

and energy production challenges, they include the following:

**Desilting of dams:** Regular removal of silt (desilting) from the dams is recommended to maintain the necessary depth for power generation. If desilting is ignored, the decreased depth of dams may affect the production of HEP since the storage capacity of the dam is severely reduced.

**Alternative energy sources:** Alternative sources of energy such as solar energy should be used to reduce the effect of pollution caused by the use of fossil fuels and fuelwood.

**Environmental conservation projects:** The establishment of power and energy production projects should go hand in hand with environmental conservation projects such as afforestation, reforestation and proper waste management.

**Community awareness creation:** Environmental conservation education should be provided to the people. Such education will encourage community members to report and take permanent or temporary measures in the utilisation of power and energy to avoid endangering the environment.

**Research on power and energy:** There is a need for governments to invest comprehensively in research on power and energy resources to identify different sources of power and efficient use of the existing energy resources.

**Technology:** Environmentally friendly technologies for power and energy production should be developed.

### Activity

Visit a nearby HEP station and study the processes involved in the production of power and then:

- (i) Identify and list the favourable conditions that determine the location of the HEP station.
- (ii) In groups of five, discuss and list the challenges that face HEP production in that HEP station.

### Focal study

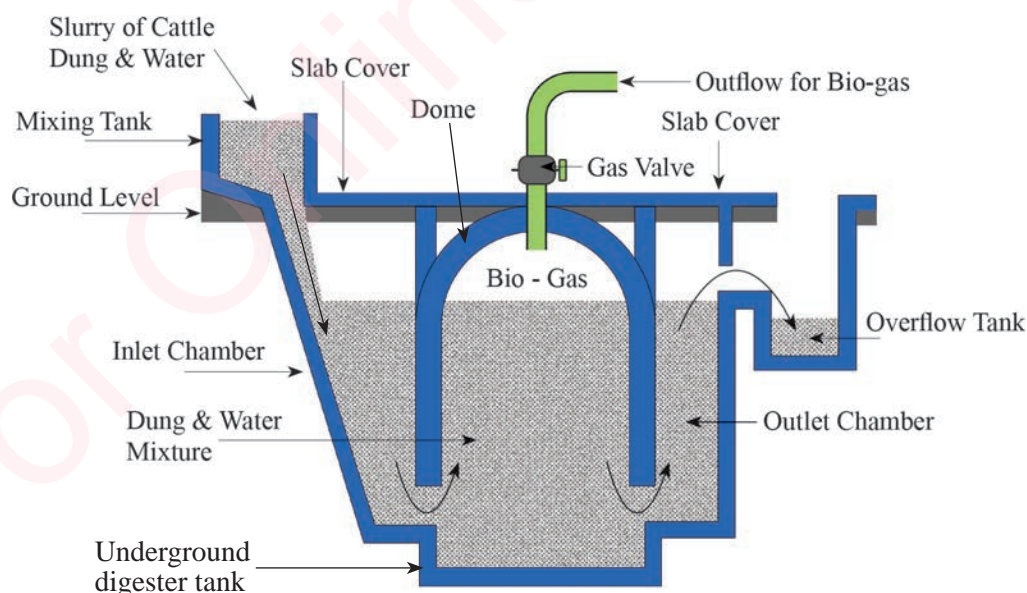
**Hydro-electric power and biogas in Tanzania:** Hydro-electric power, as discussed earlier, is produced by utilising the power of fast moving water such as a waterfall. HEP is one of the main sources of power in Tanzania. In Tanzania, electricity generation depends heavily on HEP. However, this type of energy cannot be relied upon in times of drought. The government through the Tanzania Electric Supply Company (TANESCO), a parastatal organisation, manages the HEP across the country. The company produces hydro-electricity from natural waterfalls or man-made dams and supplies it to the users in the country.

The main hydro-electric power stations are Mtera and Kidatu on Ruaha River,

Kihansi on Kihansi River, Nyumba ya Mungu and Hale on Pangani River. Biogas is a renewable source of energy generated from the decay of plants and animal waste. The gases include methane and ethane. Biogas requires high initial capital in construction of a biogas plant. The major components include trench silo for storage of solid raw material; digester (decomposer) reservoir for completing biogas production; liquid manure tank for keeping fresh liquid manure; solid manure tank for keeping and adding solid manure; pipes for distribution of biogas; and power station for provision of power (Figure 8.7). Notably, production of biogas is possible in cattle rearing regions because the major raw material for the production is cow

dung. Mwanza, Tabora, Shinyanga, Mara, Rukwa, Iringa, Mbeya, Tanga, Kagera, Morogoro and Singida are cattle rearing regions and, hence, have high potential for producing biogas. Yet, biogas in Tanzania is not well developed.

In most cases, individuals and groups carry out biogas projects at a local level, for example, the Hamasa biogas project in Marimba and Majabimu in Muheza. There are also few national programmes dealing with biogas, for example, the Tanzania Domestic Biogas Programme. It is estimated that Tanzania has 4,633 verified biogas plants and 9,990 unverified plants. Overall, the country has a potential to build 20,000 institutional plants.



**Figure 8.7** Biogas power plant

*Source: Acrosystech.com*

**Importance of HEP and biogas energy resources in Tanzania**

Tanzania's major electrical energy is obtained primarily from HEP followed by natural gas. These energy sources are important to the economy of the country. HEP and biogas energy are important in many ways.

**Use at the local level:** Production of biogas requires simple technology, which can be handled by any interested person. Based on technological simplicity, biogas is prominent at local levels in Tanzania.

**Waste management:** Use of biogas enhances management of wastes mainly animal dung. All animal dung around people's homes is collected and ferried to the processing area to produce power. People with many livestock find biogas production as an effective way of keeping their areas clean.

**Reduced over-dependence on fuelwood:** The use of biogas reduces over-dependence on fuelwood as a source of energy. In areas where biogas is used, people have reduced the use of fuelwood for heating and cooking. This may in turn reduce deforestation and emission of greenhouse gases.

**Major source of electricity:** HEP is a major source of electricity, which is widely used in Tanzania. As the government centrally manages HEP by 98 percent, all the regions access it through TANESCO, a public utility company, and puts it into various uses, lighting being the main use.

**Improvement of standards of living:** The availability of biogas and hydro-electric power in rural areas has improved people's standards of living. With power, people have managed to start small projects such as welding, carpentry, and milling. Such projects have become sources of income for the people and have improved their standards of living.

**Reduction of health risks:** It is medically proven that soot breathed from household air pollution causes respiratory diseases among children. Thus, by using HEP and biogas, such kind of respiratory diseases are reduced or eradicated.

**Establishment and growth of industries:** The availability of energy, especially HEP promotes the establishment and growth of industries that, in turn, creates employment opportunities.

**Employment opportunities:** HEP and biogas energy resources create employment opportunities especially during production, transmission and distribution of electricity from HEP stations.

**Challenges to harnessing power and energy in Tanzania:** Power and energy harnessing in Tanzania faces various challenges ranging from naturally occurring to human-made ones. The following are some of the challenges facing power and energy harnessing in Tanzania.

**Fluctuation of river volume:** In the dry season, rain may be scarce or completely absent which reduces water in dams and, consequently, lowers the generation of HEP. Tanzania has been experiencing periods of power-cut particularly during the dry season because of over-dependence on HEP.

***Inadequate capital for exploration:***

Exploration of sources of power and their harnessing is supposed to be a continuous activity. However, exploration demands large injection of capital, which is not readily available particularly in developing countries. Inadequate funds for the exploration of power sources and their harnessing has been a recurrent problem in Tanzania. There is generally little or no establishment of new sources of energy. As a result, there has been over-dependence on the same sources of power and energy, mainly HEP and natural gas.

**Human activities:** Human activities such as construction and cultivation expose soil to running water. This water carries silt which is deposited in the dam causing siltation. Siltation usually reduces the capacity of dams to store water, which in turn affects production of HEP.

**Conflicts and sabotage:** Construction of dams, roads and pipelines can lead to the displacement of people. When people are displaced without being compensated for their houses and farms, conflicts and sabotage may arise. An example of such scenario is the 2013 protest by Mtwara

residents over the construction of natural gas pipeline.

**High initial investment costs:** High costs of transmission of power from its source has affected the government's efforts in transmitting power to different parts of the country. A large percentage of Tanzania is not electrified. By year 2012 statistics indicated that only 14 percent of the country was electrified, of which 12 percent was urban and two percent was rural. Access to electricity was only 18.4 percent in the same period.

**Water-borne diseases:** Construction of reservoirs and dams may lead to the occurrence of water-borne and water-related diseases such as cholera, typhoid and bilharzia. For example, statistics indicate that about 15 million people in sub-Saharan Africa live within five kilometres of large dams and more than 1.1 million cases of malaria annually are associated with these dams.

**Addressing challenges to power and energy harnessing in Tanzania:** Despite the challenges to harnessing power and energy, the following are some of the solutions to the challenges facing power and energy harnessing in Tanzania.

**Alternative sources of power:** Alternative sources of power to support the existing sources should be explored to meet the increasing power demand in Tanzania. By 2013, the annual power demand increase was between 10 percent and 15 percent. The demand for power and

energy is expected to increase because of the new industries that are to be constructed.

***Funds allocation for exploration:*** The government is required to allocate adequate funds for exploring other sources of power. Tanzania is endowed with many power and energy sources, which have not been yet harnessed due to lack of capital.

***Training of skilled personnel:*** More young Tanzanians should be trained on HEP and biogas exploration and production.

***Improvement of infrastructure:*** In making energy more accessible to all, infrastructure should be improved. Inland roads in remote areas should be rehabilitated to ease transportation of poles for the supply of electricity. Pipeline networks for natural gas distribution should also be built in various parts of the country for electricity generation.

***Community awareness creation:*** The society should be educated on the need to conserve the environment by using environmentally-friendly sources of power.

***Environmental conservation campaign:*** Various campaigns towards environmental conservation have been launched in Tanzania. Examples include the Mama Misitu campaign which was launched in Tanzania. This five-year (2011 - 2016) campaign aimed to improve community

based forest governance. When forests are protected there would be less erosion and, hence, less siltation.

## **Solar and wind energy harnessing in USA**

USA is one of the leading countries in the world harnessing energy from the Sun. Before 2008, much of the electricity was generated from other sources such as fossil fuel and HEP. By 2018, solar power accounted for 1.44 percent of the total USA electricity, generating about 58.9 terawatt-hours (TWH).

USA needs energy that is secure, reliable, protective of the environment, and able to address climate change, create jobs and improve public health. USA reduced the use of fossil fuel as a source of energy because it is expensive and not renewable. The American Government reduces the cost of solar power and increases the cost of fossil fuel to encourage use of the former. USA, as a highly developed country in terms of technology and economy, has a very high demand for power and energy for industrial and domestic use.

Solar energy is harnessed on a large-scale in the states of California, Nevada, Arizona, North Carolina, New Jersey and Massachusetts. These areas are more conducive for harnessing solar power because of the sunny climate, clear skies and plenty of land. The electricity generated is integrated into the US National Grid.



Wind energy is also used more in USA compared to solar energy. The country has a big potential of onshore and offshore winds. Wind energy is used in running large farms and industries. The leading wind energy producing centers are California, Oklahoma, Illinois and Kansas. Wind power generation and use in USA is expanding quickly. It experiences an annual growth of 25.6 percent. For example, in 2017, wind power generated 6.3 percent of electricity in the USA.

### **Importance of solar and wind**

**energy in USA:** USA finds it more economical to use solar and wind energy than other sources of energy as they have minimal environmental effects. Solar and wind energy in USA is important in so many ways.

***Environmentally-friendly:*** The production of solar and wind energy involves activities which produce less waste in the environment compared to other sources of energy. These energies, therefore, are considered to be environmentally-friendly. For example, their production reduces the emission of carbon-dioxide and other pollutants.

***Creation of employment opportunities:*** Installation and management of solar panels and wind mills require many employees. This industry generates jobs for thousands of people.

***Industrial development:*** In USA, solar and wind energy have been found to be

feasible sources of alternative energy for industrial development. The energy generated is considered cheaper than other available sources of energy such as fossil energy, HEP, natural gas and nuclear energy.

***Expansion of agriculture:*** Large-scale agriculture has been made possible by the availability of electricity from this source. The power is used in irrigation and processing of agricultural products.

***Affordability:*** Solar and wind energy are relatively cheaper for many people in USA especially those who are unable to use other sources of electricity because it is subsidised by the government. This has improved their living standards.

***Challenges facing solar and wind energy in USA:*** Although USA has a large and strong economy, it faces challenges related to the wind and solar energy sector. The following are some of the challenges.

***Solar panel efficiency:*** Most solar power panels are 10 – 20 percent efficient, as they are stationary and cannot move to capture the sun's rays. That being the case, a large percentage of the energy from the sun remains largely untapped, although the cost of solar power has decreased.

***Reliability:*** Solar and wind energy are not reliable sources of energy because sunrays and wind happen naturally and human beings can hardly control their

occurrence. The extent of solar and wind energy production will largely depend on the intensity of wind and sunrays and the technology available to tap them.

**Cost of installation:** The initial installation cost of solar infrastructures is high. US government subsidises solar installation. This enables many people interested in this energy to afford the cost.

**Transmission costs:** Although a certain amount of wind may be available everywhere, not all wind speeds are favourable to produce wind energy. There are specific sites with the potential for wind energy production. These sites are often located in remote locations far from cities, hence making transmission of energy for use expensive.

**Land use:** Harnessing wind power tends to compete with alternative uses of land. For example, a place with strong winds, which may be considered to have the potential for harnessing wind energy may also be important for industrial development. Both are important uses of the land, hence deciding on the best use of the site might not be easy.

**Noise and aesthetic pollution:** Wind power plants may produce unwanted noise from turbine blades. They may also disturb the visual aspect of the landscape. However, compared to other conventional power plants, they have relatively less negative impact on the environment.

**Addressing challenges facing solar and wind energy in USA:** The challenges facing solar and wind energy production may hinder the expected harnessing of this potential energy if deliberate efforts are not made to address them.

**Installation of wind turbines and solar panels:** Solar and wind energy depends very much on the number and quality of wind turbines and solar panels. The higher the quality of gadgets available, the more the amount of energy produced. It is, therefore, advisable to install enough wind turbines and solar panels over a wide area to increase the amount of energy harnessed.

**Research:** Research on solar and wind energy is likely to find some solutions to many challenges facing the production of energy from wind and the sun. Research may involve studying the behaviour of wind and new technologies for tapping solar energy day and night.

**Information dissemination:** Information dissemination to the public and companies on the possibilities of combining multiple energy sources to enhance efficiency should be undertaken.

**Exercise 8****A. Answer the following questions:**

1. In four points, explain the advantages of using natural gas.
2. Briefly, explain four uses of power and energy from different sources.
3. With examples, distinguish between renewable and non-renewable sources of power.
4. State five challenges facing solar and wind energy production in USA.
5. List the advantages that Tanzania can get by using solar energy.
6. Explain why wind is a renewable energy source.
7. List and locate on a map major hydro-electric power stations in Tanzania.
8. Describe how biogas energy is produced.
9. Mention the challenges facing power and energy harnessing in Tanzania.
10. Explain how challenges facing power and energy production in Tanzania can be addressed.
11. Explain why electricity is preferable to the use of fuelwood.
12. Describe the lessons Tanzania can draw from solar energy production in USA.

**B. Write True or False for each of the following statements:**

1. The generation and distribution of electric power in Tanzania is done by the Tanzania Petroleum Development Corporation (TPDC).
2. Kidatu and Kihansi are the only hydro-electric power stations in Tanzania.
3. Fossil fuel is more expensive to harness than biogas.
4. The use of solar energy in Tanzania may help to address the problem of deforestation.
5. The major source of power and energy in the USA is the Sun.
6. Human activities around rivers affect HEP production through siltation.



## Chapter

## Nine

## Transport

**Introduction**

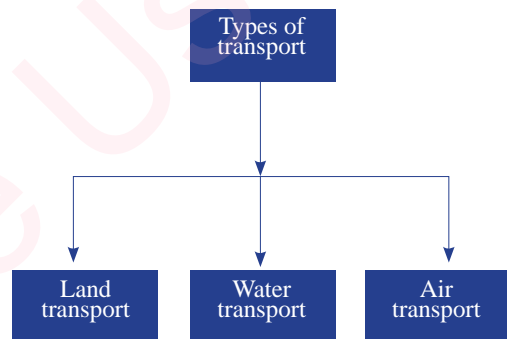
In this chapter, you will learn about types of transport systems used in different parts of the world, including East Africa, the importance of transport in Tanzania and East Africa; and the problems facing transportation in East Africa. You will also learn about measures to address the problems facing transportation in Tanzania.

**The concept of transport**

Transport refers to the physical movement of people, goods and services from one place to another. It is an important link between different parts of the world. Transport is one of the key sectors that play a crucial role in efforts aimed to achieve sustainable economic growth. The transport system ensures a balanced distribution of goods and services in different parts of the world. Transport is an important sector that enhances the socio-economic development of the world. For the transport sector to play its important role, it has to be developed and co-ordinated with the ultimate aim of bringing about a reliable, efficient, safe and environmentally-sound system of moving passengers and goods.

**Main types of transport**

Transport is categorised into land, air and water systems as illustrated in Figure 9.1:



**Figure 9.1** Types of transport

**Land transport:** Land transport involves the movement of people, goods and services from one location to another, on land. It is the most commonly used mode of transportation in the world. Land transport may further be divided into road transport, rail transport, cable transport and pipeline transport. The description of each mode of transport is provided in the sections that follow.

**Road transport:** Road transport is a means of transport that connects one place to another on the surface of the earth. It is the most common means

of transport used all over the world. Transport on roads can be grouped into the transport of goods and people. Movement along roads may be done by bike or automobile, truck, or by animals such as horses, donkeys or oxen. Cargo may be transported by trucking companies, while passengers may be transported via mass transit. Road transport is the most frequently used mode of transport in the world. It involves the use of various types of animals, vehicles, motorcycles and bicycles. Roads play a great role in socio-economic development. In most cases, the delivery of goods between cities, towns and villages is facilitated by road transport. The advantage of road transport over other modes of transport is that it even operates where other means of transport are not available.

Animal transport involves carts drawn by donkeys, camels, horses and oxen. This type of transport is common especially in places where other means of transport are not available. Animal transport is mostly used in mountainous regions and deserts to carry crops, straw, fodder and people. Luggage is packed into carts pulled by horses, donkeys and bullocks. For camels, goods are fastened to the animal. Transport of goods by road depends on the degree of development of the local infrastructure, distance, type of goods, weight and volume of the shipment. Figure 9.2 shows trucks that exemplify motor-driven transport, Figure 9.3 shows a donkey with luggage strapped onto its back and Figure 9.4 shows a man riding a cart pulled by a donkey.



**Figure 9.2** Transportation by trucks

*Source: ajot.com*



**Figure 9.3** Transportation by animals

*Source: spana.org*



**Figure 9.4** Transportation by a donkey driven cart

**Rail transport:** Railway transport is the second most important mode of transport after road transport. Rail transport involves the movement of goods and passengers on rail lines by trains. It is an important land transport mode and the most appropriate means of transportation for bulky goods over long distances. Railway transport carries many people and goods at

once compared to other means of land transport. Trains are of two main categories: passenger trains and cargo train.

Passenger trains carry both people and a limited quantity of goods, cargo trains are exclusively used for carrying goods or cargo from one place to another. Figure 9.5 shows a passenger train.



**Figure 9.5** TAZARA passenger train

*Source:* [www.zambianpolitics.com](http://www.zambianpolitics.com)

In East Africa, there are several railway lines. These include the Tanzania-Zambia Railway Authority (TAZARA) covering 1,067 km, connecting Dar es Salaam to Kipiri Mposhi in Zambia; Tanzania Railway Corporation (TRC) covering 2,600 km from Dar es Salaam to Kigoma and Mwanza; and the Kenya-Uganda line that runs from Mombasa to Kasese in Uganda covering 1,507.23 km. Also, there is a standard gauge railway under construction in Tanzania which will run from Dar es Salaam-Morogoro (300 km), Morogoro-Dodoma (426 km), Dodoma-Isaka (435 km), Isaka-Mwanza (220 km) to Isaka-Rusumo (371 km). Another railway line under construction is from Mombasa in Kenya to Kigali in Rwanda about 1500 kilometers long.

**Pipeline transport:** Pipeline transport refers to the carrying of liquid and gaseous products such as petroleum, natural gas, water and milk over long distances. For example, water supply to residential and commercial areas is distributed through a system of pipes. Pipeline transport is the most convenient and economical means of land transport especially for petroleum and natural gas, compared to road and rail transport.

A good example of pipeline transport in Tanzania is the Tanzania-Zambia Mafuta (TAZAMA) pipeline that runs from the port of Dar es Salaam to Ndola in Zambia. Another pipeline transports natural gas from Mnazi Bay in Mtwara to Kinyerezi in Dar es Salaam. Also, Tanzania and Uganda are currently constructing a trans-border pipeline known as the East African Crude Oil Pipeline that will run from Hoima in Uganda to Tanga in Tanzania covering 1,444 km. In Kenya, there is a Kenya-Uganda- Rwanda petroleum products pipeline from Mombasa to Nairobi and Eldoret. The plan is to extend it to Kampala in Uganda and Kigali in Rwanda. Figure 9.6 shows a TAZAMA oil pumping station in Tanzania.



**Figure 9.6** TAZAMA oil pumping station

*Source:* [tazama.co.zm-pumping-station](http://tazama.co.zm-pumping-station)



Other types of land transport include the use of cables and conveyor belts. Cable transport uses cable cars and ski lifts to convey passengers and goods. The run way is made up of cables or ropes. This means of transport is most appropriate in difficult terrain especially mountainous areas such as Switzerland, Poland, Austria and South Africa. Figure 9.7 shows cable transport.



**Figure 9.7** Cable transport in Cape Town, South Africa

Source: <https://img.theculturetrip.com>

A conveyor-belt is a continuous moving strip of rubber or metal mostly used in industries, airports, harbours and in mines to move objects along. It can also be called a flexible endless strip of fabric or linked plates driven by rollers to transport goods. The conveyor-belt facilitates the transportation of materials and goods over short distances. Figure 9.8 shows a conveyor-belt transporting coal in a mining industry.



**Figure 9.8** A conveyor-belt transporting coal

Source: <http://www.iconsteel.net/pages/online/applications/coal.coke.fuel>

**Air transport:** Air transport is a means of transport that carries passengers and goods through airways. Air transport facilitates integration of the global economy and provides ripe connectivity on a national, regional and international scale. It uses different aircrafts such as passenger aircraft, cargo aircrafts and helicopters. Air transport is the fastest means of transport in the world, that covers long distances within a short time. It is the most appropriate means of transportation for perishable goods. However, it is also one of the most expensive means of transport. Some of the international airports in East Africa include the Julius Nyerere International Airport and Kenyatta International Airport in Dar es Salaam and Nairobi, respectively.

Air transport is categorised into domestic and international. Domestic air transport is mainly for movement within the same country whereas an international air transport is used for carrying goods and passengers between countries. Figure 9.9 shows an air Tanzania plane.



**Figure 9.9** An Air Tanzania passenger plane

Source: [airtanzania.com](http://airtanzania.com)

**Water transport:** Water transport refers to the movement of goods and passengers on waterways through various means such as boats, steamers, dhows and ships. This type of transport takes place on dams, canals, rivers, lakes, seas and oceans. It is usually the cheapest of all modes of transport. This mode of transport is appropriate for bulky goods. There are two forms of water transport: inland and ocean water ways.

Inland transport is facilitated by ships via inland waterways such as canals, rivers and lakes between inland ports.

**Rivers:** The navigable rivers in East Africa include Rufiji, Ruvuma, Mara and Ruvu in Tanzania; Tana, Sondu Mirio and Athi in Kenya; and the Nile in Uganda. Other rivers include Rhone, Elbe, Danube and Rhine in Europe; Ganges, Indus, Hwang-Ho Yangtze Kiang and Si-Kiang in Asia; Congo, Nile, Limpopo and Senegal in Africa; and the Mississippi, Ohio and Tennessee in the United States of America. Unfortunately, most of the rivers are of limited use for navigation for the following reasons.

**Seasonal fluctuations:** The level of water in many rivers varies from one season to another. After heavy rains, these rivers tend to flood. However, during the dry season the water volume decreases, and some rivers almost disappear.

**Rapids or waterfalls:** Many rivers have rapids and waterfalls. These rapids and waterfalls may divide the river into

a number of navigable sections, for example, the Congo River.

**Short, shallow or too swift rivers waters:** Many rivers are too short, too shallow or too swift to be useful for navigation. The narrowness of the country or the size of the islands makes rivers of little navigation value; for example, rivers of Japan, Korea; Indonesia, the Philippines and New Zealand, have limited navigation value.

**Canals:** A canal is a long narrow stretch of water artificially made to enable boats and ships to travel along. Examples of canals include the Suez in Egypt, the Panama and Great Lakes of North America joined by canals with Saint Lawrence Seaway, Amsterdam - Rhine and North Sea in Netherlands and the Caledonian in England.

**Lakes:** A lake is a hollow or depression in the Earth's surface that contains fresh or salty water. Many lakes are artificial as they have been constructed to store water for HEP generation using a dam. Other lakes have been created for aesthetic, recreational, industrial, agricultural and domestic purposes. Examples of lakes in East Africa are Tanganyika, Nyasa, Kivu, Edward, Albert, Rudolf and Victoria. Others are Michigan, Erie, Ontario, Huron and Superior in North America. Figure 9.10 shows a cargo ship carrying containers whereas, Figure 9.11 shows a passenger boat.





**Figure 9.10** A container ship

Source: <http://www.imoveintl.com/container-shipping.htm>



**Figure 9.11** A passenger boat

Source: [azammarine.com](http://azammarine.com)

**Oceans:** Major ocean shipping routes in the world ocean shipping services transport more than 80 percent of all globally traded products. Marine trade contributes greatly to international trade. For example, vehicles, clothes, fuel, electronic equipment such as TV sets are carried from various manufacturing industries of the world to the market using ships. There are several shipping routes for ocean vessels to ensure a quick and safe delivery of the goods. Some of these world shipping routes are described below.

### ***North Atlantic route***

This is the busiest sea route in the world connecting the major ports of Amsterdam, London, Rotterdam, Lisbon and Oslo. These are the popular heavily industrialised parts of the world. The

route links North Eastern USA, and North Western Europe, the two most developed regions of the world. The major ports on this route are London, Hamburg, Liverpool, Glasgow, Rotterdam, Southampton, Copenhagen, Lisbon, Stockholm and Oslo.

### ***The English Channel***

This separates England from France, connecting the North Sea and Atlantic Ocean. It is today one of the busiest shipping routes on the planet. It is approximately 350 miles long. About 500 ships travel via the channel daily, hence making it a critical route in the European shipping network.

### ***Strait of Malacca***

This is the shortest route between the Pacific and Indian oceans. It links major Asian economies such as India, Malaysia, Indonesia, Singapore, Japan, China, South Korea and Taiwan. The Strait of Malacca is the world's second busiest water way with more than 83,000 vessels taking this route each year. Goods transported through this strait include coal, palm oil, Indonesian coffee and liquefied natural gas. The Malacca water ways connect the Indian Ocean and the South China Sea (Pacific Ocean).

### ***Suez Canal***

The Suez Canal is commonly known as the Highway to India. Suez Canal is a manually constructed canal which creates the shortest maritime route between the Atlantic and Indian oceans. The route stretches from the Port of Sea in Egypt, through the Mediterranean

Sea to the Port of Suez at the Red Sea, connecting Europe and Asia without navigating around Africa. It is one of the world's most heavily used shipping lanes with more than 100 vessels traversing it every day. More than 900,000 tonnes of cargo travel through the canal. Major commodities transported are petroleum, coal, metals, wood, oil seeds, cement and fertilisers.

### *Saint Lawrence Seaway*

This is the most important shipping lane in North America which connects the Atlantic Ocean with the Great Lakes. The Great Lakes and St. Lawrence River form the longest deep-draft navigation system in the world. It extends about 2,300 miles into North America and directly serves Ontario and Quebec (in Canada), Illinois, Michigan, Ohio, Indiana, Wisconsin, New York and Pennsylvania (in the United States of America). The Sea way is named after Saint Lawrence River which flows from Lake Ontario to the Atlantic Ocean. Yearly, more than 350,000 tonnes of raw materials, agricultural commodities

and manufactured products pass through this route.

### *The Panama Canal*

This is an artificial passage way designed to reduce transit time between the Pacific and Atlantic oceans. The Panama Canal connects the Atlantic and Pacific oceans across the Isthmus of Panama. The Canal is about 80 km long. More than 14,000 ships navigate the Panama Canal each year, carrying vegetable oil and fats, canned and refrigerated foods, chemicals and petroleum chemicals, lumber machinery parts and grains.

### *The Cape of Good Hope*

This route connects Europe and Africa passing by the Cape of Good Hope and Cape Agulhas at the Southern edge of Africa. It is also known as the sea route to India. It is important to the east and far west as it facilitates the transportation of tropical raw materials from Africa to Europe and the rest of the world and manufactured goods from Europe to Africa. Figure 9.12 presents major ocean shipping routes of the world.



**Figure 9.12** Major ocean shipping routes of the world

**Activity**

1. Observe the various modes of transport near your residence and list their advantages and disadvantages.
2. Visit the nearest market of your area and ask the retailers and wholesalers which mode of transport they use to transport their goods and why.
3. What modes of transport do you use in your family for different occasions?

**Importance of the transport industry in East Africa:** The transport industry is important for the socio-economic development of East African countries. The following sections explain the importance of transport in East Africa.

***Facilitating the availability of goods to customers:*** Transport makes it possible for the easy and quick movement of goods from one place to another. Thus, consumers spread in different parts of the country have the benefit of consuming goods produced at various distant places.

***Making available raw materials to manufacturers or producers:*** Transport makes it possible to carry raw materials from places where they are available, to places where they can be processed and assembled into finished goods.

***Creation of employment opportunities:*** The transport sector generates employment opportunities for drivers, conductors, pilots, cabin crew and ship captains. In addition, it creates jobs

for people indirectly in the industries that make various parts or machines and other transport equipment as well as those involved in construction and maintenance.

***Enhancing the standard of living:*** Easy means of transport facilitates large-scale production of goods at a low cost. It gives consumers opportunity to choose from a variety of goods. As such, transport helps to raise the standards of living for the people.

***Facilitating movement during emergencies and natural calamities:*** During crises, such as war or internal disturbances such as earthquakes, floods and fire outbreaks, transport helps to quicken the movement of troops and relief supplies needed in the rescue operation.

***Helping labour mobility:*** Transport helps in providing mobility to workers. It facilitates movement of workers from one country to another country, to work in different economic sectors.

***Promotion of international relations:*** Transport facilitates the movement of people from one country to another. It helps promote the exchange of cultures, views and practises between people of different nationalities. This exchange brings about greater understanding among the people and awareness about different countries and their cultures. Thus, it helps to promote a feeling of international brotherhood. Figure 9.13 shows main roads and railway lines in East Africa.



Figure 9.13 Road and Railway line transport network in East Africa



**Advantage and disadvantages of the transport sector:** All means of transport have advantages and disadvantages depending on the needs at a given time. Road transport is flexible and quick, and it can connect many places. Likewise, construction and maintenance of roads is cheaper than railways.

Railway transport has the capacity to carry both heavy and bulky goods as well as passengers. The standard gauge railway train is faster and saves time too.

Air transport is fast and suitable to use, and it cannot be affected by physical barriers.

Apart from having advantages the transport sector also faces disadvantages. For example, air transport is very expensive and it needs trained and skilled personnel. In addition, it depends a lot on the weather of the day; if the weather is bad the journey can be postponed.

Pipelines are expensive to develop and they are selective in transporting goods. Only fluid materials and natural gases are transported via pipelines.

Railway transport is not flexible and it takes long to reach the destination. For example it takes almost three days to reach Kigoma from Dar es Salaam.

Vehicles emit gases which are harmful to living organisms and the atmosphere. Their mobility can also be easily affected by weather conditions, especially during

the rainy season when many roads in the rural areas become impassable.

**Challenges facing the transport industry in East Africa:** The East African governments have made efforts to develop an adequate, safe, secure and affordable transport system that is aimed to eradicate poverty and bring about sustainable development.

Despite these concerted efforts, the transport sector experiences several challenges and constraints as discussed in the subsequent sections.

***Inappropriate national policies and their limited implementation:*** The transport industry suffers from inappropriate and badly-formulated policies which in turn slow down the implementation of sub-regional and regional agreements. In addition, these countries lack policies that allow and promote private sector participation in transport infrastructure development and operation.

***Liberalisation and privatisation in rail, air and maritime transport are still in their infancy:*** Efforts to harmonise policies and regulations pertaining to cross-border movement of goods, services and people have yet to become effective. Therefore, the East African countries have not fully implemented agreements aimed to facilitate cross-border movement of goods and passengers.

***Lack or poor transport network connectivity:*** The transport sector in East Africa suffers from a poor transport



network which is characterised by several missing transport networks in each country and between countries. As a result, the majority of rural population live without access to markets and essential economic and social services. In addition, a large proportion of the transport network is also in poor state.

***Inadequate human and institutional capacity:*** Although the number of workers in East African public transport enterprises and agencies is relatively high, the availability of skilled personnel is limited in most transport organisations. In addition to lack of adequate skilled human resources, institutions also lack people with appropriate knowledge and skills to plan, and manage infrastructural development and services.

***High transport costs:*** East Africa is one of the regions with the highest transport costs in the world. Transport services are unaffordable to many African citizens.

***Poor transport safety and security:*** The prevailing poor road safety remains a serious challenge in East Africa. Accidents and the resulting loss of life and destruction of property have assumed intolerable proportions. A major weakness in this area is associated with lack of responsible personnel for road safety. In many cases, the major constraint common to all the weaknesses identified in the management of road safety is the lack of adequate financial resources. The poor safety record of many East African airlines is another area of major concern in Africa.

***Poor transport information systems:*** Statistical information is a key input at every stage of the development process, including planning and implementation of programmes and projects. Adequate and well-organised statistical information provides tools for making informed decisions in identifying gaps, formulating policies and strategies, developing effective investment programmes and in effective monitoring and evaluation. However, in East Africa, the availability of such data is limited and poorly organised. Likewise, despite the importance of Information and Communication Technology (ICT) the transport sector has not taken full advantage of the technology due to lack of a proper policy for ICT development and integration in transport.

***Limited financial resources:*** Despite efforts made by East African governments and international and domestic development partners to mobilise financial resources for investing in transport infrastructure and maintenance of the existing facilities, huge gaps remain between the demand and supply of resources. Sustainable transport development requires huge financial outlays to build infrastructure, and provide energy-efficient and environmental-friendly transport equipment, among others.

**Measures to address transport challenges in Tanzania:** Tanzania needs to take several initiatives in a bid to address the transport challenges facing the country. Such initiatives should focus

on policy, strategy, resource mobilisation and capacity-building. The initiatives aim at translating policies and strategies into action. The following sections present some of the measures aimed to address the identified challenges.

***National policies and sub-regional and regional agreements:*** Tanzania has to demonstrate its commitment in improving the domestic investment environment by taking necessary steps. The actions need to target full liberalisation of the transport sector to attract investors, and strengthening the regulatory and enforcement mechanisms. In addition, improving co-ordination in developing and implementing regional and sub-regional agreements on transport facilitation and air transport liberalisation should be seriously considered.

***Human and institutional capacity building:*** Efforts should be directed towards institutions to ensure that they have appropriate mandates and are staffed with highly motivated and skilled human resources. These measures should involve key elements in the development of a safe, secure, affordable and environmentally-sound transport system. Also, responsible authorities need to develop and implement capacity building programmes to upgrade the knowledge and skills of staff involved in policy formulation, planning and implementation as well as those engaged in regulatory and enforcement functions.

***Environmental Impact Assessment (EIA):*** The development of a sustainable transport system, requires carrying out an environmental impact assessment. This assessment should be incorporated into the infrastructure development plans of the country. In this regard, any plan for transport construction should undergo EIA processes before approval.

***Energy efficiency and transport cost:*** Transport services in Tanzania are associated with high costs due to inadequate and poor infrastructure, poor transport facilities as well as limited competition.

***Transport safety and security:*** The government of Tanzania needs to plan for initiatives aimed to improve safety in all modes of transport. This can be done by establishing effective institutional frameworks and strengthening the existing frameworks to manage traffic and ensure safety. Moreover, there is a need to ensure compliance with safety and security regulations and standards established by relevant local, international and regional authorities.

***Transport information systems:*** Given the high demand for the use of information in the transport sector and inadequacy of necessary information in the country, Information and Communication Technology (ICT) offers a powerful tool for accessing, processing and disseminating large volumes of information in the shortest time possible.

**Financial resources:** Despite the efforts made by the government to allocate funds for transport development, the amount is far below what is actually required to finance and maintain the existing transport network. Thus, there is a need to engage the private sector in infrastructure development. The involvement of the private sector in infrastructural development and operations can help ease public resource constraints. The private sector has the potential of enhancing the productivity and efficiency of infrastructure services. This calls for improving the investment climate by updating institutional and regulatory frameworks and reducing bureaucratic procedures and practises.

### Exercise

#### A. Answer the following questions:

1. Explain what you understand by the term 'transport'.
2. Identify the main types of transport in the world.
3. Describe types of land transport.
4. Mention any five major ocean routes in the world.
5. Mention three railway lines found in East Africa.
6. List any five benefits of transport systems in East Africa
7. Mention any five challenges facing transport systems in East Africa.
8. Suggest what should be done to address the challenges facing the transport sector in Tanzania.

#### B. Write **True** or **False** for each of the following statements:

1. Air transport is the fastest mode of transport.
2. Air transport is not affected by adverse weather conditions.
3. Air transport is not suitable for short distances.
4. Helicopters are generally used for international flights.
5. Air transport does not provide any support to national security.
6. Railway transport is well connected to all regions of Tanzania.
7. Water transport is mostly used to transport goods.

## Glossary

<b>Afforestation</b>	The process of planting trees, or sowing seeds in a barren land devoid of any trees, to create a forest.	<b>Desertification</b>	A process through which fertile land becomes desert, as a result of drought, deforestation, or inappropriate method of farming.
<b>Agriculture</b>	Cultivation of crops and rearing of livestock.	<b>Distributaries</b>	Streams which split away from the main channel and never re-join the channel.
<b>Aquifer</b>	An underground layer of water-bearing permeable rock, rock fractures or unconsolidated materials.	<b>Ecology</b>	A study of the ecosystem with particular reference to the relationship between plants and animals and the environment.
<b>Biofuel</b>	Fuel that is derived from biological materials, such as plants and animals.	<b>Ecosystem</b>	Group of plants and animals that work together to remain healthy.
<b>Biogas</b>	Form of biofuel energy whereby methane gas is obtained from decomposing biomass.	<b>Eco-tourism</b>	Tourism directed towards exotic, often of threatened natural environment, intended to support conservation efforts and save wildlife.
<b>Biomass</b>	Total amount of organic material.	<b>Energy</b>	The capacity to do work.
<b>Bush fallowing</b>	Letting the land idle from time to time to maintain the fertility of the soil.	<b>Footloose</b>	Are industries whose location does not rely on the location of raw materials or the cost of transporting them.
<b>Dairy farming</b>	The rearing of livestock for the production of milk.	<b>Fossil</b>	Fuel formed by a natural process, such as anaerobic decomposition of buried dead organisms that lived a million years of age.
<b>Deforestation</b>	Removal of forest cover due to cutting or burning of trees.	<b>Fossilisation</b>	The process by which a fossil is formed.
<b>Delta</b>	Triangular tract of sediment deposited at the mouth of a river, where it diverges into several outlets.		
<b>Desert</b>	Dry, barren area of land, that is characteristically desolate, waterless, and without vegetation.		

**Forest** Large area dominated by trees.

**Forestry** The science or practise of planting and managing forests.

**Geothermal energy** Heat energy generated from the interior of the earth.

**Glacier** A mass of ice formed through the accumulation of snow for a long period of time.

**Global warming** A gradual increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect.

**Habitat** A particular environment in which one species of a plant or animal lives.

**Herbicides** Chemicals used to control or prevent weed growth.

**Human activity** Anything done (either economic or social), as a way of life.

**Industrialisation** The move from an economy dominated by agricultural production to one dominated by manufacturing.

**Infrastructure** A set of interconnected structural elements that provide a framework for supporting development processes.

**Intercropping** The practise involving growing of two or more crops in the same field.

**Irrigation** The artificial application of water to the land or soil for agricultural production.

**Land degradation** A process in which the value of the biophysical environment is degraded through a combination of human- induced processes acting upon the land.

**Land reclamation** A process of improving or recovering of new land for human use.

**Livestock** Domestic animals, such as cattle or horses, raised for home use or for sale.

**Lumbering** A process of cutting trees for making timber for transport and sale.

**Mining** The extraction of minerals from the earth's crust.

**Monoculture** An agricultural system in which the cultivation of a single crop dominates.

**Nomadic pastolarism** Livestock-keeping in which the farmer keeps on moving from place to place in search of pasture and water.

**Overgrazing** Keeping large herds of animals on the land or for a long time, which degrades the land.

**Pervious rocks** Rocks that allow water to flow along cracks or joints.

**Pesticides** Chemicals used to prevent diseases or kill pests which attack plants and crops.



**Pasture** Land covered with grass and other low plants suitable for grazing animals.

**Pollutant** A substance that contaminates something especially water or the atmosphere.

**Power** The flow of energy at any one time, and can be generated from renewable energy resources.

**Population growth** The increase in the number of people in an area due to in-migration and natural increase.

**Radiation** The process of sending off energy in the form of light, heat, x-rays or nuclear particles.

**Ranching** Vast, extensive livestock farms usually found in remote, marginal areas.

**Reforestation** The replanting of trees in depleted forests and woodlands.

**Renewable resources** Resources which can be recovered or replaced after being used; they include hydro-electric power, tidal power, wind energy, geothermal power, solar power and biogas.

**River basin** Land that is drained by a river and its tributaries.

**Sedimentary rock** Any rock formed through compaction and cementation of sediments.

## **Slash and burn agriculture**

A farming method that involves the cutting and burning of plants in a forest or woodland to create a farm.

**Soil erosion** The washing or blowing away (by water or wind respectively) of the top layer of soil.

**Soil fertility** The ability of soil to provide nutrients for plant growth.

**Tidal wave** An exceptionally large ocean wave, especially one caused by underwater earthquake or volcanic eruption.

**Tributary** A small stream in the upper course of a river that joins another stream to form the main river.

**Vegetation** Assemblage of plants in a particular area.

**Water management** The process of effective supply, utilisation and conservation of water resources.

**Water table** The upper boundary of a saturated portion of soil or rock.

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