INDUSTRIALIZATION IN AFRICA

Industry involves transforming raw materials into finished or semi-finished goods. Industries are either heavy or light industries.

Many African countries have established industries which are at different stages of development. South Africa is the most industrialized country on the continent. Others are Egypt, Nigeria, Zimbabwe, Morocco, Ghana and Angola.

Industry in South Africa

Rapid industrialization has taken place in South Africa and the country is a major exporter of industrial goods.

Distribution of industries

The heart of South African industry today lies on the Rand (Witwatersrand) and Johannesburg is the heart of the Rand. Specifically the major industrial centres of the Rand are:

1) **Johannesburg**
   The major industries include iron and steel, manufacture of railway wagons, mining machinery, vehicles, farm machinery, textiles, electricals, chemical, furniture, and cement.
2) **Pretoria**
   This is the administrative capital of the country. The industries include iron and steel, glass, cement, cables, motor engineering etc
3) **Vereeniging and Vanderbijl park**
   This is a major coal mining, engineering, and iron and steel centre. There is also tin plate industry, manufacture of alloys.
4) **Germiston**
   This town is a home of the Rand's gold refinery. It produces metal goods, chemical, textiles and foods.
5) **Springs**

The main industries are gold and coal mining, mining machinery, food processing, electrical goods, bicycles, printing machinery, glassware, paper etc

Apart from the Rand, other industrial zones of South Africa include:

a) **Cape town**
   Major industries include food processing, textiles, vehicle assembly, chemicals, leather, printing, paper.
b) **Port Elizabeth**
   Industries include food processing, vehicle assembly, tyre manufacture.
c) **East London**
   Industries include soft drinks, furniture, building materials, textiles, vehicle assembly.
d) **Durban**
   Industries include shipbuilding, oil refinery, soap manufacture, textiles, light engineering etc

A sketch map showing the industrial regions of South Africa

Factors which have favoured industrial development in South Africa

1. Availability of a wide variety /large quantities of raw materials <u>used in industries</u> to make goods such as mineral resources, water resources, forest resources and agricultural resources.
2. Availability of various sources of power <u>to run industrial machinery</u> in form of coal, HEP from Vaal dam.
3. Availability of strong capital base/ adequate capital <u>to invest</u> in industrial development provided by the government and private investors.
4. Presence of skilled and unskilled labour <u>to work</u> in industries. The unskilled labour is provided by the blacks and migrants from neighboring countries.
5. Well-developed transport system by road, railway, water and air <u>to transport/move</u> inputs and finished goods.

6. Presence of a ready/large market for produced goods, both domestic and foreign.
7. Availability of vast land for industrial establishment and expansion.
8. Supportive/positive government policies to promote home production instead of importation/ carrying out market research/encouraging investors etc.
9. High level of technology employed to improve the quality of output copied from Japan, Europe and North America.
10. High industrial research such as on engineering technology and industrial products; to improve the quality and quantity of output.
11. Internal competition between and among industries in South Africa; which leads to high quality production.

Problems facing industrial development in South Africa

1. Shortage of water for industrial use especially in and near the Rand, which limits production.
2. Artificial raw material shortages due to strikes leading to low output/ which increases the cost of production.
3. Racial segregation causing industrial strikes/riots which limits the quality and quantity of production.
4. Competition from other industrial countries which limits the exports market for output. There is also competition from imported industrial goods which limits the local market for the industries.
5. Inadequate supply of hydroelectric power for industries which limits production.
6. Environmental pollution which undermines the quality of production/ increases the costs of production (such as purifying water).
7. Dominance of foreign industrial investors who repatriate the profits instead of investing back in the industrial sector/ limits further investment in industry.
8. Fluctuations in labour supply due to migrant nature of labour which also undermines industrial production.
9. Shortage of land for industrial expansion in the highly industrialized zones, which also limits production.

10. High taxes imposed on industrial output and industries by government which increases the costs of production.

Steps taken to solve the above problems

1. Importation of raw materials from other countries to minimize domestic shortages and increase production.
2. Use of raw material saving technology such as recycling of waste material to minimize raw material shortages.
3. Establishment of related industries which use the products of other industries as inputs, hence increase in industrial production.
4. Government efforts of sensitization of the masses against racial segregation to minimize industrial unrest.
5. Protection of local industries from foreign competition by levying higher taxes on similar goods from abroad.
6. Strengthening regional cooperation to expand the markets such as south Africa is a member of COMESA.
7. Diversification of energy sources such as nuclear energy and HEP replacing coal to increase energy supply.
8. Emphasizing treatment of industrial wastes to reduce environmental pollution.
9. Enforcing anti-pollution laws / legislation to control pollution.
10. Adopting automation of industrial activities / more use of machines to minimize labour shortage.
11. Carrying out market research and advertising to expand market for output.

Industry in Egypt

Egypt is the second most industrialized country in Africa after South Africa; and most of the industries are found in Lower Egypt.

The building of the Aswan dam provided power for expansion in industrial production. This has saved the cost of importing manufactured goods.

Major industrial centres

1) **Cairo**
   The major industries include: oil refinery, textiles, electrical engineering, iron and steel, petro-chemical, cement, food processing, sugar refining and drinks.
2) **Alexandria**
   This is the second after Cairo city. Industries include: oil refinery, textiles, salt industry, chemicals, ship building and repair, food processing.

   Other industrial centres apart from Cairo and Alexandria include:

- Helwan—with iron and steel industry expanded due to iron ore from Aswan and Bahariya oasis; textiles due to cotton growing along the Nile valley.
- Port Saidi, Giza, El Mahalla el Kubra, tenth of Ramadan, Ismailiya, Kafra and El Mansura.

A sketch map showing the major industrial regions of Egypt

Factors which have influenced the distribution/location of industries in Egypt

1. Ready /large supply of raw materials to use in industries such as cotton in the Nile delta for textiles, oil for refinery at Cairo and Alexandria.
2. Availability of large quantities of power to run the machines in industries for example hydroelectric power at Aswan and oil refining at Alexandria.
3. Presence of ready/steady water supply to use as a raw material or for cooling machines. For example water from the Nile River is used in the Delta region and along the Mediterranean coast.
4. Presence of abundant skilled and unskilled labour to work in the industries for example Cairo and Alexandria which are highly populated.
5. Availability of efficient/ improved transport network to transport raw materials to industries and finished goods to markets such as road and railway in the Nile delta region.

6. Presence of a large local market in the highly populated areas such as Cairo, Alexandria, Ismailiya, and Port Said has attracted industries/ encourages many industrial investors.
7. Availability of adequate capital for industrial investment. Many investors in industries prefer the major urban centres where capital for industrial investment is easily obtained.
8. Industrial inertia—many industries located where others exist, hence concentration of primary and secondary industries in Alexandria and Ismailiya.
9. Political stability. Areas which are politically stable attract many industries by increasing the confidence of investors such as in Cairo.
10. Availability of large / extensive land to set up industries. Many industries are located where there is available land for expansion.
11. Supportive government policy towards industrial development. The government has set aside several industrial sites in the major urban centres like cairo and Port Saidi.

Problems resulting from the establishment of industries in Egypt

1. High rate of profit repatriation due to foreign ownership of many industries, and this reduces the rate of re-investment in industry.
2. Over exploitation of resources such as minerals leading to quick depletion/ exhaustion.
3. Results into environmental pollution through dumping wastes and emission of gases, hence reducing the quality of life.
4. Results into the growth of slums due to shortage of accommodation for the many industrial workers. Slums are characterized by poor structures and poor hygiene.
5. Traffic congestion has resulted in the industrial towns, hence unnecessary delays in the movement of people and goods.
6. Results into high level of unemployment in towns due to high rural urban migration and use of capital intensive technology.
7. Results into regional imbalance in development in terms of infrastructure, since the major industrial centres are more developed.

8. Destruction of natural vegetation and swamp reclamation when clearing industrial sites, leading to environmental degradation.
9. Displacement of people to provide room for industrial establishment.
10. Reduces land for other economic activities like farming which limits the rate of economic growth.
11. Destruction of the ozone layer, leading to global warming due to emission od dangerous gases to the atmosphere.

Problems facing the industrial sector in Egypt

1. Competition from imported goods and for external markets with other industrialized countries producing relatively cheaper goods, which limits the available market.
2. Limited/inadequate raw materials for industrial development such as few minerals of importance, which limits the quantity of industrial production.
3. Limited capital to invest in industrial development, and low level of output.
4. Repatriation of profits by foreign companies which own some industries, which limits further investment in industry.
5. High cost of imported raw materials which increases the cost of production.
6. Insecurity caused by Islamic fundamentalists and the recent change of / power struggle government which undermines industrial production/ destroys industrial establishments.
7. Limited land area for industrial expansion in the industrialized cities and thus limited production.
8. Environmental pollution which reduces the quality of output.
9. Limited water supply for industrial use in many parts of Egypt which limits production.

General factors limiting industrial development in Africa

1. Inadequate capital to set up large scale industries and thus limited quantity of production.
2. Limited skilled labour to operate especially the large-scale industries, which limits the quality and quantity of output.

3. Limited market domestically due to the low incomes of the people and this discourages industrial investors.
4. Low levels of technology leading to industrial inefficiency (low quality and quantity of output).
5. Landlockedness of many countries and hence high transport costs and delays in delivery of raw materials and finished goods.
6. Underdeveloped transport routes connecting industries and market centres which discourages local and foreign investors.
7. Competition from well-developed industrial countries which limits the export market for industrial output.
8. Political instability limiting investment in industries such as DRC, Liberia, and Somalia due to reduced confidence of investors.
9. Limited industrial research and hence limited quality improvement of output.
10. Insufficient power supply to run industrial machinery and this discourages investors.
11. Limited/inadequate basic raw materials for industries, hence limiting the quantity of output.
12. High taxes imposed on industries by government, hence increased cost of production.

Strategies to encourage industrial development in Africa

1. Attraction of foreign investors to raise capital and upgrade industrial production.
2. Training more local manpower to increase the quality and quantity of industrial output.
3. Formation/ strengthening of regional integrations/organizations to expand market for industrial output.
4. Carrying out research to develop technology and increase efficiency in production.
5. Improving transport network for easy delivery of raw materials and output.
6. Carrying out market research to widen the external market for output.

7. Protection of some local industries from foreign competition by levying high taxes on similar imported goods.
8. Diversifying the sources of energy such as use of H.E.P, oil, and nuclear energy for industries.
9. Importation of some raw materials to supplement the limited domestic resources.
10. Diversification of the industrial sector to avoid over reliance on a few industrial products for exports.
11. Adopting raw material saving techniques such as recycling of scrap items.
12. Automation of industrial activities/ increase mechanization to minimize labour shortage.
13. Restoring peace and stability in various parts of the respective countries to increase confidence among industrialists.

Large-scale irrigation projects in Africa

Irrigation is the artificial supply of water to support plant growth in areas which have insufficient rainfall. Irrigation is either permanent or temporary, and it is carried in areas of insufficient rainfall and where flooding is common.

Under irrigation, the extra amount of water needed depends much on the type of crops grown, the prevailing temperature and humidity, the kind of soil and other conditions in the area.

Advantages of irrigation

a) The supply of water by irrigation is regular and reliable, where as rainfall is often seasonal or unpredictable. In the desert areas, the use of irrigation allows cultivation to take place where it could otherwise be difficult.
b) Irrigation water supplied by rivers during flood times carries much silt which adds to soil fertility and hence increasing crop yields.
c) Under irrigation, cultivation can be done all year round and not only during the rainy season. This implies better use of land.

d) In desert areas the constant flow of irrigation water through the soil helps to reduce the salinity of the soil. When the water evaporates in the fields the salt content increases.
e) Modern multi-purpose dams not only support irrigation but also help to control floods, generate power, and improve the navigability of rivers.

Note: Irrigation may involve artificial application of water permanently or temporarily. Irrigation is mainly in areas of low rainfall and where flooding is common. Irrigation is one of the oldest agricultural techniques practiced by man, although it has been done at different levels at different times. It deals with water management to enhance agricultural development.

Irrigation is majorly in the semi-desert or desert areas of Sub-Saharan Africa.

Examples of major irrigation schemes in Africa include:

- Gezira irrigation scheme in Sudan
- Richard toll scheme in Senegal
- Awash valley authority in Ethiopia.
- Irrigation on Niger river

GEZIRA IRRIGATION SCHEME IN SUDAN

The Gezira scheme is located between the Blue Nile and the White Nile, north of Sennar dam but south of Khartoum in Sudan. The region receives low and unreliable rainfall less than 500mm per annum. There was need for irrigation in order to grow crops. The Sennar dam was built in 1925 in order control water and various canals leading water to the fields were constructed.

The Gezira scheme was started in 1911 by the British and Sudan government nationalized it in 1950 and set up the Sudan Gezira board to manage it up to date. The Gezira scheme is about 480,000 hectares which was earlier set up. Later in 1962, the Managil extension was completed and farmland increased. This Managil extension is about 324,000 hectares.

There are two main canals from which thousands of kilometers of smaller channels developed on rectangular system carrying water throughout the whole scheme.

A sketch map showing the location of Gezira irrigation scheme

Organization of the Gezira scheme

The Sudan government and the Gezira board jointly own the Gezira scheme. The Sudan government provides the land and is responsible for its irrigation. The tenants (over 10,000 today) work on the land and produce crops **especially cotton**. They use the land rent-free only to work satisfactorily. There are also grow other crops for food as well as cash. These crops include: groundnuts, Dura, maize, lubia (a bean for food and cattle fodder), rice, sorghum, and sugarcane.

The Sudan Gezira board manages the processing and selling of crops, supplies seeds, fertilizers and gives advice to farmers. It also looks after the light railway system, farm machinery and distribution of profits. The income depends on the price of cotton. After all expenses have been deducted the distribution is as follows: 36%nto government, 50% to the tenants, 4% to village councils and social services, and 10% to the Sudan Gezira board.

Objectives of the Gezira irrigation scheme

- To open up more land for both settlement and farming
- To provide water for irrigation all year round.
- To modernize the economy from pastoral nomadism to settled agriculture
- To diversify the agricultural sector(to grow food crops in addition to cotton)
- To control flooding from the blue Nile.
- To encourage economic development of Sudan.

Factors which have favoured the establishment and development of Gezira irrigation scheme in Sudan

1. Availability of ready water supply for irrigation from the Blue Nile and White Nile throughout the year for growing of cotton, maize, rice, lubia, groundnuts.

2. The gently sloping landscape from the Blue Nile towards the White Nile, and therefore both irrigation and drainage can be done using gravity flow, hence low irrigation costs, and thus large-scale production.
3. The gently sloping landscape has also favoured the construction of transport network and mechanization of farming made possible such as the use of tractors.
4. Availability of vast/extensive land due to sparse population and hence a large expanse of land was put under irrigation farming.
5. Presence of fertile alluvial soils (dark brown clay soil rich in minerals) of the Gezira plain from seasonal flooding of the Nile favouring the growth of crops. However today artificial fertilizers are applied to maximize production.
6. The soils have high clay content and hence impervious to water sinking away and this saved the construction of water-proof lining (concrete channel) when canals were filled with water.
7. The land is well above the water table and so water-logging never occurs.
8. The arid climate of the area also favoured irrigation farming because there was no expensive clearing of bush/forests. (The arid climate necessitated use of irrigation so as to make the fertile land productive by supplementing the little unreliable rainfall for supporting the growing of crops like cotton).
9. Availability of cheap labour in the area to work is irrigation farming because people were already in the area cultivating poor cereals (on the mercy of rains) and herders with skinny cattle such as nomadic Dinka and Nuer.
10. Presence of skilled labour initially provided by the British and Egyptian experts who were used in the construction of the dams, canals, operation of machinery, grading, textile industries and ginneries.
11. Availability of adequate capital provided by the government and the British to set up the Gezira scheme, purchase of agricultural machinery like tractors , irrigation systems , payment of research personnel and establishment of infrastructure like labour camps ,road network.
12. Availability of large supply of electricity especially hydro-electric power generated by Sennar dam and Jabel Aulia dam(Roseires dam) for pumping water from the reservoirs into the canals / fields and running machines in the ginneries and textiles.

13. Presence of improved transport infrastructure such as the railway and triangular road network. This provides accessibility to ginneries and helps in moving inputs into the fields leading to the development of the scheme.
14. The introduction of modern machinery such as caterpillars and tractors for digging channels and large scale cultivation; multiple seed drills for large scale planting ; also gravity flow irrigation, over-head irrigation, and tank irrigation.
15. Availability of ready market for crops grown both local and foreign. There are ginneries and textile industries at Khartoum, Hasa Heisa, and export markets in Germany, Italy, UK, Japan, and India.
16. The desire to achieve self-sufficiency in food production and reduce food imports also explains the development of large-scale irrigation in Sudan.
17. Supportive/ favourable government policy such as by setting up the scheme to allow people to settle down to produce food and cash crops for economic development of Sudan and establishing the necessary infrastructure.

Contribution of the Gezira irrigation scheme to the economy of Sudan

1. Promotes agricultural modernization within the Gezira plains and throughout Sudan by enhancing highly mechanized scientific farming based on irrigation, application of fertilizers and pesticides on a large scale.
2. Increased production of both food and cash crops by the farmers such as cotton, lubia, maize, dura, and thus increased incomes to the farmers leading to a higher standard of living.
3. The scheme has promoted education and training for the people in the area such as training centres, adult education benefiting the local people to enhance farming and also improve the general welfare.
4. Generation of employment opportunities to many people on the scheme both the skilled and the unskilled labourforce such as managers, extension offcers, hence improving the standards of living.
5. Promoted development of social services such as sporting and leisure facilities, educational facilities, health facilities, piped water in many areas such as Sennar, Wadi Medani, Kosti These have resulted from the revenue accruing from the Gezira scheme.

6. Development of transport infrastructure especially within the Gezira plain for example the railway line and road net work for transporting cotton and other farm products to the factories and to the market.
7. Promoted development of the industrial sector for example the high quality cotton produced has promoted the growth of ginneries and textile industries, grain milling and fertilizer industries
8. The Gezira scheme generates foreign exchange to Sudan through the export of crops particularly cotton to the outside countries like Germany, Italy, UK, Japan, and India.
9. The scheme has promoted the growth of urban centres in the Gezira plains such as Wadi Medani, Kosti, Sennar, Hasa Heisa, and Al Husa Ayhisah by attracting a large population.
10. The Gezira scheme has also emphasized the planting of forests of eucalyptus trees and the afforestation program carries a number of benefits such as providing building wood/poles, natural beauty.
11. The scheme has promoted cooperation among the tenants and therefore cooperatives have been introduced for marketing the produce and advising farmers.
12. Promoted international cooperation between Sudan and the countries which import the products, which promotes international harmony and peace.
13. Diversification of the economy hence reducing over dependence on a few sectors like mining.
14. Promotion of the tourism sector due to irrigation canals and farmlands, hence generating foreign currency.

Shortcomings of the Gezira irrigation scheme

1. Silting of the irrigation canals since irrigation water deposits its suspension material in them and regular dredging is quite costly.
2. Salination due to the high rates of evaporation in the Gezira scheme and this has limited plant root growth, limiting yields of crops like cotton and sugarcane.
3. The reservoirs are shallow leading to flooding of farmlands and this has increased the spread of pests and diseases such as Bilharzia.

4. Displacement of people as land was being set aside for the scheme such as Dinka and Nuer nomads who used to graze their animals in the area.
5. The Gezira scheme was very expensive to undertake such as high costs of establishing farmlands, irrigation channels, dams, plus high costs of maintaining the irrigation scheme.
6. Industrial—related problems such as pollution from the ginneries, textiles, grain milling at Omdurman, Khartoum, and Wadi Medani.
7. Urban—related problems such as slum growth, alcoholism, robbery in the urban centers which have developed like Barakat, Sennar, Omdurman.

Problems facing the Gezira irrigation scheme

1. Silting of the irrigation canals and man-made lakes, leading to the flooding of farmlands. Reservoirs are shallow resulting into the flooding of crop fields.
2. Excessive evaporation due to hot temperatures leading to increased soil salinity in the central valley and thus poor yields.
3. It has encouraged the spread of waterborne diseases such as bilharzia in the central valley due to stagnant water.
4. Soil exhaustion due to over cropping leading to low land productivity.
5. Over use of farm chemicals fertilizers and pesticides leads to pollution of rivers and thus creating health problems.
6. Irrigation farming encourages the spread of water weeds such as rhizomes which compete with the crops and thus low yields.
7. High costs of production / maintaining the irrigation projects such as constant dredging of the canals; and this reduces the profit levels.
8. Fluctuations in water flow along the rivers during the dry season which leads to low yields.
9. Growth of weeds such as rygenis which compete with the crops and thus reducing yields / increases the costs of production.
10. Shortage of labour on the irrigation farmlands, which limits the agricultural activities.
11. Fluctuations in the prices of the crops grown on the world market, leading to fluctuations in incomes.

Note: Other irrigation schemes in Sudan include:

- Kenana sugar scheme (south of Sennar)
- The Rahad river scheme (for mainly cotton, grounds nuts , dura, maize and vegetables)
- Danazin scheme.

IRRIGATION FARMING IN EGYPT

More than 90% of Egypt is desert, which is divided into two by the Nile River. The Nile Valley and delta are main centres of settlement and cultivation. Less than 10% of the land area is suitable for cultivation and hence the need for irrigation.

A sketch map of Egypt showing irrigated areas

Conditions favouring irrigation farming in Egypt

1. The area is arid/ receives low and unreliable rainfall necessitating irrigation farming. More than 90 % of Egypt receives less than 250mm of rainfall.
2. Presence of extensive/ large/ vast and cheap land to establish the irrigation farms due to the low population.
3. Low incidence of pests and diseases due to hot temperatures which supports growth of crops.
4. Relatively flat landscape/ gently sloping landscape in the central valley which allows the use of machines like tractors on the farms and allowing irrigation under gravity flow.
5. Large/ constant supply of water for irrigation from the Nile river and the large oases such as Baharia, Farafra, Dakhla ; and lagoons especially in the Nile delta.
6. Presence of well-drained and fertile alluvial soils deposited during flooding to support the growing of crops.
7. Large supply of skilled labour to work on the irrigation farms such as drivers, harvesters and managers.

8. Modern technology employed on the farms such as refrigerated trucks, cold rooms, construction of canals.
9. Presence of modern transport network by railway, road, air, foe easy marketing and distribution of crops to market centres.
10. Large sums of capital to invest in irrigation farming such as purchasing farm machinery, chemicals, and fertilizers.
11. Large/Ready market for farm produce within the urban centres of Egypt and other countries.
12. Supportive/ positive government policy towards irrigation farming through giving tax incentives and encouraging farm research.
13. Formation of cooperatives which reduce the costs of production such as through collective buying of farm inputs.

Contributions of irrigation farming to the economy of Egypt

1. It has increased the production of both food and cash crops and this improves incomes / improves the quality of life.
2. Promotion of infrastructural development such as dams, roads, railway, and canals intended for easy movement, irrigation.
3. Generation of foreign exchange through the exportation of the some cash crops such as cotton to other countries, which increases export earnings.
4. Generation of more employment opportunities to the people, which improves their standards of living.
5. Promotion of industrial development by providing raw materials such as such as textiles using cotton, grain milling using grains.
6. Generation of government revenue through taxation of farming companies and workers' incomes, and the revenue is used to provide social services.
7. Facilitated diversification of the economy hence avoiding over dependence on a few sectors/ as an alternative foreign exchange earner.
8. Strengthened international relations between Egypt and other countries which import its farm products such as UK, Germany, and USA, which promotes further trade/ capital inflow.
9. Promoted growth of urban centres such as Cairo, Qena, Asyut, Aswan; and associated facilities such as recreation, hospitals, and educational facilities.

10. Promotion of crop research which develops new varieties of canes, experiments with pests and disease control, soil improvement and fertilizer application techniques.
11. Promotion of tourism development since the irrigation schemes attract many tourists, which brings in foreign currency to the country.
12. The schemes have enabled the provision of water for both domestic and industrial use.
13. Irrigation farming has converted wasteland into productive use.

Problems resulting from/ Shortcomings of the irrigation scheme

1. *Silting of the irrigation canals* as irrigation water deposits its suspension material in them. Regular dredging is necessary which is quite costly.
2. *Irrigation has led to salination* (increased saltiness of the soil) due to the high rates of evaporation in the irrigation scheme and this limits plant growth which in turn has limited yields.
3. *Some reservoirs are shallow leading to flooding of farmlands* and this has increased the spread of pests and diseases such as Bilharzia; which undermines the standards of living.
4. *Displacement of people as land was being set aside* for the scheme such as the nomads who used to graze their animals in the area. it was also costly to relocate such people.
5. *The scheme was very expensive to undertake* such as high costs of establishing farmlands, irrigation channels, dams, pumps plus high costs of maintaining the irrigation scheme—hence straining the government budget.
6. *Irrigation encourages environmental pollution such as from* the chemicals used in controlling crop pests and diseases and the emission of fumes and disposal of wastes from the processing factories.
7. *Urban—related problems* such as slum growth, alcoholism, robbery, gambling and these problems are very costly to eradicate.
8. By encouraging settlement in the formerly dry areas, *irrigation has created a problem of land scarcity.* Today there is competition for land between farmers and industrialists.

Problems facing irrigation farming in Egypt

1. Excessive evaporation due to hot temperatures leading to increased soil salinity in the central valley and thus poor yields.
2. It has encouraged the spread of waterborne diseases such as bilharzia in the central valley.
3. Soil exhaustion due to over cropping leading to low land productivity.
4. Over use of farm chemicals fertilizers and pesticides leads to pollution of rivers and thus creating health problems.
5. Irrigation farming encourages the spread of water weeds such as rhizomes which compete with the crops and thus low yields.
6. High costs of production / maintaining the irrigation projects such as constant dredging of the canals
7. Fluctuations in water flow along the rivers during the dry season which leads to low yields.
8. etc

Steps taken to improve irrigation farming in Egypt

1. Construction of water reservoirs to supply water for irrigation.
2. Reclaiming of dry land for crop farming to increase production.
3. Extension of canals and aqueducts to transfer water to the farms.
4. Practicing mixed farming to encourage interdependence between crops and livestock.
5. Specialization of farming activities and thus increase in the quality of output.
6. Constant dredging of canals to allow efficient flow of water for irrigation.
7. Carrying out market research / international cooperation to widen the export market for farm output.
8. Increasing research into better yielding, fast maturing and disease resistant varieties.
9. Hiring labour during the peak periods such as harvesting.
10. Formation/ strengthening of cooperatives to easily acquire loans to expand the farms.
11. Controlling weeds using herbicides and thus increasing the farm yields.

12. Intensive cultivation to increase the yields and thus offset the high costs of irrigation.

IRRIGATION FARMING IN SENEGAL

River Senegal forms the boundary between Mauritania and Senegal, which are West African, countries bordering the Atlantic coast. In this area, annual rainfall is about 400mm or less. However, most of the northern areas are in a desert. Therefore because of river, there was need to establish irrigation schemes to increase food production. The major schemes are the Richard toll scheme and the delta scheme. The major crops grown are maize, tomatoes, sorghum, sweet potatoes, sugar canes, millet, rice, cucurbits, and beans.

A sketch map of the Richard Toll irrigation scheme in Senegal

Conditions favouring irrigation farming in Senegal

1) The area is semi-arid/ receives low and unreliable rainfall necessitating irrigation farming.
2) Presence of extensive/ large/ vast and cheap land in the area to establish the large irrigation farms.
3) Low incidence of pests and diseases due to hot temperatures which supports growth of crops.
4) Relatively flat landscape/ gently sloping landscape which allows the use of machines like tractors on the farms and also allowing irrigation under gravity flow.
5) Large/ constant supply of water for irrigation from river Senegal and its tributaries like Doue, and Taoue
6) Presence of fertile alluvial and silt soils deposited in the area due to annual flooding to support the growing of crops.
7) Availability of large sums of capital provided by the government to construct canals, pumping stations and crop farms.

8) Large supply of skilled labour to work on the irrigation farms such as drivers, harvesters and managers.
9) Modern technology employed on the farms such as use of tractors for farming, construction of canals.
10) Presence of modern transport network by railway, road, air, foe easy marketing and distribution of crops to market centres.
11) Large sums of capital to invest in irrigation farming such as purchasing farm machinery, chemicals, and fertilizers.
12) Presence of a large market for farm produce within the urban centres of Senegal, and other countries like Gambia, Mauritania among others.
13) Supportive/ positive government policy towards irrigation farming through giving tax reductions and encouraging farm research.

THE AWASH VALLEY AUTHORITY IN ETHIOPIA

This was established by the Ethiopian government to transform an arid area into an agriculturally productive area. The valley through which the Awash River flows stretches for about 1200 km long from the mountains of Addis Ababa to Lake Abe on the Djibouti border in the Danakil desert. In this area rainfall varies year to year between 250mm and 750mm and this area was formerly devoted almost entirely to nomadic pastoralism.

This project consists of various schemes which are:

a) Wonji scheme mainly for sugar canes
b) Malka- Amibara scheme for cotton, maize, tobacco, vegetables
c) Tendaho scheme in the Danakil desert for cotton.

A sketch map showing the location of Awash Valley Authority

Factors which favoured the establishment of the Awash valley authority

1) The area is semi-arid/ receives low and unreliable rainfall (250-750mm per annum) necessitating irrigation farming.
2) Presence of extensive/ large/ vast and cheap land in the area due to the low population to establish the irrigation farms.
3) Low incidence of pests and diseases due to hot temperatures which supports growth of crops.
4) Relatively flat landscape/ gently sloping landscape in the area which allows the use of machines like tractors on the farms and also allowing irrigation under gravity flow.
5) The sunny arid climate that favours the ripening and harvesting of crops.
6) Large/ constant supply of water for irrigation from River Awash.
7) Presence of well-drained and fertile alluvial soils deposited during the times of flooding to support the growing of crops.
8) Large supply of skilled labour to work on the irrigation farms such as drivers, harvesters and managers.
9) Availability of modern technology employed on the farms such as construction of dams such as koka dam just north of wonji , Tendaho dam and Kesem dam and construction of canals.
10) Presence of modern transport network by railway, road, air, foe easy marketing and distribution of crops to market centres.
11) Availability of large sums of capital to invest in irrigation farming such as purchasing farm machinery, chemicals, and fertilizers.
12) Presence of a large market for farm produce within the urban centres like Addis Ababa and other countries.
13) Supportive/ positive government policy towards irrigation farming through giving tax reductions and encouraging farm research.

MULTI-PURPOSE RIVER DEVELOPMENT PROJECTS IN AFRICA

A multi- purpose project refers to a project set up to serve many purposes.

They are examples of how rivers can be fully used to yield benefits for that particular country. It involves a large and a man-made lake (reservoir) behind it.

Examples of multi-purpose river development projects in Africa

1) Aswan high dam on river Nile in Egypt.
2) The Volta river project(Akasombo dam)
3) Kainji dam on the Niger river in Nigeria
4) Kariba dam between Zambia and Zimbabwe on Zambezi river
5) Cabora Bassa dam on the Zambezi river (Mozambique)
6) The Orange River scheme in South Africa.
7) Lesotho highlands water project.
8) Inga dam on Congo River in DRC.

A sketch map showing the major river dam projects in Africa.

KAINJI DAM PROJECT (NIGER DAM PROJECT)

The project is located in the northwestern part of Nigeria across the Niger River at Kainji. The project was opened in 1969 and lies in a remote, thinly populated and very poor part of Nigeria. The dam is 66 meters high and 55 meters long and has produced a manmade lake behind it, known as Lake Kainji (130 km long and 1300 km^2).

A Sketch map showing the location of Kainji dam project.

Objectives of the Kainji dam project

- To generate hydroelectric power (the main aim of building the dam)
- To control flooding of the Niger River.
- To promote irrigation, there by facilitating farming to increase food production.
- To promote the industrial sector

Factors which have favoured the establishment of Kainji dam project.

1. Presence of the Niger River with large volumes of water that is, sufficient water supply to generate power.

2. Presence of waterfalls –fast flow of water to turn the turbines and generate power.
3. Presence of a narrow gorge at the place (that is a narrow gap as the Niger River flows through a low line of plateau)—which increases the water pressure behind the dam to generate power.
4. Presence of a hard basement rock which offered a firm foundation for the construction the dam.
5. The sparse population of the area, allowing cheap /easy compensation of the displaced people.
6. The need to provide hydroelectric power for domestic and industrial use. There was a large market for Hydroelectricity.
7. Presence of adequate/ large sums of capital for the construction of the project from the government of Nigeria World Bank, Italy, Britain, USA, Netherlands.
8. Presence of skilled labour used in the construction of the dam project especially from abroad and cheap labor provided by nationals.
9. High level of technology used in the setting up of the project such as the use of large turbines.
10. Supportive government policy to develop the multipurpose scheme to promote economic growth such as by mobilizing funds for the construction.

Contribution of the Kainji dam project to the development of Nigeria

1. Generated hydroelectric power for the country. The dam produces over half of the country's generation capacity. This increases the standards of living.
2. Promotion of the industrial sector due to the production of the hydroelectric power to run machines in industries.
3. The dam has controlled flooding of the Niger River since the huge reservoir holds back a lot of water; hence better living conditions.
4. Generation of employment opportunities for the people of Nigeria such as at the dam and the industrial sector—hence improving the standards of living.
5. Fishing has been promoted by Lake Kainji behind the dam, hence increasing people's incomes.

6. The depth of the water in the reservoir has increased navigation (water transport) yet the depth of the water in the Niger up –river from Lake Kainji has also increased navigation, thus promoting trade activities.
7. The project has promoted irrigation farming such as the **large sugar plantation at Bacita**, rice and vegetables.
8. Promoting of the tourism sector since the project is a tourist attraction, and hence generating valuable foreign exchange.
9. Promotion of urbanization/ development of urban centres such as Yelwa is a flourishing inland port, this is associated with various facilities like banks, schools.

Problems created by the establishment of the Kainji dam project

1. Displacement of people by the formation of the Kainji lake reservoir. Many villages were submerged and over 60,000 people were displaced, hence costly relocation.
2. High costs of resettling and rehabilitating the displaced people –hence increased government expenditure.
3. Loss of grazing land since a large area was drained by Lake Kainji.
4. Has led to a decline in farming activities in some parts of the Niger delta, due to loss of silt which used to maintain fertility since it now settles in the lake and yet currents are eroding its edge.
5. A large/vast would be cultivation land has been drowned by the reservoir lake, thus limiting farming activities.
6. Pollution of the environment due to development of the industries, which in reduces the quality of life.
7. Stagnation of water leads to easy spread of pests and diseases that is, waterborne diseases like bilharzia.
8. Salination causing infertile soils especially in the Niger delta zone and this limits farming activities.
9. The reservoir lake is a barrier to easy communication in the area, since it occupies a large area.

Steps being taken to solve the above problems

1. Resettling of the displaced people in other areas, with careful planning.
2. Spraying to control pests and diseases
3. Treating of wastes before disposal / emphasizing environmental laws to regulate careless dumping.
4. Regular dredging to remove the silt from the water body.
5. Introducing of a ferry, lake steamers to ease communication around the lake formed.
6. Carrying out afforestation in other areas, to compensate for the destroyed vegetation.
7. Enforcing of law and order to control urban-related problems such as the high crime rate.

ASWAN HIGH DAM PROJECT

This project is found in Egypt near the country's border with Sudan, and it is one of the biggest multipurpose river projects in Africa, together with Lake Nasser-the man-made lake behind the dam.

There are two dams at Aswan and both have power stations. The first dam was constructed in 1902 at Aswan to control flooding. But this was totally inadequate and in 1956 a new dam was set up south of Aswan called the **Aswan high dam**. This Aswan high dam was completed in 1970. It is 3600m long and 111m high. At the top its 40m wide and its base is almost a km wide yet it is a very strong dam. Behind the dam is Lake Nasser (500kmlong nearly 150km into Sudan).

A sketch map showing the location of the Aswan high dam in Egypt

Aims for the construction of the Aswan high dam

- To control flooding along the Nile river (therefore when the original dam was inadequate anew high dam was put up)
- To provide water for irrigation (since Egypt is largely a desert country).
- To generate hydroelectric power
- To create a reservoir for water supply for domestic and industrial use.
- To improve navigation by increasing the water level of the Nile river.
- To create employment for the people.

Note: The dam was financed Russian capital and expertise, and Egyptian labour was used in great part.

Factors that favoured the establishment of the Aswan high dam project

1. Presence of the Nile River with large volumes of water that is, sufficient water supply to generate power.
2. Seasonal floods of River Nile which made it necessary to control floods by constructing a dam.
3. Presence of waterfalls –fast flow of water to turn the turbines for generating HEP power. (strong head of water/ force to turn the turbines)
4. Presence of a narrow gorge which offered a suitable site for river damming (and also which increases the water pressure behind the dam to generate power).
5. Presence of a hard basement rock, which offered a firm foundation for the construction the dam.
6. Little and unreliable rainfall, which necessitated storing of water for use during the dry season.
7. Vast/ large tracts of land to accommodate the reservoir / man-made lake upstream. This is due to the sparse population of the area, allowing cheap /easy compensation of the displaced people.
8. The need to provide hydroelectric power for domestic and industrial use. There was a large market for Hydroelectricity.
9. Presence of adequate capital/large sums of capital for the construction of the project from the government of Nigeria World Bank, Italy, Britain, USA, Netherlands.

10. Presence of skilled and unskilled/ cheap labour used in the construction of the dam project especially from abroad and cheap labor provided mainly by nationals.
11. High level of technology / modern technology used in the setting up of the project such as the use of large turbines to produce quality work.
12. Supportive government policy to develop the multipurpose scheme to promote economic growth such as by mobilizing funds for the construction and encouraging investors.

Benefits of the Aswan high dam

1. The dam has controlled flooding of the Nile in Egypt which used to threaten life in the lower Nile, since the reservoir holds back a lot of water.
2. The project has promoted irrigation, hence increasing cultivable land. This has increased food and cash crop production such as rice, cotton, maize, orchards, and wheat.
3. Generation of hydroelectric power which has promoted a number of activities such as trade/service sector.
4. Promotion of industrial development due to hydroelectric power and water supply such as the aluminium plant, grain mills.
5. Generation of employment of opportunities to the people of the region such as at the dam, farm lands and industry—hence increasing incomes.
6. Promotion of tourism development and hence valuable foreign exchange. The dam, lake Nasser and irrigated farmlands are all tourist attractions.
7. Promotion of urbanization such as as Luxor, Qena, and Cairo, and associated infrastructural development such as banks, commercial buildings and roads.
8. Fishing has been developed due to presence of Lake Nasser behind the dam, hence increasing incomes of the people.
9. Lake Nasser and the dam also supply water for domestic and industrial use.
10. Diversification of the economy by developing many economic activities in the region such as farming, trade, industries—hence increasing national income.

Problems caused by the Aswan high dam project

1. Has led to the displacement of many people who used to live in the area now covered by Lake Nasser.
2. The project has led to expensive resettling of the displaced people (the nomads). They had to be given double hectorage of their former land/ increasing government expenditure.
3. Pollution of the environment due to many industries setup in the region.
4. It has led to a decline in farming in some parts of the upper Nile delta region, due to the loss of silt which used to maintain soil fertility as it now settles out in Lake Nasser.
5. Decline in fishing industry at the coast due to loss of silt deposits now settling out in the lake, which would support plankton growth.
6. Due to loss of water through evaporation and irrigation, the fresh water in the soil near the mouth is being replaced by salty/saline sea water and some rendered unfit for cultivation.
7. The extension of perennial irrigation is resulting into spread of diseases especially bilharzia due stagnant water.
8. The delta has reduced in size as it is not receiving significant silt deposits, and hence currents are eroding the edge of the delta, and this limits coastal/delta activities such as tourism.
9. Resulted into urban related problems in the developed towns such as high crime rate, traffic congestion.
10. The manmade lake is a barrier to communication in the area around it, since it occupies a large area.

Steps being taken to solve the above problems

1. Resettling /re-locating of the displaced people in other areas.
2. Getting loans to rehabilitate the displaced people.
3. Treating of industrial wastes before disposal. The government is also putting up environmental laws to regulate pollution.
4. Applying of artificial fertilizers/ manure to increase soil fertility in the delta zone.
5. Regular spraying with chemicals to control water borne diseases.
6. Improving medical services to control water borne diseases.
7. De-silting of the lake and canals through regular dredging.

8. Introducing of a ferry, lake steamers to ease communication around the lake formed.
9. Strengthening policies and law enforcement to control urban related problems.

THE AKASOMBO DAM PROJECT (VOLTA RIVER PROJECT)

The Akasombo dam project was opened in 1966 and was built across the Volta River where the river passes through a narrow gorge. The project was funded by Ghana, USA, Britain, and the World Bank.

Objectives of the Akasombo dam project

- To generate hydro electric power especially for smelting aluminium and other industries.
- To control and regulate the flow of river Volta which was characterized by seasonal fluctuations in the water level.
- To improve inland water transport / navigation.
- To improve agriculture through providing water for irrigation.
- To store water for industrial and domestic use.
- To create a lake behind the dam to act as a fishing ground and a tourist attraction.

Note: The Volta dam complex includes a power dam and station on the west bank and a flood control dam and saddle dam on the east bank. Lake Volta is the man-made lake which has developed behind the dam.

Ghana has also developed other dams such as:

- Bui dam project on black Volta
- Kpong dam near Akasombo dam

A sketch map showing the Akasombo /Volta river project

Factors which have favoured the establishment of the Akasombo dam project

1. The seasonal fluctuation of river Volta and therefore the need to regulate the flow such as controlling of flooding during the rainy season.
2. There was need to generate hydro electric power , to replace thermal which was consuming a lot of foreign exchange through oil imports.
3. Presence of a narrow gorge (deep narrow valley) for easy construction of the dam.
4. Presence of river falls—hence fast flow of water to turn turbines.
5. Presence of a hard basement rock which provided a firm foundation for the construction of the dam.
6. Presence of a large /extensive land behind the hills due to sparse population, which could accommodate a large reservoir behind the dam.
7. Presence of adequate capital to establish the dam provided by Ghana, World Bank, Britain.
8. High level of technology employed to put up the project, provided by especially Britain and USA; such as use of large turbines to generate power.
9. Presence of skilled labour used in the construction and maintenance of the dam project.
10. Presence of a large market for power in the area and surrounding countries, which encouraged investment in the dam project.

Problems resulting from the establishment of the Akasombo dam project

1. Resulted into displacement of many people from their land, since many villages were drowned by the lake water.
2. Led to high costs of resettling the displaced people and disruption of families.
3. Pollution of the environment due to development of many industries such Aluminium smelting at Tema.
4. Resulted Loss of agricultural land since large areas were covered by the lake water.
5. The lake formed effectively divided Ghana into two providing a barrier to east-west communication.
6. Loss of biodiversity –vegetation and animal life when setting up the dam project.

7. Decrease in the delta size due reduced silt deposits and this negatively affects costal/ delta activities such as tourism.
8. Resulted into urban related problems such as slum growth, unemployment and high crime rate.
9. Siltation of the lake which necessitates constant dredging which is expensive.
10. Reduction in farming activities in the delta region due to loss of fertile alluvial soils.
11. Stagnation of water leading to water leading to water borne diseases such as bilharzia.

KARIBA DAM PROJECT

The Kariba dam is located on the Zambia—Zimbabwe border on River Zambezi.

Factors which favoured the establishment of the Kariba dam project

1. Presence of a permanent river with waterfalls, hence fast flow of water to turn the turbines.
2. High volume of water in River Zambezi, hence sufficient water supply for generating power.
3. Presence of a narrow gorge called Kariba—that enabled construction of the dam.
4. Existence of a hard basement rock which provided a firm foundation for constructing the dam
5. The need to control the seasonal floods of the river, by regulating the volume of water.
6. Presence of a wide valley to act as the reservoir for water behind the dam.
7. Availability of adequate capital provided by governments of Zambia and Zimbabwe to set/construct the dam.
8. Presence of skilled labour that helped in the construction of the dam.
9. Increased demand for hydro-electric power, due to growing population, the Zambian copper belt and the mines in Zimbabwe—encouraging dam construction.

10. High level of technology employed when constructing the dam such as the use of large turbines.
11. Supportive government policy towards the construction of the dam in order to develop the region such as by providing power.
12. Presence of raw materials such as rocks used in the construction of the dam.
13. Extensive/large tracts of land available for the dam project/ to be occupied by the reservoir due to low population density

Benefits of the construction of the Kariba dam

1. Provision of adequate power for the mining industry in Zambia and Zimbabwe.
2. Provision of hydro electric power for industrial and domestic use.
3. Rive r flooding has been controlled, since a lot of water is held back in the reservoir lake.
4. It has provided employment opportunities to the people of the area, thus increasing incomes/ improving the standards of living.
5. Generation of government revenue through taxation of the dam project and workers' incomes, and hence supporting the provision of social services.
6. Has led to the growth of towns /urbanization such as Lusaka and Harare—with associated facilities.
7. It has led to the reduction in the price of energy, since it reduced the importation of coal for power.
8. Promotion of the tourism sector, since the project is a tourist attraction. This generates foreign exchange to Zambia and Zimbabwe.
9. Promoted international cooperation between the governments of Zambia and Zimbabwe, hence more trade contacts.
10. Lake Kariba created behind the dam has promoted fishing activities, thus increased incomes of the people.
11. Lake Kariba is also used for navigation /water transport—hence promoting trade activities.
12. Promoted environmental protection / reduced deforestation for fuel energy, since more people use hydro electricity.

Problems which resulted from the construction of the Kariba dam

1. Displacement of many people from their land, since a large area was downed by the lake (due to back ponding of water to form Lake Kariba).
2. Led to high costs of resettling of the displaced people and disruption of families.
3. Pollution of the environment due to the development of the industries in the area.
4. Led to loss of agricultural land since a large area/the valley was covered by the lake.
5. Resulted in urban-related problems such as high crime rate, prostitution, and slum growth.
6. Lake Kariba is a habitat for mosquitoes and snails which are disease causing vectors /pests.
7. Loss of biodiversity –vegetation and animal life when setting up the dam project.
8. High costs of establishment of the project, hence diverting resources from other sectors.
9. The lake is a barrier to communication between Zambia and Zimbabwe, since it occupies a large area.
10. Loss of fertile soils behind the dam/in the man-made lake, hence limiting agricultural production.

CABORA BASSA DAM

Cabora Bassa dam is located on river Zambezi in Mozambique, and it was completed in 1975.

A sketch map showing the location of the Kariba dam and the Cabora Bassa dam

Factors which favoured the establishment of Cabora Bassa dam

1. Presence of the Zambezi River with waterfalls/ fast flowing water to turn turbines.
2. The need to control the fluctuations of the Zambezi River such as controlling floods during the rainy season.

3. Presence of a narrow gorge (called Cabora Bassa) for easy construction of the dam.
4. Existence of a hard basement rock which offered a firm foundation for constructing the dam.
5. Low population density of the area, hence availing extensive/ large tract of land to be occupied by the reservoir lake.
6. Availability of adequate capital to set up the dam provided by the governments of Portugal and South Africa.
7. Presence of a large market for hydro-electric power in South Africa and Mozambique (local and foreign)—hence encouraging the dam project.
8. High level of technology employed when setting up the dam such as the engineering technology to fix the turbines.
9. Presence of skilled labour to construct and maintain the dam project.
10. Presence of raw materials such as rocks used in the construction of the dam.
11. Supportive/favourable government policy to promote economic growth by the multi-purpose scheme such as by financing the project.

Contribution of the Cabora Bassa scheme to the development of Mozambique

1. Provision of power for industrial and domestic use—hence better standards of living.
2. Hydro electricity is exported to South Africa, hence earning Mozambique foreign exchange.
3. Facilitated development of inland water transport by the man-made lake behind the dam—hence enabling trade activities.
4. Provision of water for irrigation, hence supporting crops like cotton, sugar cane, rice among others.
5. The man-made lake behind the dam has also promoted fishing activities, hence increasing people's incomes.
6. The tourism sector has been promoted, since the dam project (dam and lake) is a tourist attraction—hence generating foreign exchange.
7. Provided employment opportunities to the people of the area, hence increasing incomes/ improving the stanrdardsm of living.

8. Floods of River Zambezi have been controlled by the reservoir created which holds back a lot of water.
9. It has promoted development of towns such as Tete, Blantyre, Moatize and Zobue—with associated facilities.
10. Generation of government revenue through taxation of various activities supported by the dam project, and the revenue supports the provision of social services.

MINING IN AFRICA

MINING IN ZAMBIA

Mining is the most important economic activity in Zambia and the dominant mineral is copper. Zambia's deposits are found in a 50km wide belt extending from Ndola–Luanshya areas north westwards to Bancroft. These deposits are continued into Zaire through Lubumbashi.

Mining started in the old mines of Roan-Antelope, Nkana, Mufulira, and Chibuluma. Copper mining is the largest customer of railway transport and power.

Other minerals in the Zambian copper belt include:

- Cobalt in Chibuluma and Nkana
- Gold and silver are removed during copper processing
- Zinc, manganese, and lead mined at Kabwe.

NOTE: other copper producing countries in Africa include: Democratic Republic of Congo, South Africa, Zimbabwe, Namibia, and Morocco.

A Sketch map showing the Zambian copper belt

Factors which have favoured the development of the mining sector in Zambia

1. Presence of extensive/large deposits of copper. The copper belt covers 50km wide and 110 km long, hence economically viable to exploit for a long time.
2. Nearness of some minerals to the surface, making the use of the cheap open cast method possible.
3. Presence of cheap labour to work in mining sector provided by nationals, since there is no gainful employment in agriculture.
4. Presence of skilled labour provided by foreign companies for high quality production in refining and processing. Even local people have been trained.
5. Availability of large quantities of power supply necessary for processing and smelting mainly got from Kariba dam on river Zambezi and Kafue power station.
6. Presence of large sums of capital mainly provided by foreigners who invest money in extraction and processing of copper.
7. Presence of a large market for copper such as United Kingdom and Japan. Copper is used in making electrical appliances, armaments, minting coins among others. .
8. Improved transport infrastructure such as the completion of the Tazara railway connecting the copper belt to Dar- es-salaam port for export.
9. Improved technology (such as the use of caterpillars) brought in by foreign companies to increase efficiency, making mining relatively cost-effective/increasing efficiency.
10. Supportive/positive government policy towards the mining sector. The Zambian government has a controlling interest in the mines administered by the Zambian consolidated copper mines company/corporation.

Methods of copper mining

There are two types of mining used:

- Open cast mining
- Underground mining

Open cast mining

This method is used when the copper ore is near the surface. The top soil is removed and the copper ore is blasted using explosives. The copper ore is then crushed to reduce the size. It is then loaded into trucks and taken to the processing plants.

Open cast mining exists at Kalengwa, Baluba, Bwana mkubwa, Nchanga mines.

Shaft/ underground mining

A large part of Zambia's copper production comes from underground mines, and therefore underground/shaft mining is greatly used. Vertical shafts are dug into the ground to appropriate levels. From these, horizontal tunnels leading to the ore body are constructed. Supporters are provided from the roof to the floor of the tunnels. The copper ore is then blasted using explosives causing shattering. The ores are crushed and loaded on small wagons and taken to the vertical shaft, and lifted to the surface, and taken to processing plants.

Underground mines exist at Nchanga, Konkola, Mindola (Ndola), Mufulira, Chibuluma.

Uses of copper

- Making household utensils
- Making wires for electrical equipment
- Minting of coins(money)
- Making military weapons(like bullets)
- Making machinery bearings
- Good alloy with zinc to form brass.

Export routes

- Tanzam /Tazara railway –most of the copper is transported by railway to the port of dare s salaam for export.

- Railway to Lobito port in Angola.
- A combination of road and railway through Malawi to port Nacala in Mozambique.

The Zambian copper is exported mainly to United Kingdom, Japan, Germany, and Canada.

Environmental problems resulting from mining sector in Zambia

1. Pollution of the environment in form of noise, dust from the mines and the discharge of toxic wastes from the copper refineries, which causes health complications.
2. Destruction of vegetation where minerals are being extracted and hence destroying the habitat of wild life.
3. Destruction of the soil structure/disfiguring of the landscape. It is also associated with soil erosion, and slides and general land degradation.
4. There is stagnant water in the hollows/depressions created, hence breeding of disease causing vectors. There is also flooding of the mines.
5. Destruction of what would be agricultural land due to large quantities of waste rock debris deposited allover covering the soil.
6. Influx/movement of people from rural areas to the mining centres which has also reduced agricultural production.
7. Displacement of people due to development of large open cast mining with less or no compensation.
8. Urban—related problems result such as traffic congestion, high crime rate, drug abuse.
9. Emergence of ghost towns where minerals are exhausted and hence the towns abandoned.
10. Regional imbalances in development in terms of infrastructure, since the areas without minerals are given less attention by government.
11. Mining accidents occur leading to loss of life and property.

Ways of solving the above problems

1. Environmental laws /standards put up to control pollution of the environment.

2. Emphasizing reforestation and afforestation programmes to reduce vegetation depletion.
3. Refilling of the mining pits/hollows to avoid stagnant water and possible accidents.
4. Spraying with chemicals to kill disease causing vectors and medical treatment of the affected people.
5. Resettling /re-location of the displaced people elsewhere.
6. Strengthening urban authorities and police to control urban problems like drug abuse and high crime rate.

Problems faced by the miners when extracting copper

1. Suffocation due to too much dust leading to diseases such as lung cancer
2. Flooding of the mines at times which limits their work
3. High underground temperatures (too much heat) unfavourable for workers.
4. Collapsing roofs and flying stones leading to loss of life
5. Noise pollution during mining reducing the quality of life.
6. There are too many tunnels that sometimes the miners get lost. This is compounded by darkness of the mines which affects their work.

Problems resulting from over dependence on one dominant export commodity (copper) in Zambia

1. Price fluctuation on the world market which greatly affects the economy by leading to uncertain incomes, and this was especially during the 1970s.
2. Restrictive international commodity quotas which reduces the available market.
3. Over exploitation leading to quick exhaustion of the copper.
4. Neglect of other sectors of the economy such as diverting labour and funds from agriculture to copper mining.
5. The closure of some mines leading to the problems of unemployment.
6. Competition from other producing countries leading to narrow market
7. Competition from synthetic substitutes which also reduces the demand for copper.
8. Large scale exploitation of copper leads to environmental degradation such as ugly landscape created.

Steps being taken to solve these problems

1. Efforts of diversifying the economy such as the growing of tobacco and maize; and developing the industrial sector.
2. Zambia is now a member of regional and international agreements which is widening the market potential.
3. Improving of the processed mineral quality to the acceptable international standards to expand its market.
4. Importing of more food especially maize in order to supplement the available food supply.
5. Controlling production to reduce price fluctuations.
6. Opening up of new mines after the exhaustion of some old mines.

General Problems facing the mining industry in Zambia

1. Exhaustion of some mines, since mining has taken place for long such as in Bwana Mkubwa and Roan-Antelope, this limits production.
2. Due to exhaustion of minerals and closure of some mines, ghost towns have emerged with redundant infrastructure.
3. Fluctuation of copper prices on the world market leading to uncertain incomes yet Zambia greatly depends on copper exports.
4. Accidents occur during mineral exploitation leading to loss of life such as due to falling rocks.
5. Limited power supply for the mines and this has resulted into importation of coal from Zimbabwe.
6. Landlockedness of Zambia with no direct and easy access to the sea. It has to export through other countries which are often in political unrest such as Zimbabwe, Angola, and DRC.
7. Increasing costs of mining due to increasing depth of the copper bearing rocks (seams/layers).
8. Profit repatriation by the foreign owned companies (such as Anglo-American company) resulting into loss of revenue.
9. Competition from other countries producing copper such as USA, DRC, and South Africa which limits the market for Zambian copper.

10. Limited labour supply to work in the mines and the poor working conditions there which limits copper production.
11. Underdeveloped technology and use of depreciated machinery in some areas, which limits efficiency in mining sector.

Possible ways of solving those problems

1. Opening alternative routes for copper exports.
2. Building political relations with the neighbors for easy exportation of copper.
3. Opening up new mines where some are exhausted.
4. Carrying out market research to widen the export market for copper.
5. Recruitment of labor from the neighboring counties such as Angola, DRC, Malawi to work in the mines.
6. Replacement of the old and outdated machinery with new modern machinery to increase production.
7. Emphasize processing of mineral ores into manufactured goods to minimize the effects of price fluctuations on the world market.
8. Pumping fresh air into the mines to reduce suffocation.
9. Supporting tunnels to prevent collapsing.

The Shaba—Zambia copper belt

MINING IN SOUTH AFRICA

South Africa is gifted /blessed with plenty of mineral resources and the country has the most developed mining sector in Africa. Minerals mined in South Africa include: gold, diamonds, coal, iron ore, tin, manganese, platinum, uranium, chromium, phosphates, copper, asbestos, limestone, zinc, and nickel among others.

Gold mining

Gold is a heavy, fairly soft yellow metal and easily molded. It is greatly valued by man since it is the world's money (international currency). South Africa has the world's largest known reserves of gold. Gold mining takes place on the Rand (Witwatersrand) covering parts of the Orange Free State and Transvaal.

The main gold fields of the Rand include:

- Johannesburg
- Springs
- Krugersdorp
- Klerksdorp
- Vierfontein
- Odendalsrus

Gold mining started in 1886 and many people came in to dig/exploit this precious metal and eventually big companies.

A sketch map showing the gold fields of South Africa

Method of gold mining in South Africa

Gold mining in South Africa is similar to copper mining in Zambia (using the underground / shaft method). The rocks which contain gold are called reefs

Illustration

NB: The minerals which occur with gold include: uranium and silver.

Other African countries with significant gold deposits include: Ghana, Zimbabwe, and Democratic Republic of Congo (DRC).

Conditions which have favoured gold mining in South Africa

1. Presence of large gold reserves /deposits which encourage investment in the mining sector/making mining economically viable.
2. High quality of the gold mines, with gold being a very precious metal used as international currency encourages mining investment.
3. Presence of cheap labour to work in the mines provided by local people and migrants from neighboring countries.
4. Presence of skilled labour to carry out extraction and processing provided by foreigners and locally trained people.
5. Presence of sufficient/adequate capital to invest in the mining sector provided by foreign and local companies.
6. Presence of a ready market for gold both locally and internationally.
7. Availability of large power supply for mining and processing such as hydroelectricity, coal and oil.
8. High level of technology used by mining companies such as use of caterpillars, shaft /underground mining to increase production.
9. Efficient transport and communication system such roads and railway to transport gold to processing centres and markets.

10. Positive/supportive government policy such as encouraging local and foreign investors, controlling the mining activities.
11. Increased research to discover more valuable gold fields and advancing the mining technology.
12. Political stability of South Africa which encourages many investors in mineral exploration, extraction and processing.

Uses of gold

- Mainly used in jewelry industry.
- Used in gold craft industries
- Internationally used as money and hence a medium/standard of exchange.

Diamond mining

Diamonds are formed beneath the ground by great heat of volcanic activity and occur in rocks called **kimberlite**.

The leading producers of diamonds in Africa include: DRC, South Africa, Botswana, Ghana, Namibia, Sierra Leone, Tanzania, and Angola.

In South Africa diamond has the greatest deposits in **Kimberley** and **Hope town** in the Rand. Other mines include: the premier mine near Pretoria, Bultfontein, Jagersfontein, and Koffiefontein.

Most industries connected with diamonds are found in Johannesburg—with most of the diamond cutting factories plus diamond research centre.

Note: diamonds are a hard material, form of carbon and look like pieces of ice. When cut they glitter and shine beautifully. But they are difficult to find , mine and recover from parent rock.

Method of diamond mining

Diamond mining is done using:

- Open-cast mining
- Shaft/underground mining

South Africa also has alluvial deposits. These are found along the Vaal—Hartz—Orange valleys, in stream beds, dried up river courses and on river terraces. It is believed that these deposits were removed from their original pipes many years ago by riverine and rain-wash erosion and hence deposited. Such deposits are also located along the coastal margins in marine sands and gravels between Fort Nolloth and Walvis Bay.

Such alluvial diamonds are mined using a method called **placer or alluvial mining**. In this method a steel dredge or a gravel pump is used to dig up the alluvial deposits (waterlogged alluvium). The alluvium is mixed with a great deal of water. The mixture is rotated and in the process the lighter particles (sand, mud, dust) are washed off, leaving the heavier ores (diamonds settled down.

A sketch map showing the diamond fields of South Africa

Uses of diamonds

- Used in making jewelry
- Making industrial equipment like drill bits and abrasive drilling wheels.
- Cutting tools in industries
- White sparkling diamonds are cut into pyramidal gems.

Coal mining

Coal is a major industrial mineral especially for iron and steel industries. It is also used to generate electricity alongside other sources of power. Southern Transvaal

is the leading coal producing state in South Africa. Huge deposits occur at Witbank and Vereeniging.

Iron ore mining

Iron is possibly the most useful metal. In South Africa large deposits occur in Pretoria, Middleburg, Waterburg, Vryburg and north western Cape.

Problems facing the mining sector in South Africa

1. Shortage of labour to work in the mines and related industries which undermines production.
2. Shortage of water needed in processing of minerals especially in the Rand which also limits production.
3. Price fluctuations of minerals on the world market leading to uncertain incomes.
4. Competition with other mineral producing countries like Ghana, DRC producing gold which limits the available market.
5. Long routes to the coast which increases the transport costs.
6. Labour unrest which often leads to strikes and hence limiting production. This is due to poor working conditions and racial segregation.
7. Accidents occur during mining leading to loss of life such as due to falling rocks.
8. Suffocation due to lack of fresh air and flooding of the mines which scares away many potential workers.
9. High costs of mining due to increasing depth of the mines.
10. Exhaustion of some high grade mineral deposits due to over exploitation.

Solutions to the problems facing the mining sector in South Africa

1. Recruiting labour from neighboring countries such as Swaziland, and Mozambique to minimize labour shortage.
2. Construction of dams to trap water such as Vaal dam and Vaal Barrage on Vaal River. Underground sources are also tapped to minimize water shortage.
3. Carrying out market research in order to expand market for the minerals.
4. Emphasis on processing the minerals into finished goods to minimize the effects of price fluctuations on the world market.
5. Controlling production to reduce price fluctuations.

6. Abolition of apartheid which has reduced racial segregation and labour unrest.
7. Emphasis on production of high value minerals such as gold and diamonds to offset the high costs of mining.
8. Pumping fresh air into the mines to reduce suffocation and tunnels are supported to prevent collapsing.

Mining in Nigeria

Nigeria is the largest producer of oil south of the Sahara. Oil mining started in 1937, but commercial production started in 1956. Large scale oil fields / deposits exist in the Niger delta and offshore in the ocean. Refineries exist at Port Harcourt, Warri, and Kaduna.

In Nigeria many companies both domestic and foreign are engaged in the oil industry such as shell—BP, Gulf, Mobil, Texaco, Nigerian national oil corporation. Most foreign companies originate from Britain, USA, France, Italy, Japan, and Germany.

Apart from oil/ petroleum, Nigeria produces natural gas, a cheap clean industrial fuel. Other important minerals in Nigeria include:

- Iron ore at Enugu and Itakpe near Lakoja
- Coal mined at Lafia and Enugu supplying power
- Tin in Baunchi on Jos plateau

A sketch map showing the distribution of minerals in Nigeria

Note: other countries producing oil in Africa include Libya, Algeria, Egypt, Angola, Namibia, Ivory Coast, Sudan, among others.

Process of oil drilling

- The basic equipment for oil drilling is a derrick—which is a steel tower about 40m high.
- Exploration /prospecting/survey of the oil is done and installing of the derricks/oil rigs follows.
- The derrick carries a drill stem on which steel drilling pipes are screwed /attached, having a drilling bit. The drilling bit is used to drill into/cut through the rock strata/layers to reach the oil well below.
- Lubricating mud is pumped into drilling pipe to lubricate the bit and to bring up rock samples.
- Once the bit reaches the oil stratum/layer, crude oil rushes out by natural pressure or pumped out to the surface using oil pumps if natural pressure is weak.
- The oil is then transported through pipes, fuel tankers, trucks to the refinery.

Illustration

Transportation of oil

(a) Pipe lines

This is the cheapest and most efficient way of transporting oil. The initial cost in laying the pipes is high but cheap in the longrun and simple to operate and maintain.

(b) Tankers

These are special cargo vessels designed to carry oil only.

(c) Oil trucks

These are more used for important delivery of the refined oil.

Marketing of oil

Oil from African countries (like Nigeria) is exported to countries like USA, United Kingdom, Italy, France, Germany and Belgium. Nigeria became a member of OPEC (Organization of petroleum exporting countries) in the late 1970s.

Uses of oil/ petroleum

1. Providing fuel for transport vehicles, airplanes, ships, railway transport
2. Used to generate thermal electricity used in industries, homes, and institutions
3. Oil is a lubricant in vehicles, machinery and other appliances (Greece, engine oil)
4. Used in making plastics, fertilizers, insecticides, drugs, perfumes, detergents, acids, synthetic rubber and fibres
5. Making tar (Asphalt),
6. Making gases , and spirits

Problems of over depending on crude oil as an export

1. Price fluctuations leading to unstable incomes
2. Over exploitation of crude oil leading to quick exhaustion
3. Closure of some mines leading to problems of unemployment.
4. Over production leading to a fall in prices and low incomes
5. Competition from other producing countries leading to narrow market
6. Restrictive international commodity quotas reduce market hence low export earnings
7. Neglect of other sectors hence limited resource base
8. Competition from alternative sources of energy which limit income/ market
9. Large scale exploitation leads to environmental degradation such as by disfiguring the landscape.

***Factors which have favoured the development of the mining sector in Nigeria**

1. Presence of large reserves of minerals in the country. For example large reserves of oil at Oloibiri, port Harcourt and offshore deposits.

2. Presence of adequate capital to invest in the mining sector such as oil drilling, oil refining—provided by local and foreign investors.
3. Large supply of skilled and semi-skilled labour to work in the mining sector, brought in by the foreign companies and those trained locally such as engineers , geologists
4. High level/improved technology employed in mining such as oil drilling pipe technology and refining technology.
5. Presence of a large market, both domestic and foreign. Nigeria mainly exports oil to USA, United Kingdom, Italy, France and the rest of Africa.
6. Efficient transport system. Nigeria is not landlocked and is lucky to have oil reserves at the coast which minimizes the transport costs to export markets.
7. Large quantities of power in form of hydro-electric power at Kainji dam on Niger River, oil and natural gas to support the mining industry.
8. The setting up of various processing industries such as the port Harcourt refinery, at Warri, and Kaduna, to increase the quality of output.
9. Positive/ supportive government policy such as encouraging many companies to invest in the mining sector.
10. Nigeria is also strategically located reasonably close to the markets in Western Europe, USA and South America which leads to easy exportation.

Problems resulting from oil mining (negative effects of mining sector)

1. Pollution of the environment, involving water, air and noise pollution from the mines and processing industries.
2. Results into underdevelopment of rural areas. Distant people have been attracted to the mining areas, hence neglecting rural activities like agriculture.
3. Dereliction of land, disfiguring of the landscape where mining has taken place. After exhaustion of minerals, wasteland is left behind.
4. Profit repatriation by the foreign—owned companies such as shell, Texaco. These send profits back to their home countries.
5. Resulted into income inequalities. High wages are paid to workers in the sector unlike other sectors.
6. Results into regional imbalance in development, in terms of infrastructure. Mining zones are more developed than other areas.

7. Urban—related problems such as unemployment, high crime rate, slum growth, among others.
8. Results into destruction of vegetation when clearing mining sites which has damaged the landscape and water sources.
9. Displacement of people from areas where minerals (oil wells) were discovered, with les or no compensation.

MINING IN LIBERIA

Liberia has large quantities of iron ore and is currently the world's 10th largest iron ore exporter. Other minerals but of little economic importance include diamonds.

Deposits of iron ore exist at: Wologisi Mountains near Voinjama, Bie hills on the border with Sierra Leone, Bomi hills.

A sketch map of Liberia showing the location of iron ore deposits

Conditions which have favoured iron ore mining in Liberia

1) Presence of large reserves /deposits of iron ore which encourage investment in the mining sector/making mining economically viable. (estimated about one billion tonnes)
2) High quality of the iron ore which encourages mining investment by large companies.
3) Presence of cheap labour to work in the mines provided by local people and migrants from neighboring countries.
4) Presence of skilled labour to carry out extraction and processing provided by foreigners and locally trained people.
5) Presence of large sums of capital to invest in the mining sector provided by foreign and local companies.
6) Presence of a ready market for gold both locally and internationally.

7) Availability of large power supply for mining and processing such as hydroelectricity, coal and oil.
8) High level of technology used by mining companies such as use of caterpillars, shaft /underground mining to increase production.
9) Developed transport and communication system such roads and railway to transport iron ore to the coast for marketing.
10) Positive/supportive government policy such as encouraging local and foreign investors, controlling the mining activities.
11) Increased research to discover more valuable gold fields and advancing the mining technology.

Note: The mining of iron ore is done by open cast method where it near the surface and underground mining method for that iron ore deep underground.

The most productive of Liberia's iron ore fields is run by LAMCO (Liberian American Swedish Minerals Company) on the western slopes of the Nimba mountains).

Marketing of iron ore. Liberia has no iron and steel industries and iron ore is exported mainly to Germany, USA, Netherlands, France, Belgium, and Japan.

Other countries in Africa producing iron ore include Zimbabwe, Swaziland, Sierra Leone, Nigeria, Mauritania, Angola, Guinea, Ivory Coast, South Africa and Egypt.

Challenges facing the mining sector in Liberia

1) Shortage of skilled labour to work in the mines and related industries which undermines production.
2) Price fluctuations of minerals on the world market leading to uncertain incomes.
3) Competition with other iron ore producing countries Zimbabwe, Swaziland, Sierra Leone, Nigeria, Mauritania, South Africa which limits the available market.
4) Accidents occur during mining leading to loss of life such as due to falling rocks.
5) Exhaustion of some high grade mineral deposits in some regions due to over exploitation.

6) Over dependence on foreign companies such as American companies in exploiting iron ore, which leads to profit repatriation and hence limiting further investment in mining.
7) Iron ore deposits occur in hilly areas making the development of transport routes difficult.
8) Inadequate capital to invest in the mining sector, which undermines the quality and quantity of production. High costs are involved in exploiting, setting up railway lines and developing processing centres.
9) High costs of mining due to increasing depth of the mines.
10) Continuous heavy rainfall which makes iron ore turn into mud during the rainy period.
11) Political instability in the country in the recent past characterized by civil wars.

Steps taken to improve the mining sector in Liberia

1) Campaign for national security to increase the confidence of mining investors.
2) Opening up new deposits such as the Wologosi mountain ranges in western Liberia and the Bie mountain range in north eastern Liberia.
3) Use of the conveyor belts to transport the ore down the hills to the railhead.
4) Recruiting labour from neighboring countries to minimize labour shortage.
5) Carrying out market research in order to expand market for the minerals.
6) Controlling production to reduce the effects of price fluctuations.
7) Emphasis on production of high value minerals such as gold and diamonds to offset the high costs of mining.
8) Attraction of more foreign investors to invest in the mining sector such as American companies.

MINING IN EGYPT

Egypt is located in North Africa and is Libya's eastern neighbor. It also has large oil deposits. Oil was first discovered in the delta region and later in the western desert.

Today over 80% of the oil comes from fields around the Gulf of Suez. Oil production and exports have been increasing over the years.

The leading four oil fields in and around the Gulf of Suez are: Ramadan, July, El Morgan, Belayim, Abu Rudais.

Egypt is also important producer of natural gas and the fields occur in the western desert, offshore near Alexandria and in the Nile delta.

A sketch map showing the mining areas of Egypt

The gas is transported by pipelines to the major industries such as the Talkha fertilizer plant, Helwan iron and steel industry, textile factory at Mehella el Kubra. Oil refineries also exist at Alexandria.

Oil is mainly exported to Mediterranean countries.

N.B.: LEAVE SPACE FOR SKETCHES AND ILLUSTRATIONS WHERE NECESSARY