outside the country.

# TRANSPORT

Transport can be defined as the movement of people, animals, goods or services from one place to another. It provides a link between different parts of the country, region or world. People move from one place to another, either permanently or temporarily for various reasons.

## Main Types of Transport

### Main Types of Transport System at Global and East African Level

*Describe the main types of transport system at global and East African level*

Types or modes of transport refer to the means by which people, goods, animals or services are moved from one location to another. There are three broad modes of transport. These include:

1. **Land transport:**(i) Human transport (ii) Animal transport (iii) Road transport (iv) Railway transport (v) Pipeline transport
2. **Air transport**
3. **Water transport**

Each of these types of transport will be discussed in details below.

## Land transport

This is a kind of transport that takes place on land surface. Categories of land transport include the following:

### Human transport

Human transport or human portage is the transport of people and/or goods using human muscle power, in the form of walking, running and swimming. This is the old means of transport that is still used today by majority of the people in various parts of the world. Human transport involves people carrying light goods from one place to another. They carry goods on their heads, backs, and shoulders or hold them in their hands. Sometimes movement of goods can be enhanced by use of machines such as wheelbarrows, hand carts, or trolleys.

Commercial human transport, where people, called porters, are paid to carry goods, is common in less developed countries. Human transport remains popular for reasons of cost saving, leisure, physical exercise and prevention of pollution (by refraining from the use of motor vehicles which release fumes that pollute the environment). It is sometimes the only type of transport available especially in undeveloped or inaccessible places, such as mountainous or swampy areas.

Although humans are able to walk without infrastructure, the transport can be enhanced through the use of roads, especially when using human power with vehicles, such as bicycles and carts.

### **Advantages of human transport**

1. **Availability:** It is a means of transport that is readily available all the time. It may also be the only means available where other forms of transport cannot be used.
2. **Cheap:** Human transport is cheap and affordable than any other form of transport. It can be used anywhere and by everybody. Where the owner transports his/her own goods, no costs are incurred.
3. **Safety:** It is safer than road, air or water transport because few accidents occur during transportation.
4. **Flexibility:** Human transport can be used to transport different types of goods to various places in urban and rural areas. It is convenient as it is not affected by congestion.
5. It complements other forms of transport like road and railway transports. When goods arrive at destination, it has to be carried to places where it can be transported by other means of transport. This includes moving goods to warehouses, stores, onshore, or across areas inaccessible by vehicles.
6. Human transport does not pollute the environment as it does not involve the release of gases as compared to other forms of transport. It causes little or no noise, emits no smoke and spills no oil.

### **Disadvantages of human transport**

1. It is extremely slow and laborious.
2. It depends on the physical fitness of the person. When sick or injured, transport cannot be undertaken. Thus, it is severely curtailed by sickness or injuries.

3. It is not suitable for carrying heavy and bulky goods. It is not also convenient for carrying goods over long distances. This transport is only suitable for carrying light goods over short distances.

### **Animal transport**

This is the use of animals for movement of people and goods. Animals have been used as means of transport since ancient times. This kind of transport was used to back up (support) human transport, especially when the goods and people were to be moved over long distances.

This form of transport is commonly used in areas where other means of transport are hard or difficult to use. The animals commonly used include donkeys, mules, horses, camels, oxen, elephants, water buffaloes, lamas and dogs.

Animals that carry goods on their backs are referred to as *pack animals* whereas those that transport goods by pulling are referred to as *draught animals*, *draft animals* or *beasts of burden*. Humans may ride some of the animals directly, use them as pack animal for carrying goods, or harness them, alone or in teams, to pull wheeled vehicles.



*Animal transport*

Animal transport has the same advantages and disadvantages as human transport. However, its advantages over human transport include the following:

1. It is faster than human transport.
2. It can be used to carry heavier and larger loads over long distances.
3. It can be used in places with adverse (harsh or hostile) conditions which humans cannot withstand e.g. in deserts and water-logged places.

### **Road transport**

A road is an identifiable route, way or path between two or more places. Roads are typically smoothed, paved or otherwise prepared to allow easy travel.

Road transport is most common on land and reaches even the most remote areas. It involved the use of various vehicles such as motor cars, buses, trucks, motorcycles, bicycles, carts etc. It is one of the most important means of transport and is crucial to the development of commerce and industry. All the movement of goods begins and ultimately ends by making use of roads. Roads act as an important feeder to the other modes of transport such as railway, water and air transports.

Roads are constructed and owned by the local or central government. They play a big role in the economic development of many countries. This can be proved by the fact that the highly developed nations in the world have the best road networks. This is because roads facilitate the movement goods and people, thus boosting trade and commerce.

Though road transport has some limitations, it is necessary in the development of commerce and industry. It plays a very significant role in the economic development of a country.

### **Advantages of road transport**

There are numerous advantages of road transport in comparison to other modes of transport. **Advantages of road transport include the following:**

1. Road transport requires much less capital investment as compared to other modes of transport such as railways and air transport. The cost of constructing, operating and maintaining roads is cheaper than that of the railways. Roads are generally constructed by the government and local authorities and only small revenue is charged for the use of roads.

2. It involves different types of vehicles and hence gives the person a wide freedom to choose the kind of transport to use. One can use a bus, lorry, truck, etc, depending on the weight and bulkiness of goods to be transported.
3. Road transport is most suited for carrying goods and people to and from rural areas which are not served by rail, water or air transport. Exchange of goods between large towns and small villages is made possible only through road transport.
4. Road transport has a great advantage over other modes of transport for its flexible service. Its routes and timings can be adjusted and changed to individual requirements without much inconvenience. One of the outstanding advantages of road transport is that it provides door to door or warehouse to warehouse service. This reduces cartage, loading and unloading expenses.
5. It is more economic and quicker for carrying goods and people over short distances. Delays in transit of goods on account of intermediate loading and handling are avoided. Goods can be loaded direct into a road vehicle and transported straight to their place of destination.
6. As the intermediate loading and handling is avoided, there is lesser risk of damage, breakage etc. of the goods in transit. Thus, road transport is most suited for transporting delicate goods like chinaware and glassware, which are likely to be damaged in the process of loading and unloading.
7. As compared to other modes of transport, the process of packing in motor transport is less complicated. Goods transported by motor transport require less packing or no packing in several cases.
8. If the goods are to be sent immediately or quickly, motor transport is more suited than the railways or water transport. Water transport is very slow. Also much time is wasted in booking the goods and taking delivery of the goods in case of railway and water transport.
9. Road transport not only requires less initial capital investment, but also the cost of operation and maintenance is comparatively less. Even if the rate charged by motor transport is a little higher than that by the railways, the actual effective cost of transporting goods by motor transport is less. The actual cost is less because motor transport saves in packing costs and the expenses of intermediate loading, unloading and handling.



10. Road transport is a feeder to other modes of transport. The movement of goods begins and ultimately ends by making use of roads. Road and motor transport act as feeders to the other modes of transport such as railways, ships and airways. Goods are normally transported to and from airports, ports, or railway stations by road.

11. Roads can be constructed, developed or maintained while they continue to be used. This is unlike railways, airports or sea ports which have to await full construction before they can be used.

### **Disadvantages of road transport**

In spite of various merits, road transport has some serious limitations. The following are some of these limitations:

1. Motor transport is not as reliable as railway transport. During rainy season, earthy roads become unfit and unsafe for use. Heavy rains may also cause flooding and cut off some sections of the road making it impassable.

2. There are more chances of accidents and breakdowns in case of motor transport. Thus, motor transport is not as safe as rail, air or water transport. This is especially because of reckless driving, defective vehicles, overspeeding, overloading and poor states of some roads, among other reasons. The accidents cause loss of life and damage to goods.

3. This mode of transport is unsuitable and costly for transporting heavy and bulky goods over long distances. Vehicles can only carry a limited number of people and amounts of goods compared to ships or trains which carry heavy loads. Where transport involves carrying bulky and heavy goods, then water or railway transport would be a better option.

4. The speed of motor transport is comparatively slow and limited compared to air transport.

5. Goods transported by road face the risk of being stolen by robbers while on transit. Most of such incidences occur in remote and bushy areas.

6. Motor vehicles emit gases which contribute to air pollution. Also some vehicles produce too much noise which pollutes the air.

7. Road transport face the problem of congestion (traffic jam), especially during peak hours. People traveling by road may waste much time and fuel in jams as the vehicles take long time to reach desired destinations.

8. The road transport is comparatively less organized. More often, it is irregular and unreliable. The rates charged for transportation are also variable and unequal.

### **Railway transport**

This is a means of transport that involves the movement of people, goods or services from one place to another via rails and trains. Railway transport is capable of carrying many passengers and cargo per single trip as compared to road or air transport.

Railways in East Africa were constructed by the colonialists mainly for carrying raw materials from the mainland to the coast for shipping overseas. Most railway lines run from the interior to sea ports in the coasts. These lines have remained intact hitherto, only that most of them have been renovated and maintained to meet and suit the current transportation needs.

The central line, formerly known as Tanganyika Railway, is the most important railway line in Tanzania. It runs west from Dar es Salaam to Kigoma on Lake Tanganyika via Dodoma. A branch leads to Mwanza on Lake Victoria.

The TAZARA Railway, also known as the Uhuru Railway or Tanzam Railway, links the port of Dar es Salaam in Tanzania with the town of Kapiri Mposhi in Zambia's Central Province. The single-track railway is 1860 km long and was built from 1970 to 1975 as a turnkey project financed by China.



*Tanzania's railway network*



## *Railway transport*

### **Advantages of railway transport**

1. The greatest advantage of the railway transport is that it is the most dependable mode of transport as it is least affected by weather conditions such as rain, fog, etc. compared to other modes of transport.
2. The railway transport is better organised than any other form of transport. It has fixed routes and schedules. Its service is more certain, uniform and regular as compared to other modes of transport.
3. Its speed over long distances is more than any other mode of transport, except airways. Thus, it is the best choice for long distance traffic.
4. Railway transport is economical, quicker and best suited for carrying heavy and bulky goods over long distances.
5. It is a cheaper mode of transport as compared to other modes of transport. More loads and a great number of people can be transported in a single trip over long distances at relatively low costs.
6. Railway is the safest form of transport. The chances of accidents and breakdowns of railways are small as compared to other modes of transport. Fewer accidents are reported in railway transport.
7. The carrying capacity of the railways is extremely large. Moreover, its capacity is flexible which can easily be increased by adding more wagons.
8. It is not affected by the problem of congestion as is the case with road transport.
9. Trains have such facilities as cafes, bathrooms and sleeping space, making long distance travel quite comfortable.
10. There are good cargo handling facilities such as cranes and fork lifts used at cargo handling stations. These save on time as well as cost.

11. Modern passenger trains called bullet trains are very fast and efficient. Travelling over 200 km/h, they cover long distances in a very short time. Such trains are common in Japan and China.

### **Disadvantages of railway transport**

Although railway transport has many advantages, it has certain serious limitations. The following are some of the disadvantages of railway transport:

1. The railway requires a large investment of capital and it takes a long time to construct. The cost of construction, maintenance and overhead expenses are very high as compared to other modes of transport. A lot of money is required to lay down the rail and all other facilities like warehouses, stations, safety, etc.
2. Another disadvantage of railway transport is its inflexibility. Its routes and timings cannot be adjusted to individual requirements. People travelling or transporting goods by railway have to adhere to time and schedule. Also railway transport cannot provide door to door service as it is tied to a particular track.
3. It involves much time and labour in booking and delivery of goods through railways as compared to road transport.
4. Railway transport (except in the case of bullet trains) is normally slow. So it is not suitable for transportation of perishable goods like milk, vegetables and meat as they can easily go bad while on transit. It is also not reliable for transportation of goods which are urgently needed like newspapers, medicines, etc.
5. Railway transport is not economical for transporting people or few light goods over short distances.
6. Railway tracks come in different gauges. Some are narrow while others are wide. If two countries use different railway gauges, then railway networks between the two countries cannot be connected.
7. Railway transport can not benefit the rural people as there are very few or no railway stations to serve these areas.

### **Pipeline transport**

Pipeline transport is the transportation of goods through a pipe. Liquid and gases are transported in pipelines, but pneumatic tubes can also transport solid capsules using compressed air. For liquids and gases, any chemically stable liquid or gas can be sent through a pipeline. Short-distance systems exist for sewage, slurry, water, milk and beer, while long-distance networks are used for petroleum and natural gas.

Pipelines are most convenient, efficient and economical mode of transporting liquids like petroleum, petroleum products, natural gas, water, milk, etc. Even solids can also be transported through pipelines after converting them into slurry.

The pipes used to build pipelines usually range between 10 cm and 120 cm in diameter. The pipelines are made of steel or plastic tubes. They are built either above or under the ground, though those built underground are difficult to detect and repair in case a leakage occurs. The oil or gas is moved through the pipelines by pump stations along the pipeline.

The Tanzania Zambia Mafuta (TAZAMA) pipeline which runs from the port of Dar es Salaam in Tanzania to Ndola in Zambia, covering 1710 km, and the local Songogas pipeline from Songosongo to Dar es Salaam are examples of pipelines.

In Kenya, a pipeline managed by the Kenya Pipeline Company extends from Mombasa to Nairobi, covering a distance of 450 km. The pipeline transports refined petroleum products from Mombasa to Nairobi.

### **Advantages of pipeline transport**

1. Pipeline transport is not associated with environmental pollution. This can only occur if there is a leakage that is not detected and repaired in time.
2. Pipelines can be laid through difficult terrains as well as under water, making pipeline transport flexible.
3. This kind of transport is not affected by congestion as is the case with road transport. So it is the safest and fastest means of transporting fluids.
4. It needs very little maintenance. Although initial investment on pipeline construction is higher, the operation and maintenance costs are low.

5. This type of transport is not affected by adverse weather events such as floods, heavy rains, fog, etc.
6. It complements other forms of transport. For example, oil is alternatively transported in tankers via roads or water.
7. Accidents and theft are greatly reduced compared to other modes of transport, such as roads.

### **Disadvantages of pipelines transport**

1. It is not flexible when it comes to delivering the products such as natural gas and oil to ultimate consumers. The product has to be delivered through other means such as roads.
2. It is only economically viable if there is constant supply of the fluids. It is not suited for rare or occasional uses.
3. If the pipeline is not well maintained and repaired timely, leakages can occur and pollute the environment. This may lead to loss of biodiversity.
4. Pipelines are mainly convenient for transporting fluids. They are not suitable for transporting other goods, though in some cases other solids can be transported under pressure.
5. Underground pipelines cannot be easily repaired and detection of leakage is also difficult.
6. Pipelines are expensive and they take a long time and intensive labour to build. In poor, developing countries like Tanzania, the funds for construction of the pipeline may not be available, hence leading to dependence on loans and grants from donors.
7. They have fixed carrying capacities which cannot be exceeded. Pipelines have specific diameters and hence carry fixed amounts of the fluid.
8. Pipelines conveying flammable or explosive material, such as natural gas or oil, pose special safety concerns and there have been various accidents. Pipelines can be the target of vandalism, sabotage, or even terrorist attacks. In war, pipelines are often the target of military attacks.

### **Air Transport**

This is the movement of people, goods or services from one place to another through the air. It is the fastest mode of transport and involves the use of aircraft such as aeroplanes, helicopters and hot air balloons. Aviation is able to quickly transport people and limited amounts of cargo over longer distances, but incur high costs and energy use. For short distances or in inaccessible places, helicopters can be used.

There are two broad categories of air transport, namely, domestic and international. Domestic air transport involves movement of people and goods within the country while international transport involves movement of people and goods from one country to another.

Air transport is not well developed in most developing countries because of the high costs involved to set up, operate maintain the industry.

Though air transport is fast, the cost of its operation is very high and thus it is suitable for only rich passengers, mails and light and costly cargo. However, in advanced countries like U.S.A., Germany, etc. it offers a tough competition to the railways.

### **Advantages of air transport**

1. The supreme advantage of air transport is its high speed. It is the fastest mode of transport and most suitable mean where time is an important factor. It is thus suitable for carrying goods of perishable nature, which require quick delivery, and light goods of high value such as diamonds, gold, etc. over long distances.
2. It provides a regular, comfortable, efficient and quick service. Travelling by air is comfortable especially over long distances.
3. Air transport is not affected by physical barriers such as mountains, forests, lakes, rivers, etc. It follows the shortest and direct routes as these barriers do not interfere with aircraft movement.
4. It is flexible since the routes and planes can be swapped when need arises.
5. The transport is scheduled, so there is no time wasting. This enables travelers to plan their journey in advance, a fact which makes this mode of transport reliable.



6. It does not require huge capital investment in the construction and maintenance of surface track.

7. Air transport can be used to carry goods and people to the areas which are not accessible by other means of transport. It can operate even where all other means of transport cannot take place due to the floods or other natural calamities. Thus, at that time, it is the only mode of transport which can be relied upon to do the relief work and provide the essential commodities of life.

8. Air transport plays a very important role in the defence of a country. Modern wars have been fought mainly by aeroplanes. It has upper hand in destroying the enemy in a very short period of time.

### **Disadvantages of air transport**

1. It is the costliest means of transport. The fares of air transport are so high that they cannot be afforded by the common people.

2. Air transport is controlled to a great extent by weather conditions. When storms, fog, mist, snow, heavy rain or any signs of unfavourable weather conditions are detected, take off of planes is delayed, routes changed or flights cancelled.

3. In case of accidents there is very little chance of survival. Therefore it has contributed to loss of life of many people in the world.

4. Air transport is unsuitable for carrying cheap, bulky and heavy goods because of its limited carrying capacity and high transport costs.

5. It requires a large amount of capital investment in the construction and maintenance of aeroplanes.

6. Air transport requires specialized skills and high degree of training for its operation. Training of the personnel in the aviation sector is a very expensive venture. This is a problem for poor countries which are not able to train a sufficient number of personnel to keep up with the demand since training is very expensive.

7. It is relatively inflexible as it only serves places that have airports and airstrips. An exception is the use of a helicopter which can land in various areas.

8. Insecurity problems are also experienced in air transport. There are cases of hijacking and terrorist attacks.

## **Water transport**

Water transport is the movement of goods and people by means of a watercraft, such as a barge, boat, ship or sailboat, over a body of water, such as a sea, ocean, lake, canal or river. The need for buoyancy is common to watercraft, making the hull a dominant aspect of its construction, maintenance and appearance.

Water transport is the cheapest and the oldest mode of transport. It operates on a natural track and hence does not require huge capital investment in the construction and maintenance of its track except in case of canals. The cost of operation of water transport is also very less. It has the largest carrying capacity and is most suitable for carrying bulky goods over long distances. It has played a very significant role in bringing different parts of the world closer and is essential to foreign trade.

Water transport consists of:

1. Inland water transport
2. Ocean and sea transport

Inland water transport involves the transport of people and goods by rivers, canals and lakes. Ocean/sea transport involves the transport of people and goods by the oceans and seas

### **Inland water transport**

Most inland water transport takes place in lakes, navigable rivers and canals. Lakes that are major waterways in East Africa include Lake Victoria, Lake Tanganyika and Lake Albert. Navigable rivers are those that are deep, wide and slow enough for water vessels like ships and boats to sail on. There are very few navigable rivers in East Africa and Africa as a whole. Most of the rivers are not navigable throughout the year and only a small portion of their courses are suitable for navigation. Examples of navigable rivers in Africa include Rivers Nile, Zambezi, Congo, Niger, and Ogooue in Gabon. Other navigable rivers in the world include River Rhine in Europe, Rivers Indus and Ganges in Asia, and Rivers Yukon, Albany and Mississippi in North America.

Canals are channels that are made through land to allow water vessels like ships or boats to travel along. Examples of canals include the Suez Canal which connects the Mediterranean Sea with the Red Sea and the Panama Canal which connects the Caribbean Sea with the Pacific Sea. Canals in Europe include Ludwig Canal which joins River Danube to River Main, and the Dortmund-Ems Canal which joins River Rhine to the North Sea. Canals in North America have been built along the Great Lakes and include Welland Canal which connects Lake Erie to Lake Ontario.



*Suez Canal*

### **Sea and ocean transport**

Sea transport enables countries and continents to connect with sea ports in all parts of the world. Passenger and cargo liners are used in ocean or sea transport. The use of passenger liners is diminishing because of the impact of air transport. However, sea transport has been improved by refrigeration and containerization. Refrigeration enables transportation of perishable goods whereas containerization ensures there is safety and security, ease of handling and economic use of space in the transportation of goods.

Ocean transport is crucial for foreign trade. It has brought the different parts of the world closer and has knitted together all the nations of the world into one big world market. It is, obviously, the cheapest mode of transport.

Ocean transport includes:

1. Coastal shipping
2. Overseas shipping

### ***Coastal shipping***

This is one of the most important means of transport for carrying goods from one part to another in a country. It is a cheaper and quicker mode of transport and is most suitable for carrying heavy, bulky and cheap cargo like coal, iron ore, etc. to distant places. However, it can serve only limited areas.

### ***Overseas shipping***

This involves movement of goods and people from one country or continent to another country or continent. There are three types of vessels employed in the overseas shipping:

1. *Liners*: Liners are the ships which have regular fixed routes, time and charges. They are, usually, a collection of vessels owned by one person or company, i.e., a fleet. They provide a uniform and regular service. Liners sail on scheduled dates and time, whether full of cargo or not. An example of liners in Tanzania is Azam Marine Transport, which is a collection of water vessels owned by one person and operating between Dar es Salaam, Zanzibar and Tanga.
2. *Tramps*: Tramps are ships which have no fixed routes. They have no set rules, charge rates or schedule. Usually, they do not sail till they have full cargo. They can be chartered by exporters and are ready to sail anywhere and at any time. They are not as fast in speed as liners. Tramps are more suitable for carrying seasonal and bulky goods.
3. *Tankers*: Tankers are the vessels which are specially designed to carry oil, petrol and such other liquids. They have a large capacity ranging from 200,000 to 300,000 tonnes of oil, and very rarely, we may have super tankers with a capacity of about 1,000,000 tonnes of oil.

### **Advantages of water transport**

1. Water is a natural route which does not require any cost of construction and maintenance. Even the cost of construction and maintenance of canals is much less. Moreover, the cost of operation of the inland water transport is very low. Thus, it is the cheapest mode of transport for carrying goods from one place to another.
2. It is the most suitable means of transporting larger quantities of heavy and bulky goods such as coal, machinery, hardware and timber over long distances.
3. There is minimal congestion in water transport compared to road transport. Congestion can only occur at ports during loading and unloading of cargo.
4. The risks of accidents and breakdowns, in this form of transport, are very minimal as compared to any other form of transport.
5. Some cargo ships are specialized for transportation of the same type of cargo, e.g. petroleum, chemicals, foodstuffs, or animals. So the safety of cargo is ensured.
6. Water navigation facilities such as ports, tugs and lighthouses do not need frequent repairs and maintenance as compared to transportation infrastructures of other modes of transport.
7. It is suitable for transportation of fragile or breakable goods, such as glass, since there is very limited shaking and jolting on the waterways.

#### **Disadvantages of water transport**

1. Water transport is very slow and therefore this mode of transport is unsuitable where time is an important factor since it takes a long time to travel or move goods from one place to another.
2. Rivers and canals cannot be operated for transportation throughout the year as water may freeze during winter or water level may be reduced greatly during dry season. Also during heavy rains, the rivers may flood or flow too fast, making them unsuitable for navigation.
3. Modern shipping vessels are very expensive. Port construction, as well as purchase of loading and unloading machinery is also expensive. As such, a lot of capital is required to effectively operate water transport systems.

4. Water transport system cannot be constructed anywhere. It can only be done in a limited area which is served by water bodies.
5. The inland water transport by rivers is unreliable and sometimes the river changes its course which causes diversion in the normal route of the river.
6. There is sometimes a problem of strong winds and storms, which greatly interfere with the shipping schedule.
7. Some water bodies are infested with dangerous animals such as crocodiles, hippopotamuses and snakes, which can endanger the lives of people sailing through water.

## Importance of Transport

### The Importance of Transport in Tanzania and East Africa

*Explain the importance of transport in Tanzania and East Africa*

The following is an outline of the importance of the transport industry in East Africa:

1. **Source of employment:** The transport employs many people in different fields. People are employed in the construction of infrastructures such as roads, railways, airports, ports, railway stations, and many other transport facilities. Yet a good number of East Africans are employed directly as drivers, conductors, pilots, cabin crew, captains of ships, mechanics, traffic controllers etc. These people are directly engaged in the transportation business. By supporting other sectors, such as trade and commerce, it also offers employment to many other people. These people include those working in automobile manufacturing industries, petroleum production and sale, and manufacture of various products used in the transport sector.
2. **Promotes trade and commerce:** The transport sector aids the movement of goods and services. As such it promotes trade and commerce by facilitating the movement of these tools of trade from production areas to consumers.
3. **Promotes unity and understanding:** Transport enables people from different places or country to travel and interact. This improves understanding and unity between people of different ethnic groups within the country or people of different races and cultures from different countries. This helps to create a better understanding and it eliminates any enmity between or

among different people. This has led to good relationship between and among different countries in the world.

4. ***Facilitates exploitation of natural resources:***A sound transport network linking areas with natural resources such as minerals, forests and water facilitates exploitation of these resources because they can be easily transported from their deposits or sources to consumers or to industries for processing.

5. ***Encourages the development of industries:***Transportation encourages the development of other industries. For example, enhanced transport of agricultural produce from rural areas leads to growth of the primary industries such as food processing and lumbering industries. Similarly, access to mineral deposits by roads, railways etc encourages the development of mineral processing industries as these industries are assured of the availability of raw materials because of a well developed transport system linking the deposits with industries. Also transport industry encourages the development of petroleum production and refinery so as to produce enough oil required for running vehicles, road construction machinery, and other machines.

6. ***Encourages development of settlements:***Normally, people like to set up settlements in places which are accessed by various means of transport. Good transport system enables people to move from one place to another or transport their goods with ease. Therefore, availability of transport services encourages people to settle in certain areas.

7. ***Source of government revenue:***The government collects revenue from motor vehicle insurances, taxes on imported automobiles and fuels, driving licences, parking fees, and tax on use and access of some transportation infrastructures such car packing fees, etc.

## Problems Facing Transport Industry

### Problems Facing Transportation in East Africa

#### *Identify problems facing transportation in East Africa*

Most transport infrastructures in East Africa are very poor. The countries in the region are very poor economically. So they allocate just a small proportion of their fiscal budgets for infrastructure development, renovation and maintenance. These countries mainly depend on donors to finance their projects. As a result many projects they plan are not implemented.

The following are some of the problems facing the transport industry in East Africa:

1. **Lack of capital:**The development of the regional transport network has mainly been hampered by insufficient financial resources. A great deal of capital is required to lay down good transportation infrastructures. Likewise, vehicles are very expensive to purchase and operate. Because East African countries are among the poorest countries in the world, they cannot afford to construct good infrastructures to improve the transport sector.
2. **Lack of skilled labour:**The countries have not invested adequately in development of skills among labour. There is a lack of skilled labour to engage in the transport sector which includes construction of infrastructures, repair and operation of machinery etc. The training of labour in the industry, especially in air, railway and water transport is very expensive.
3. **High fuel costs:**The price of oil in the world market is persistently escalating. This makes operation of the transport sector even more costly. Increase in the price of fuel leads to rise in costs of transport and it also affects other sectors of the economy. This makes transport and other sectors expensive and thus unaffordable to most East Africans.
4. **Political problems:**Political instability affects the transport industry severely. During chaos most of the economic activities cannot be carried out and the transport infrastructures and other public goods may be destroyed by enemies. There has been political instability in countries like Burundi, Rwanda and Somalia. This has not affected transport in the respective countries alone, but also the rest of the countries in the region. Uganda and, to some extent, Kenya have also been in political turmoil in the past. During war, the countries cannot invest adequately in transport sector as much capital is spent on the purchase of weapons and other security gears.
5. **Landlockedness:**Many countries in the region are landlocked, so they use other countries' sea ports to export and import goods and services. In case of any misunderstanding between these countries, transport is curtailed severely. Uganda, Rwanda and Burundi are landlocked countries. They rely on ports of other countries such as Mombasa and Dar es Salaam to export and import their goods to and from overseas.
6. **Impassable waterways:**Very few lakes and rivers in East Africa are navigable. Most rivers are interrupted by cataracts, waterfalls and rough beds, so they are not ideal for navigation. Only small sections of rivers are navigable all the year round. Some waterways contain floating vegetating such as water hyacinths which clogs the water ways making them impassable.
7. **Thick vegetation:**A large part of East Africa is covered with dense vegetation. This hinders transport in two ways:-First, construction of roads, railways and airports in such places is



very expensive. This is due to extra costs incurred in clearing the vegetation. Also areas covered with forests are associated with heavy rainfall, making them unsuitable for infrastructure construction. Secondly, the thugs and robbers prefer to hide in thick forests in order to waylay, attack and rob passengers of money and other properties. Travel through places like that may be so dangerous and is often avoided especially during the night.

8. ***Rough terrain:*** Mountainous and rugged terrain of East Africa makes construction of roads, railways, airports and pipelines very difficult and expensive.

9. ***Differences in railway gauges:*** The railway lines in East African countries are of different gauges. Also the width of the tracks differs. This makes it impossible for countries to be connected with railway transport.

10. ***Corruption and embezzlement:*** Due to notorious bribery and other forms of corruption in East African countries, the transport infrastructures are often constructed below standard such that they wear out quickly within few years of operation. This is because the little funds set aside for construction of various infrastructures are very often embezzled by greedy government officials for their own benefits. Tanzania is the best example where many corruption scandals are reported each year.

## The Measures to Address Transportation Problems in Tanzania

*Explain the measures to address transportation problems in Tanzania*

**Measures taken to address the problems of transport industry in Tanzania include the following:**

1. Government officials involved in corruption scandals pertaining to embezzlement of funds allocated for construction of transport infrastructures should be heavily punished. They should be jailed and their properties confiscated by the government for the public interest.

2. The country should put more efforts to collect revenue and seek assistance from donors to assist in infrastructure construction. Also the revenue collected must be spent wisely.

3. Training of manpower in various fields of transportation sector like pilots, cabin crew, mechanics, civil engineers etc will help to produce skilled labour needed in the transport industry. This can be achieved by introducing transport-related courses in schools, colleges and universities.

4. Formulation of policies and laws that promote the development of the transport industry. This will attract both local and foreign investors to invest in the transport industry.
5. Fluctuation in oil prices affects the transport industry significantly. When the oil prices go up the transport costs also rises. This problem can be solved by keeping sufficient oil reserves so that when the prices shoot up the industry is not affected.
6. The transport industry should keep pace with advancements in technology of the transport sector in order to increase efficiency and reduce accidents. The government should formulate policies that ensure maintenance of the level-playing field for all investors. It may also consider tax relaxation for local investors.
7. The East African countries should build railway lines with the same gauges and trucks so as to ensure connectivity with all countries in the region.