



**GEOGRAPHY OF RWANDA BY Mr. NSENGIYUMVA Anastase**  
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**FACULTY OF EDUCATION**

**Department of Sciences**

***Module of Geography OF RWANDA***

***LEVEL 3&4***

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**THIS MODULE OF GEOGRAPHY OF RWANDA IS COMPOSED  
OF THREE UNITS**

**UNIT 1: PHYSICAL GEOGRAPHY OF RWANDA UNIT**

**2: HUMAN GEOGRAPHY OF RWANDA**

**UNIT 3: ECONOMIC GEOGRAPHY OF RWANDA**

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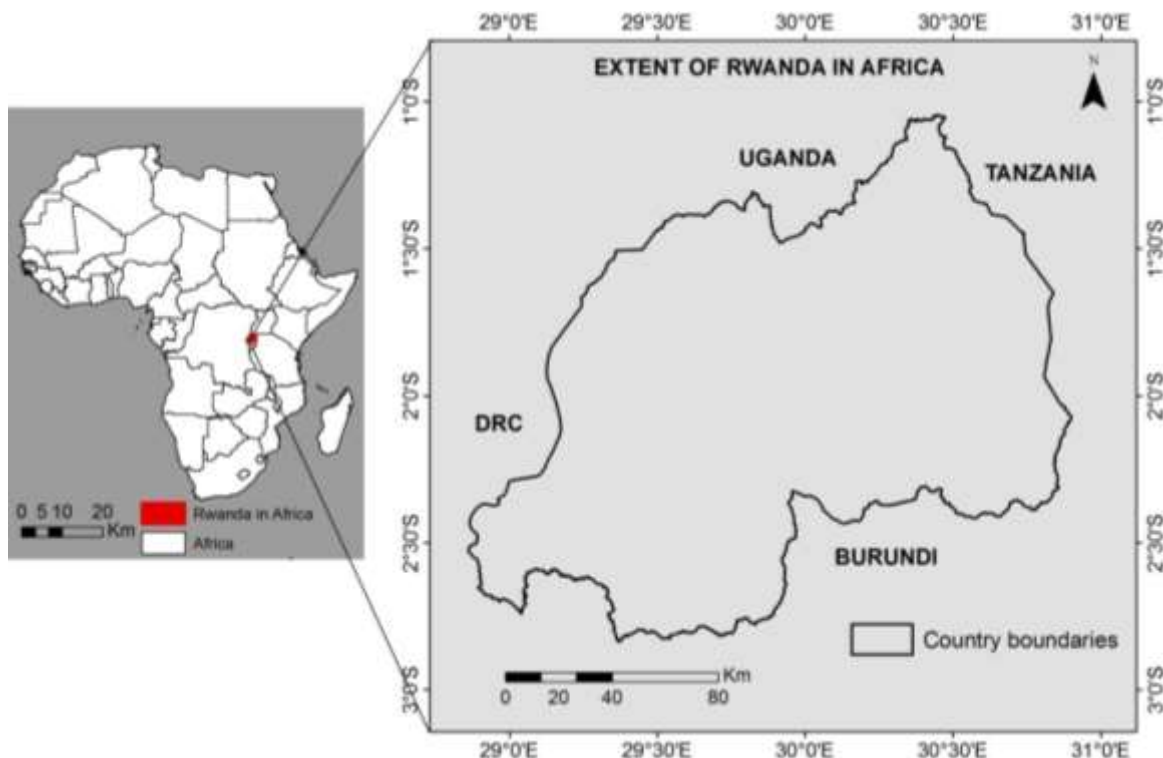


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**UNIT 1: PHYSICAL GEOGRAPHY OF RWANDA**

*1.1.General presentation of Rwanda*

**Location of Rwanda:** Rwanda is one of the East African countries, located between Uganda in North, Burundi in South, Tanzania in East and DRC in West. It geographical coordinates vary between **1°4'** and **2°51'** South of Equator, and between **28°53'** and **30°53'** East of Greenwich Meridian. It lies approximately at 120 kilometres south of the Equator, at **1,100** kilometres from the Indian Ocean, at **1,920** kilometres from the Atlantic Ocean, at **3,750** kilometres from the Mediterranean Sea, and at **3,980 km** from South Africa Cape (i.e: Rwanda has doesn't border with any sea or ocean, hence being called a **Landlocked country**).



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**Figure 0-1: Location of Rwanda in Africa**

**The size, population density:** Rwanda is a small country that covers an area of 26,338 square kilometres. Its population is estimated to be approximately **12,626,950** people in 2019 (According to WORLDOMETERS and UN Data October, 2019). The population density of is estimated to be **479** people per Km<sup>2</sup>; this made Rwanda to be one of the highest populated countries in Africa.

**The administrative division:** Since the administrative reform of 2006, **Rwanda is subdivided into 4 provinces and Kigali City (capital city of the country), 30 districts, 416 sectors, 2148 cells and 14816 villages.** Eastern Province is composed of **95 sectors** from **7 districts** (Bugesera, Gatsibo, Kayanza, Kirehe, Ngoma, Nyagatare and Rwamagana), Northern Province includes **89 sectors** of **5 districts** (Burera, Gakenke, Gicumbi, Musanze and Rulindo), Southern Province is made of **101 sectors** of **8 districts** (Huye, Kamonyi, Gisagara, Muhanga, Nyamagabe, Nyanza, Nyaruguru and Ruhango) while Western Province is divided into **7 districts** with **96 sectors** (Karongi, Ngororero, Nyabihu, Nyamasheke, Rubavu, Rutsiro and Rusizi), then, Kigali City is composed of three districts (Gasabo, Kicukiro and Nyarugenge).

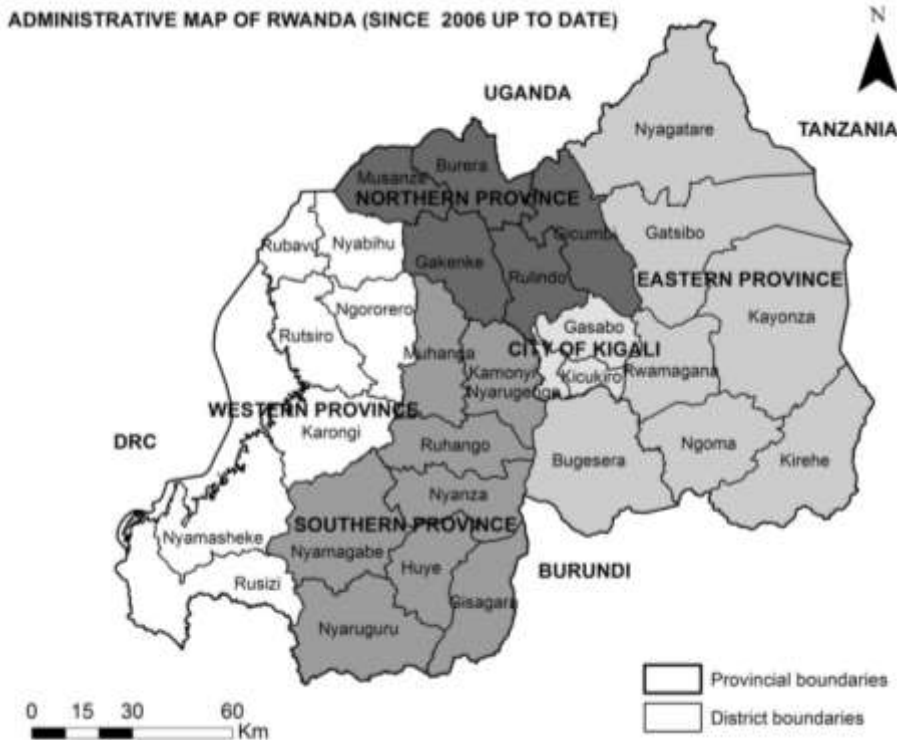
**Figure 2: The map of Rwanda showing its 4 provinces and Kigali City**





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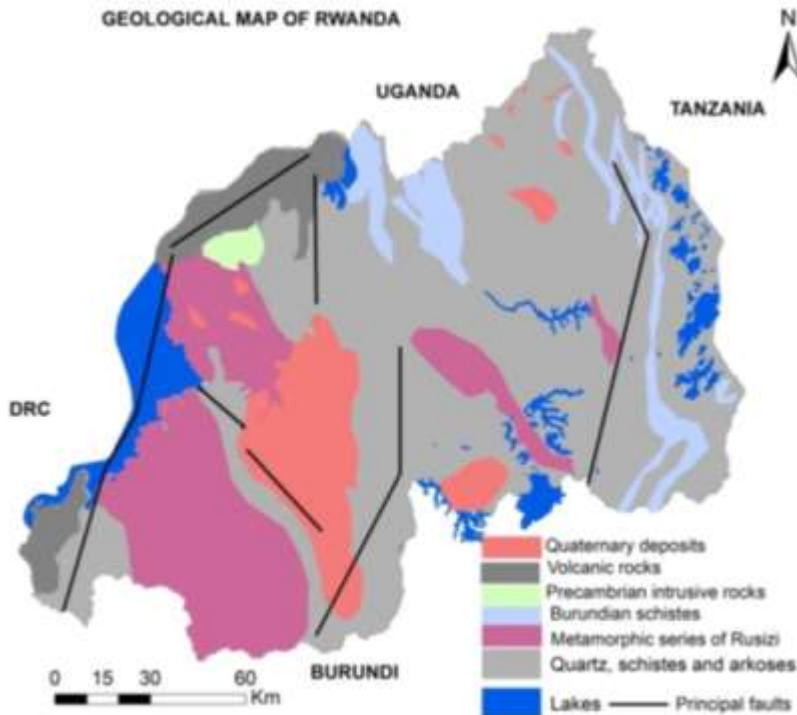


**Figure 3: Administrative map of Rwanda**

### *1.2. Geology of Rwanda*

**Geology** as a science that deals with solid Earth, the rocks (types and other physical and chemical characteristics of rocks) of which it is composed, and the processes by which they change over the time.

**Geological features** of Rwanda are mainly composed of Precambrian rocks, few Cainozoic volcanic rocks and Holocene deposits. The Precambrian rocks of Rwanda make integral part of the big rock known as Kibara cratons chains which extends from Kasai, through Dodoma to the south of Uganda. The stratigraphical studies divide the Rwandan Precambrian rocks into two groups: the “**Rusizian**” or the group of “Rusizi” (formed from - 2100 up to -1650 million years) and the “**Burundian**” or “the group of Burundi” (put into place between -1050 and -980 million years). These two geological groups are composed of several quartzite, metamorphic rocks and granite sediments.



**Figure 4: Geological map of Rwanda**

The Rusizian is recognized by a very advanced metamorphism of its rocks: gneiss, granites, micaschists, and amphibolites and covers a part of West of the country while the Burundian covering a major part of Rwanda. Rwanda belongs to the rock system of Burundi that make one portion of Kibara rock chain which spreads from Shaba in DRC to Uganda.

The Cainozoic rocks (put into place from - 40 million years to -100, 000 years) are divided into two parts that are deposits of Pleistocene and Holocene ages which have filled the bottom of valleys, lakes and rivers. Then, the Cainozoic volcanic intrusions cover a part of West while the extrusions are localized in northwest of the country. The last are made of eight volcanoes of which six are found on Rwandan side: Mikeno (4437m) and Sabyinyo (3634m) being oldest (about 2.5 million years old) followed by Bisoke (3711m) and Karisimbi (4507m) with Gahinga (3475m) and Muhabura (4127m) being the most recent while Nyamuragira and Nyiragongo located in DRC are still active volcanoes.

### *1.3. The lithology of Rwanda*

**Lithology** is the study of the general physical characteristics of the rocks. The lithology of a rock unit is a description of its physical characteristics (colour, texture, grain size and composition) visible outcrop, in hand or core samples.



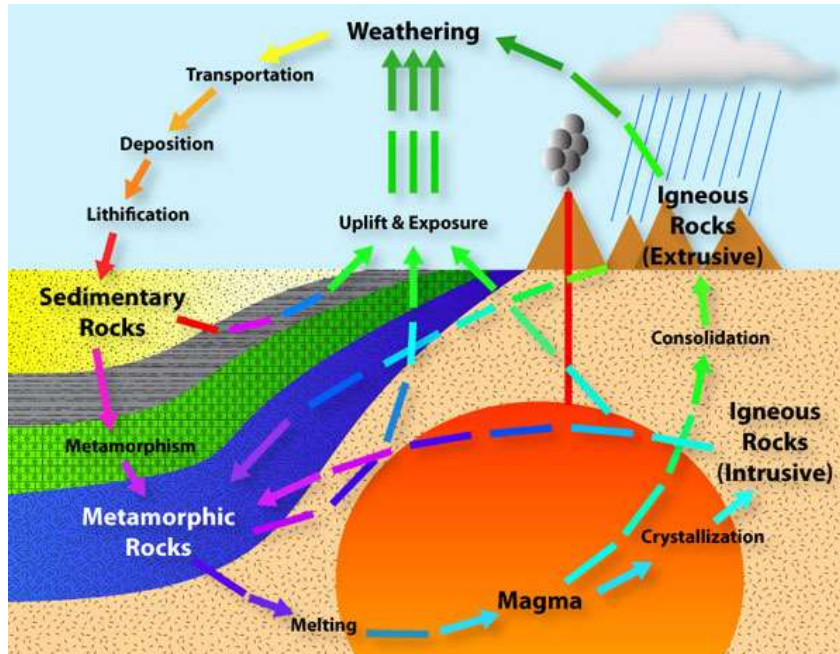
The world surface is covered by three types of rocks (Metamorphic, Igneous and sedimentary rock). Each part on the world is dominated by any one or all of the 3 types of rocks depending on the landform formation process of the relief features of such region. The land surface of Rwanda is also made of various rocks which are diversified depending on their nature or the way they were formed. The most dominant are *granite, basic, calcareous and volcanic rocks*.

**Granites rocks** are largely expanded on more than 25% of the surface of the country but it is very difficult to recognize them due to their high level of alteration. They are found at Bugesera in form of quartzite sand, in central and east part of the country in form of *non-gneissic granites, biotitic pegmatite, or muscovite* (at Kigali, Rusumo, Muhazi and Mutara regions). Hence, western regions are characterized by a mixture of *gneissic and granite, migmatite and gneiss or micaschistus*. The most extended granite in the country is batholite of Kitabi-Mayaga which are commonly called “Granite of Nyabisindu” which covers over 100 km<sup>2</sup>.

**Basic rocks** less localized in Rwanda, are much expanded in eastern region at Rusumo and in the western region of the country in Karongi and Gatumba region as well as in the south west of the country at Kitabi, part of Rusizi and Nyamasheke districts while the calcareous rocks commonly known as limestones are mainly localized in Musanze, Kibuye and Bugarama.

**Volcanic rocks** localized in western part of the country, they are especially made of alkaline basalts with some trachytes while in northwest of the country are dominantly composed of sanidines, melitite, trachytes rocks and pyroclastic materials. Note also that volcanic rocks are also known as **magmatic or igneous** rocks as they are formed under volcanicity.

**The figure 5: The rock cycle**



#### 1.4. Pedology of Rwanda

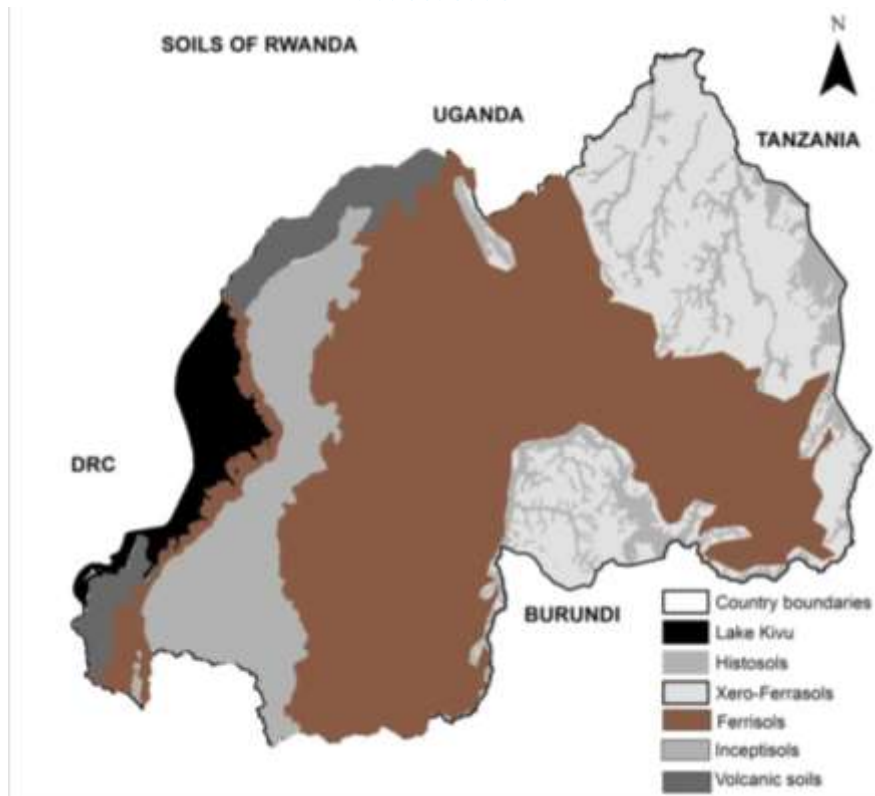
**Pedology** is the study of soils in their natural environment. It is one of two main branches of soil science, the other being edaphology. Pedology deals with pedogenesis, soil morphology, and soil classification, while edaphology studies the way soils influence plants, fungi, and other living things.

The term soil refers to a loose and unconsolidated materials derived from rock disintegration that forms the uppermost layer of the earth's crust. A soil constitutes a vital part of plants and is exploited for agriculture. The first determination and the classification of Rwandan soils were done in 1955 which was inspired from American classification of soils, then, adapted to the realities of the country. As Rwanda is located in inter-tropical zone, it is mainly characterized by strong altered soils. The country is embedded with iron clays having red or brown colour resulting from decomposition and migration of chemical elements like silica ( $\text{SiO}_2$ ) and precipitation of oxides, iron hydroxides and aluminium resulting into soils known as Kaolisols rich in kaolinite which are more frequent in warm areas of the countries.





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**Figure 6: Soil map of Rwanda**

Note that: Soils are categorised according to their characteristics. **Soil colour** (whitish, reddish, brown, dark brown, grey and black), **soil texture** (fine, coarse sand, large particles), **Soil organic matter** (decayed plants or animal remains/humus), and **soil air** (soil atmosphere), **soil permeability** (fast, moderately or slowly), **soil structure**, **soil porosity**, **soil water** (soil moisture) and **soil P<sup>H</sup>**.

The following are the main categories of the soils prevailing in country:

1. **Kaolisols (altered soils):** These form the main type of soils in Rwanda. They are developed on weathered parent material which mainly had clay mixed with iron and aluminium oxides. They appear reddish and thick due to presence of iron and Aluminium oxides. Their profile reveals an upper humus horizon of low humus while the structure of the middle section differs for different subtypes. Kaolisols become water during rainy seasons. They are usually deep and they are found in central region of Rwanda. Kaolisols are subdivided into:
  - (i) **Xero-Ferrasols** which are characterised by thin layer of humus, beneath humus lies thicker layers resulting from accumulation and cementation of iron and aluminium oxides. They become more prevalent as one moves towards the eastern regions, that is known also as Xero-kaolisols region which is warm and dry lowlands that has monthly average temperature above 20°C while annual



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mean precipitation turns around 1000mm. These climatic conditions are favourable to high alteration of soils leading to degradation, high accumulation of iron and aluminium sesquioxides which make the lateritic soils to be abundant in this region than the rest of the country.

- (ii) **Humus-bearing kaolisols** which are largely composed of elements and compounds of aluminium, iron and in smaller quantities, calcium, sodium and potassium. These kaolisols subtype of soils are mainly determined by vegetation type, climate, parent rock material and geographic relief. Geologically they are young soils that resemble to their parent material more than older soils, which have been altered over time by climate and vegetation.
2. **Ferrisols** of central plateau are extended on granite, gneiss or basalt mother rocks. Even though the content in plant nutrients of these types of soils is moderate, their high level of permeability and deep profiles make them to be relatively high resistance to erosion. Therefore, they are able to sustain continuous cropping and they are suitable for perennial crops. Ferrisols are loamy soils with a content of clay ranged between 20% and 35%.
  3. **Highland soils/ Inceptisols or altitude forest soils** are localized in regions of high altitude extended on Congo-Nile Ridge covered by natural forests. This region is characterized by low temperature and high amount of precipitation that make the soils to be rich in organic matters lied on less altered rocks making them to be weakly developed in horizons. Hence, this presence of organic matters makes the soils to be good for agriculture but they are mostly localized in mountainous regions covered by protected natural forests of Nyungwe, Gishwati and Mukura respectively.
  4. **Volcanic soils** are mainly black in colour, less altered and rich in minerals like  $K^+$ ,  $Ca^{2+}$ ,  $Na^+$ ,  $Al$  that make them to be good for agriculture. These volcanic soils occupy about 14% of national territory and are mainly localized in west on sides of Lake Kivu and north-west of the country meanwhile they contribute highly to agricultural production of the country.
  5. **Valley soils:** These are mainly found along river valleys. They are mainly of alluvial origin. The two main categories of valley soils are **vertisols** and **organosols**.
    - (i) **Vertisols** are black clays, rich in minerals like  $Fe_2$ ,  $Al_3$ ,  $Ca_2$ ,  $K$ ,  $Mg_2$ , etc., but poor in organic matter because are less altered due to their high content in water. These types of soils are expanded on about 10% of national area mainly in warm and dry valleys of Ngoma, Umutara and Bugesera.
    - (ii) **Organosols or wet soils**, they consist mostly of high organic matter (peats and mucks). When they are they become hard and end up cracking. They form when the formation rate of organic matter is more than its rate of destruction/ slow decomposition rate of animals and plants'





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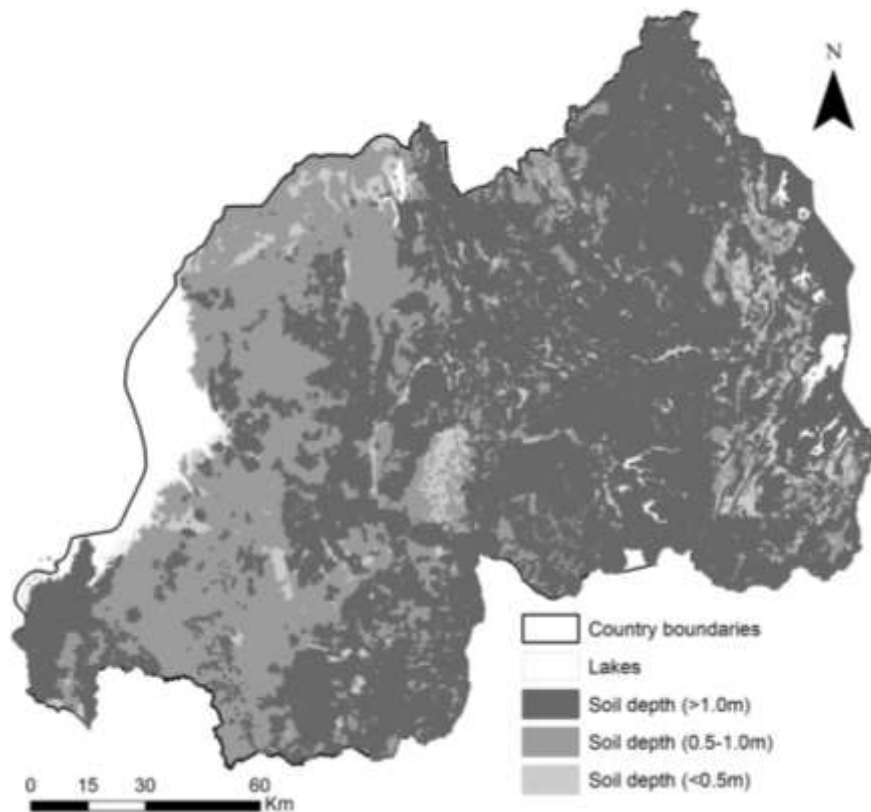
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remains within the soil. They are generally difficult to cultivate due to its poor drainage (they are water logged soils), but very important when they are drained. They are found in different swamps of Rugezi etc.

6. **Histosols** or peaty soils are localized in valleys and swamps where the permanent presence of water prevents the decomposition of the organic matters which makes the peaty soils to be composed of organic matters at the rate of 75%. They are mainly found in swampy regions of Rugezi, Cyabaralika, Kamiranzovu, Akanyaru, Akagera and Gishoma.

Even though, 60% of Rwandan soils have more than one meter of depth, most of them have less than five meters of depth. The soils covering quartzite, granite and volcanic materials extended on steep sloping areas have the depth oscillating between 0.5m to one meter and occupy around 15% of the national area while shallower soils having less than 0.5 m of depth cover around 25 % of territory areas. Thus, the deeper soils located in warm eastern lowlands are frequently dominated by lateritic soils.



**Figure 7: Soil depth map of Rwandan**

Therefore, the texture and depth of Rwandan soils expose them to be least permeable and much exposed to fluvial erosion and landslides leading to soil degradation accompanied by low agricultural productivity becoming as additional challenge to hilly topography for agricultural activities in Rwanda.



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### 1.5. Soil erosion in Rwanda

**Soil erosion** is a process in which the top most layer of Earth is removed by running water, wind and glacier. Erosion is directly responsible for the leaching of arable **soils** and indirectly for increased transport of solids through waterways downstream. At least 37.5 percent of the **land** in **Rwanda** needs to be managed before being cultivated, and overall an estimated 39.1 percent of the **land** has a high **erosion** risk.

➤ **Causes of soil erosion in Rwanda**

- (i) Heavy rainfall
- (ii) Indiscriminate cutting trees on slopes/deforestation
- (iii) Swamp reclamation which lowers the water table and makes soils susceptible to erosion.
- (iv) Uncontrolled grazing (overstocking or overgrazing.
- (v) Human activities such as mining, quarrying, construction etc.
- (vi) Monocropping and over cultivation which reduce soil nutrients

➤ **Effects of soil erosion in Rwanda**

- (i) Loss of soil fertility
- (ii) Decline in crop yields (productivity).
- (iii) Famine which is rampant among the local people where there has been severe erosion
- (iv) Forced population migration/displacement
- (v) Destruction of natural vegetation cover and infrastructure
- (vi) Loss of lives
- (vii) Water pollution

➤ **Soil conservation methods in Rwanda**

- (i) Application of fertilizers on poor soils
- (ii) Crop rotation (growing different crops at different times on the same piece of land).
- (iii) Land terracing
- (iv) Afforestation and reforestation in grazing and mountainous regions.
- (v) Reducing the number of animals grazing.
- (vi) Practicing agro-forestry
- (vii) Mulching (covering the soil with grass/crops remains)
- (viii) Planting of grass and use of sand /stones on bare ground
- (ix) Strip cropping (planting at right angle to the direction of wind to limit wind erosion.



### 1.6. Topography of Rwanda

The relief of Rwanda is a result of combination of tectonic movements and fluvial erosion. The tensional movements taken place during Cretaceous has established the Eastern Africa Rift Valley which is made of two branches: the eastern containing lakes like Shala, Abaya, Stephanie, Turkana, Baringo, Bogoria, Nakuru, Elementaita, Naivasha, Magadi, Natron, Manyara, Eyasi, Rukwa and western rift valley and Rwanda is found in the part of “western-rift valley” which forms a semi-circle bow with basins containing Lake Malawi, Lake Tanganyika, Lake Kivu, Lake Edward, Lake George and Lake Albert, these lakes are known as **western rift valley lakes**.



**Figure 8: Rwanda in Eastern Africa Rift Valley**

The landforms resulting from compression movements have been up and down lifted throughout the years by fluvial erosion. Other endogenic processes that led to the formation of the present Rwandan relief include Warping (down and up warping), Folding and volcanicity. The mentioned movement led Rwandan relief to be subdivided into six topographic features characteristics of relief of Rwanda.

This ascending topography from east to west (from 900m to 4,500m) is mainly made of lowlands in the East, highly dissected hills in central and high mountains in west and North West of the country as it is described below:

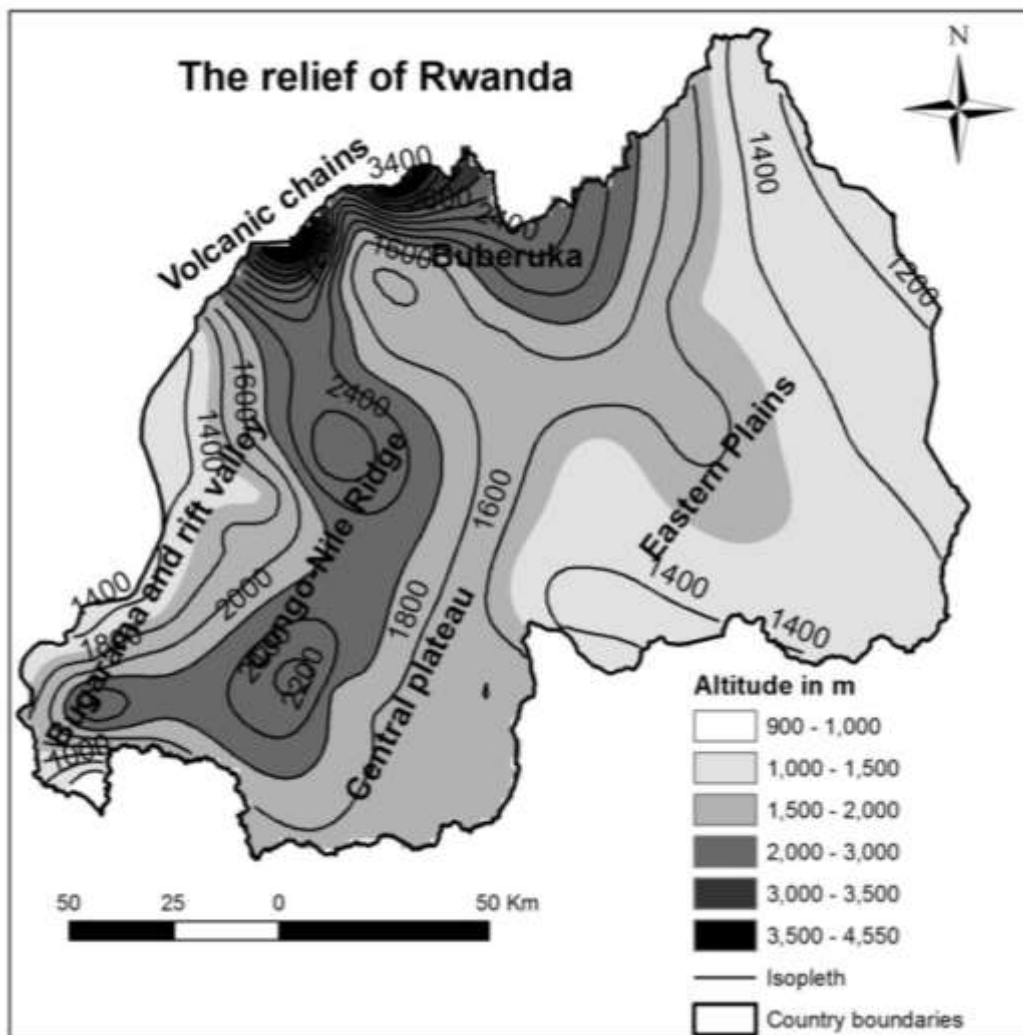


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- **Eastern lowlands** (Eastern plains) are extended in eastern part of the country from Rwandan border to Tanzania until Kigali city. They are approximately covering Eastern Province, Kigali City and small part of Gicumbi district of Northern Province. The eastern lowlands are dominated by plains and depression with altitude generally varying between 1,000m and 1,500m.
- **Central plateau** covers nearly a half of the country, it is bordered by Buberuka region at north and bordering Republic of Burundi at south while it spreads from the buttresses of the Congo Nile Ridge at west to the border of Kigali city at east. The topographic elevation varies between 1,500m and 2,000m. It is made of numerous hills having often flat peaks separated by large valleys embanked of alluvial deposits. Thus, this hilly region gave to the country the nomination of "Country of One Thousand Hills".
- **Congo-Nile Ridge** stretches from the north to the south on a length of about 160 km with a width varying between 20km and 50km (east to west). It divides Rwanda's drainage into Congo basin flowing towards the west and Nile basin that flows towards the east of the country. It is limited by Lake Kivu at west and central plateau at east while it is bordered by volcanic chains at north and it stretches towards Burundi in south by ending in Nyungwe natural forest at Rwandan side. It culminates on Mount Muhe (3,000 m) at the north and it decreases to 1,200m in Rutsiro and ends at south with an altitude turning around 2,750 m. It is a mountainous chain with sides highly dissected by a lot of valleys, with stiff slopes and pointed summits and the mean elevation is estimated to 2,500m.
- **Buberuka landforms** are mountainous region covering mainly Burera and Gicumbi districts. They are bordered by Republic of Uganda at North, volcanic chains of Birunga at west, central plateau at south and eastern lowlands at east and south east. The topographic elevation varies between 2,000m and 2,200 m, they have long parallel watersheds, cashed valleys, long and steep slopes.
- **Volcanic chains of Birunga** made of six massive volcanoes are extended towards Uganda in North and Democratic Republic of Congo (DRC) in west. They are limited by Buberuka landforms at east and Congo-Nile Ridge at south and their elevation vary as follows: Karisimbi (4507m), Mikeno (4437m), Muhabura (4127m), Bisoke (3711m), Sabyinyo (3634 m) and Gahinga (3474m).
- **The plain of Bugarama** located in southwest of the Congo-Nile Ridge is considered as an extension of Imbo plain stretching towards Burundi. It makes part of tectonic depression of western branch of Eastern African Rift Valley filled of deposits and having the lowest altitude of 900m.



**Figure 9: Topographic/physiographic units of Rwanda**

Apart from Bugarama plain which is extended on 9,00m of elevation, the rest of country (more than 90%) has an elevation which is above 1000m. In addition to that, the topography of Rwanda is frequently dominated by hills; hence, the promotion of extensive mechanical agriculture for market orientation becomes very difficult. However, Eastern, South eastern and Bugarama plains can be suitable for extensive agriculture if irrigation projects are undertaken to reduce the vulnerability of crops to dry conditions prevailing in these regions.

The relationship between relief and human activities/land use in Rwanda

- ✚ Farming takes place on broad valleys such as Nyabarongo (Sugar cane plantation).
- ✚ Extensive agriculture on the plateaus is possible because these areas are flat and are easy to cultivate.
- ✚ People avoid land that has steep slopes because; they are not suitable to establish settlement, farms or roads and railways.





- ✚ Crops like tea is grown on sloping land where soil is well drained.

### *1.7. Climate of Rwanda*

Climate refers to the average weather data/conditions of place, measured and recorded over a very long period of time usually 30-40 years. Weather is a state of the atmosphere of a specific area at a given period of time. Although, Rwanda would have equatorial climate by considering its geographical position (it is located between 1°4' and 2°51' south hemisphere), it enjoys tropical climate moderated by the elevated altitude ranged between 900m and 4507 m. The annual rainfall varies between 850mm in North east and 1600mm on the Congo-Nile Crest, rainfall increases east to westwards while temperature decreases from east to westwards with increase in altitude. Even though, Rwandan climatic observatory system is operational since the beginning of 20<sup>th</sup> century, the country is still having drawbacks in climatic forecasting studies.

The climate of Rwanda is also characterised by 4 seasons: Short rain season (Umuhindu), Long rain season (Itumba), Short dry season (Urugaryi) and Long dry season (Impeshyi).

#### **1.7.1. Principal controls of climate of Rwanda**

The climate of Rwanda is controlled by the position and intensity of anticyclones such as Mascarene, Saint Helena, Azores and Siberian anticyclones.

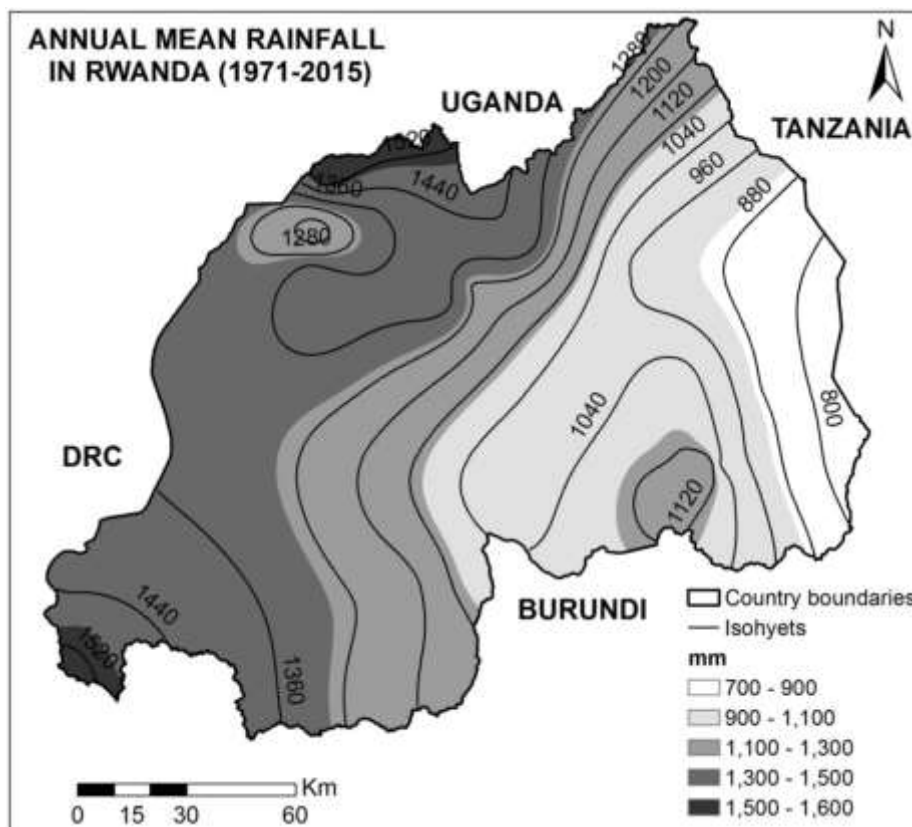
- Inter-tropical Convergence Zone (ITCZ) departs from coasts of Somalia passes over Lake Victoria to be more humidified and reaches over Rwanda to give a rainy by the beginning of September and it heads southwards by the end of November.
- Dry and cold air masses (Siberian anticyclones) from Arabian sea pushed by winter monsoon passes over Lake Victoria to yield some humidity which gives a little rainfall mainly in highlands of the country from December to February.
- Rwanda experiences the influence of Mascarene anticyclones coming from the coasts of Mozambique to converge with wet winds (Saint Helena anticyclones) coming from South Atlantic Ocean by passing over Congolese basin and over Lake Kivu to form ITCZ above Rwanda that yields a heavy rainfall over the country from March to May.



- From June to August, the country comes under influence of dry anticyclones of Saint Helena and Azores that cause the dry conditions over the country mainly in eastern lowlands while the western highlands benefit a little rainfall from anticyclones of Saint Helene from Atlantic Ocean humidified a bit by Lake Kivu. At that time, the wet air masses from Southeast in Indian Ocean reach East African coasts but they are deviated towards North-east by the Indian summer monsoon to yield rainfall over South and South-east Asia.

### 1.7.2. Spatial and temporal variations of climate in Rwanda

The four climatic regions prevailing in Rwanda are controlled by the topography of the country. The Eastern lowlands varying between 1,000 m to 1,500 m in altitude receive the rains varying between 850mm to 1,100mm annually with annual average temperatures ranged in 20 °C-22 °C while the central plateau region located between 1,500m to 2,000m in elevation enjoys the rainfall oscillating between 1,100mm and 1,300mm with annual average temperatures varying between 18°C and 20°C.



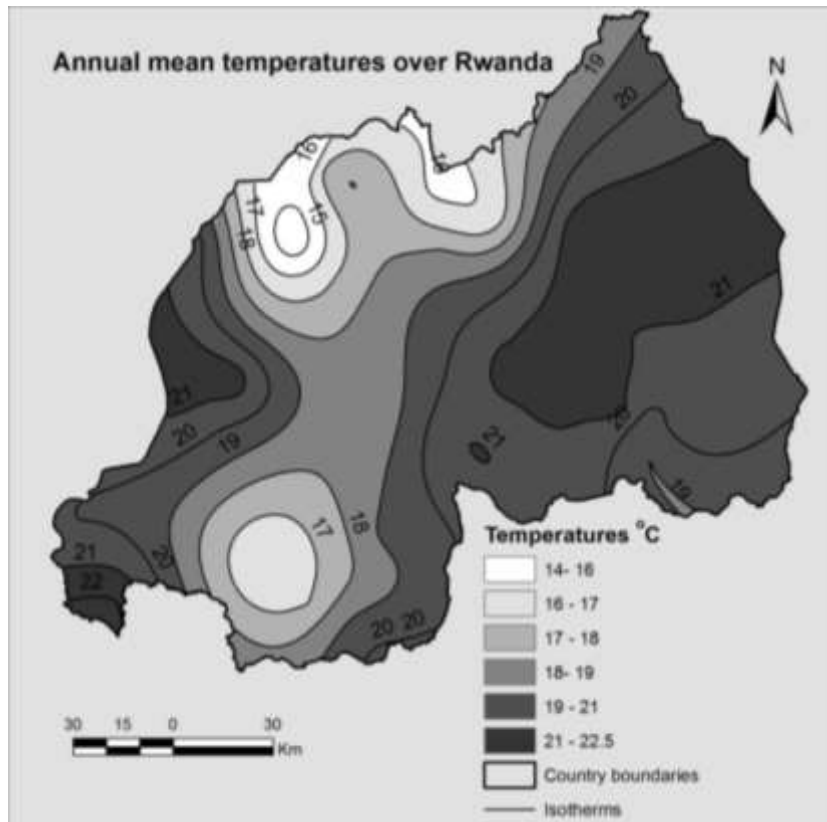
**Figure 10: Spatial variations of rainfall in Rwanda**

Meanwhile, the highlands which include Congo-Nile Ridge and volcanic chains of Birunga having the height varying between 2,000m and 4,500m benefit the annual rainfall ranged between 1,200mm and





1,600mm while Lake Kivu sides and Bugarama plain experience the rainfall varying between 1,200mm and 1,500mm per year with annual temperature ranged between 19°C and 22°C.



**Figure 11: Spatial variations of temperatures in Rwanda**

Although, temperatures change slightly, the rainfall is unequally distributed throughout the years. Therefore, **four seasons** share the annual rainfall with maximum being received during rainy season (autumn) called also long-rains season occurring in March, April and May which is followed in rains by normal-rainy (spring) named as short-rains season starting from September to end with November. From June to August (winter), the country is dry while the normal season (summer) named also as short-dry season is recognized from December to February.

### 1.7.3. Factors that influence the climate of Rwanda

Apart from the regional circulation of anticyclones (e.g. Mascarenes, Saint Helena, Azores and Siberian) which control the seasonal variations of precipitations over Rwanda, there are other factors that influence the climate of Rwanda. Those are the following:

- **The effect of relief:** Regardless the type of season, the spatial distribution of rainfall and



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temperature in Rwanda is controlled by the topography of the country. Hence, the amount of precipitations increase westwards in opposition to decreasing temperatures in function of elevation of relief meaning that the highlands are most wet and cold while the lowlands are the most dry and warm.

- **Effects of local winds:** local winds are common in low lying areas, mountains and on shores of lakes like Ruhondo, Burera, Muhazi, Ihema and Mugesera. They are formed due to temperature differences and result into land and sea breezes. The sea breeze takes place during the day because the land gains too much heat than the sea. Air above the land becomes warm, expand and cold air rise from the sea blowing to the land to replace the risen air. The diagram of a sea breeze is shown below.
- **The position of the overhead sun:** Rwanda experience two rainy seasons in the year when the sun is overhead the equator (21st march and 22nd June). This creates inter tropical convergence zones (areas of low pressure) that influence prevailing winds and cause rainfall. In October and November as the sun advances south wards North east trade winds that are moist over Lake Victoria causes rainfall in Rwanda.
- **Aspect or slope of the land:** on-wind ward slopes are warmer and wetter than leeward slopes. Such scenarios are observable on eastern sides of Congo-Nile Ridge facing on-coming Mascarene anticyclones while the Western sides get nourishment from Saint Helene anticyclones originated from Atlantic Ocean and humidified by Lake Kivu during their course.
- **Soil cover:** Although, the major controls of climate of Rwanda have been mentioned above, it is obvious that differential soil coverage creates a slight variation in radiation, evapo-transpiration, humidity, temperatures and rainfall at Rwandan territory.
- **Influence of water bodies:** Water bodies like lakes influence the climate of Rwanda. A good example is Lake Kivu which influences the coastal areas.

### 1.7.4. The concept of climate change in Rwanda

Climate change is the large-scale, long term shift in the weather patterns. For instance the average temperatures over a large area may generally increases.

➤ Causes of climate change in Rwanda

- (i) Pollution (contamination of the environment)
- (ii) Industrial and motor vehicles emissions (emitted gases/smokes)
- (iii) Bush burning
- (iv) Deforestation

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- (v) Population pressure on the natural resources
  - Effects of climate change in Rwanda
    - (i) Drought (long period of dry weather)
    - (ii) Shortage of water supply
    - (iii) Loss of livestock due to lack of pastures/starvation
    - (iv) Forced displacement/migration of people and animals
    - (v) Disappearance of some living organisms
    - (vi) Landslides
    - (vii) Floods
    - (viii) Aridity and desertification
  - Climate change adaptation and mitigation in Rwanda
    - (i) Efficient use of water when in plenty
    - (ii) Growth resistant crops (cassava, yams, etc)
    - (iii) Recycling of water
    - (iv) Apply irrigation farming
    - (v) Storing excess water during the rainy seasons
    - (vi) Afforestation and reforestation
    - (vii) Restraining settlement and infrastructural development
    - (viii) Construction of dams
    - (ix) Apply zero grazing
    - (x) Subsidizing alternative source of energy to substitute firewood and charcoal use.
    - (xi) Educate public on the causes and effects of climate change
    - (xii) Minimize the industrial and motor vehicles emission as declared by international laws and regulations on the environmental management.

### ***1.8. Vegetation in Rwanda***

Apart from planted vegetation, natural vegetation of the country is mainly localized in function of type of climate and topography. The high concentration of forest is found in wet and cold highlands while the savannah vegetation is dominating in warm and dry lowlands.



### 1.8.1. Categories of Rwandan vegetation

The natural forests of are classified in 4 types namely: Mountainous forests ( Nyungwe and Volcanoes National parks), Savannah woodlands (Southern and Eastern parts of Rwanda), Riverine and Marshland vegetation (along Akagera, Nyabaorngo and Rusuzi river swamps, Rugezi swamp,) and Savannah rasslands (Central and Eastern Rwanda).

The following are five main categories of Rwandan vegetation:

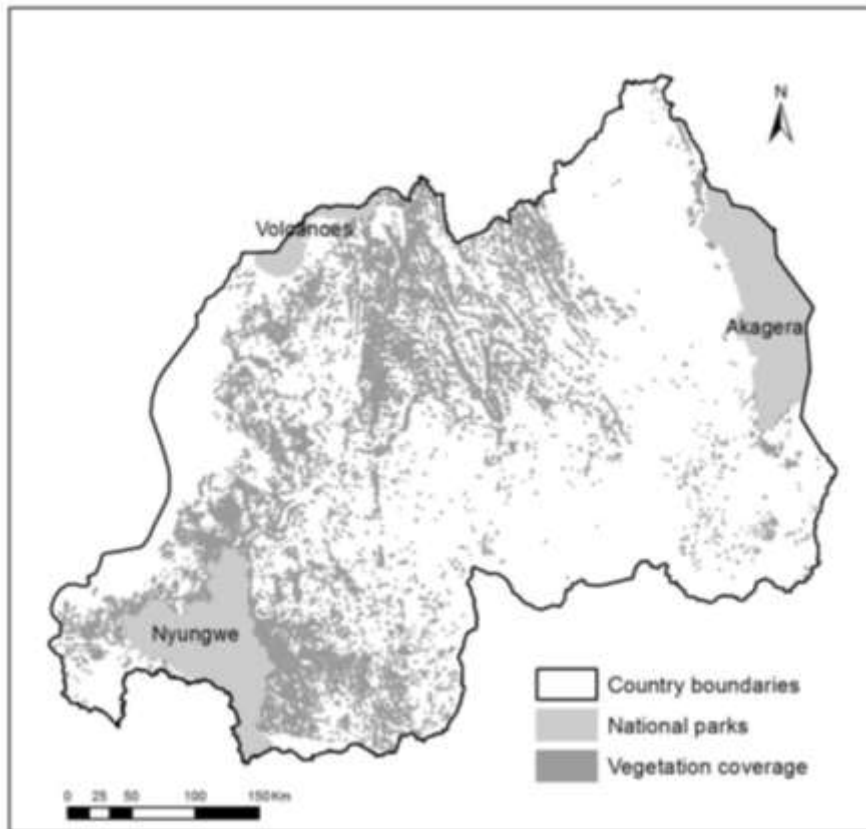
- **Natural forest of Congo-Nile Ridge** which comprises Nyungwe, Gishwati and Mukura natural forests. Nyungwe national park covers an area estimated at 101,958 hectares and it is extended at an altitude varying between 1700m and 3000m while Gishwati forest covers 1,003 hectares at elevation oscillating between 2100 and 3000m. Then, Mukura forest is extended on a surface area of 1, 913 hectares at an elevation varying between 2300m and 2700m. The plant formations of Congo-Nile Ridge are constantly threatened by the demographic pressure. This is the case of Gishwati natural forest whose surface area has decreased progressively due to invasion of people seeking cultivation and farming land. Actually, the government of Rwanda is trying to protect this forest which plays an important role in the ecological balance of the country.
- **Volcanoes national park** is composed of natural forest whereby alpine and sub-alpine vegetation like bamboos are dominating up to 2800m of altitude, followed by “Hagenia Abyssinicas” (Umugeshi) at an approximate altitude of 2800m to 3600m while heather’s vegetation is dominating at the summit of volcanoes. It covers around 16,000 hectares of an area and it is natural habitat of mountain Gorillas.
- **Akagera national park** is made of savannah and gallery-forest dominated by gramineous and acacias vegetation which are more resistant to the dry conditions prevailing in that region. It covers around 90,000 hectares and it is extended in lowlands with an elevation varying between 1000m and 1500m. However, the scattered savannah vegetation in eastern lowlands and central plateau in altitude varying between 1500m to 2000m can be also attached to this group.
- **Marshlands/Riverine vegetation** (165,000 ha) is dominated by the vegetation made of papyruses that produce the organic matters badly decomposed due to the cold, acidic and weakly oxygenated waters but they end up generating peaty accumulations. This type of vegetation is found mainly in marshlands of Kamiranzovu, Gishoma, Rugezi and around lakes such as Muhazi, Bulera and Ruhondo, etc.



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- **Planted forest scattered** in different part of the country on 415,450 hectares and they are dominated by exotic species like Eucalyptus, Pinus, Grevillea robusta and trees scattered on farmlands (agro-forestry) and along anti-erosion terraces. The small forests like Buhanga forest (100 ha) in Musanze district and Busaga forest (151ha) in Muhanga district can be attached to this group



**Figure 2: Map of forests of Rwanda**

The recent study conducted by MINITERE in 2007 has estimated the forest and vegetation (this estimation has taken into consideration natural forests and vegetation, woodlots, planted trees and agro-forestry resources) coverage at 240, 746 hectares equivalent to around 10 per cent of 23,835 km<sup>2</sup> of the national dry lands compare to the coverage of 659,000 hectares estimated in 1960. Thus, these results suggest a loss of about 64 per cent of forest or 1.35 per cent per year since 1960 up to 2007 which can be attributed to the rapid population growth that has increased pressure on natural vegetation.

Therefore, the progressive deforestation observed in recent years has exposed the country to be more vulnerable to fluvial erosion, floods and desertification of dry areas leading to soil degradation, destruction and low productivity of crops. This accelerated deforestation may provoke the lost of some of ecosystem services and products provided by forests such as protection of water catchments, regulation of water flow, influencing climate, water purification, food, tourism, medical services, honey and handcrafts among others.



### 1.8.2. Importance of forest for Rwanda

Forests exert an overbearing influence on life on the earth. They not only provide a safe haven for a richly diverse biota but also favorably modify climatic parameters. The importance of forests is, thus, multidimensional and this makes deforestation a process with devastating and wide ranging consequences.

#### (i) Economic importance of forests

Forests constitute the largest renewable natural resources. They provide a wide variety of goods and services including:

- **Employment:** Through forestry, many people are employed as researchers, forest guards and forest officers. Some are employed as lumber jerks, in the exploitation of timber for forests.
- **Source of food:** Various food products are obtained from planted trees.
- **Source of industrial raw materials:** Forest products constitute raw materials for industries. Timber and tree logs are used in making papers, pulp and furniture industries.
- **Promotion of tourism:** Forest provides suitable habitats for wildlife, beautiful scenery and picnic sites. This attracts tourists who bring in foreign exchange to the country.
- **Promotion of education and research:** Forests promote education and research by offering training grounds for professionals and researchers through research institutions.
- **Source of building and construction materials:** Timber and poles from the forest are used in the building and construction industry.
- **Source of energy:** Wood obtained from forests is used in the provision of energy (wood fuel) which is used in many rural households and in factories of Rwanda.
- Some plants play an important role in pharmaceutical and pesticide industries of Rwanda.

#### (ii) Ecological importance forests

Forests play a major role in maintaining conditions of life on the earth. Forests stabilize global climate. They do so by profoundly influencing natural cycles, in particular, the hydrological and carbon cycles. They protect biodiversity. The number of species per unit area is much greater in a forest than in any other terrestrial biome.

#### (iii) Cultural importance of forests



Forests have great aesthetic value. Their green canopy and dense surroundings have always held a great appeal to the human mind. Forests have great spiritual significance in the traditions of Rwanda.

(iv) **Environmental Importance of forests**

Forests are important in environmental conservation. Trees bind the soil together thus prevents soil erosion. They preserve moisture and provide humus thus help in promoting soil fertility

### 1.8.3. Problems affecting lumbering in Rwanda

Forests of Rwanda experience a number of problems, which include:

- ✚ **Deforestation:** In many areas the forest cover is being cleared due to encroachment as a result of the rising population. Forests are being depleted to create room for settlement and agriculture.
- ✚ **Excision of forests:** Thousands of hectares of forests are often being excised to give way to public utilities and projects.
- ✚ **Increase in animal population:** The increase in the grazing population and browsing animals has led to the destruction of trees in the forests, mostly in the eastern regions of the country. Animals are often fed on foliage and young trees thus destroying the forests.
- ✚ **Illegal logging:** Unlicensed people harvest trees for charcoal burning and timber products. This destroys forests and leads to the extinction of some tree species.

### 1.9. Drainage of Rwanda

Drainage is a lay out, shape or an actual plan made by a river and its tributaries on the landscape.

The current drainage of Rwanda might resulted from the inversion of the northwards drainage by the setting up of volcanic hills in Northwest of the country which were accompanied by the toppling of the Rwandan–Burundian western block. The valley of the “paleo-Nyabarongo” was obstructed by a stream of lavas, then; the inversed flows invaded low valleys of the former hydrographical network and provoking the creation of many lakes and marshlands in the eastern lowlands of the country.

The three former basins (Akanyaru-Nyabarongo, Ruvubu and Kivu basins) were transformed into two present hydrologic basins named as Congo and Nile basin respectively with Congo-Nile watershed being dividing line of these two hydrologic basins.





The water of these both hydrologic basins covers 8% of the national area equivalent to about 2143 km<sup>2</sup> on which 101 lakes cover about 1300km<sup>2</sup>, 861 rivers occupy about 72.6km<sup>2</sup> with 6462 km in length while the water of 860 wetlands and valleys covers 770 km<sup>2</sup>. This number of lakes and rivers makes the country to be part of great lakes region.

### 1.9.1. Major Rivers and Drainage Basins

#### (i) Rivers flowing towards the Congo Basin

The Congo basin flows towards Lake Kivu in the west of Congo-Nile Ridge excluding volcanic chains of Birunga and drains around 33 per cent of the national area with 10 per cent of the country water. The drainage density is high (density of 0.75 km/km<sup>2</sup>). The Congo basin is rich in rivers and poor in lakes as long as it is not covered by any lake apart from Lake Kivu bordering the country to DRC. The major rivers flowing throughout this basin are:

- River Sebeya and its main tributary, Pfunda. Its source is Gishwati forest.
- River Koko and its tributary, Kore. Its source is located in Rutsiro Mountain.
- Rivers Kilimbi and Matovu Muzimu, with their sources in Nyungwe forest.
- River Karundura, with its source at Mount Myaga in Nyungwe forest.
- River Kamiranzovu, with its source in Nyungwe forest.
- Rusizi River, the outlet of Kivu Lake.

Rusizi River has also affluents namely Rubyiro and Ruhwa flowing at the border of Rwanda with Burundi

#### (ii) Rivers flowing towards the Nile basin

The Nile basin is more extended than the Congo basin but with less density (0.25 km/km<sup>2</sup> in many areas). It drains around 67 per cent of the national area with 90 per cent of territory water but the water is unequal distributed in this basin. The three main rivers are Nyabarongo, Akanyaru and Akagera:

- **Nyabarongo:** This River has its source at Mwogo River. It takes a north direction and is joined by rivers Rukarara, Mbirurume, Kiryango and Satinskyi, Mukungwa. At Ngara River, Nyabarongo turns southwards and is joined by rivers Base, Bakokwe. Finally it receives the Akanyaru River water at the exit of the Rweru Lake close to the Burundian-Rwandan border to form Akagera River.
- **Akagera:** the initial waters of Akagera are from Nyabarongo and Akanyaru rivers. Akagera receives waters of rivers Kibaya and Kagogo from Rwagitugusa in the mountain chains of Kibungo. It also receives river water from Ruvubu (from Burundi) and finally Akagera is joined by the waters of Karangazi and Muvumba rivers.

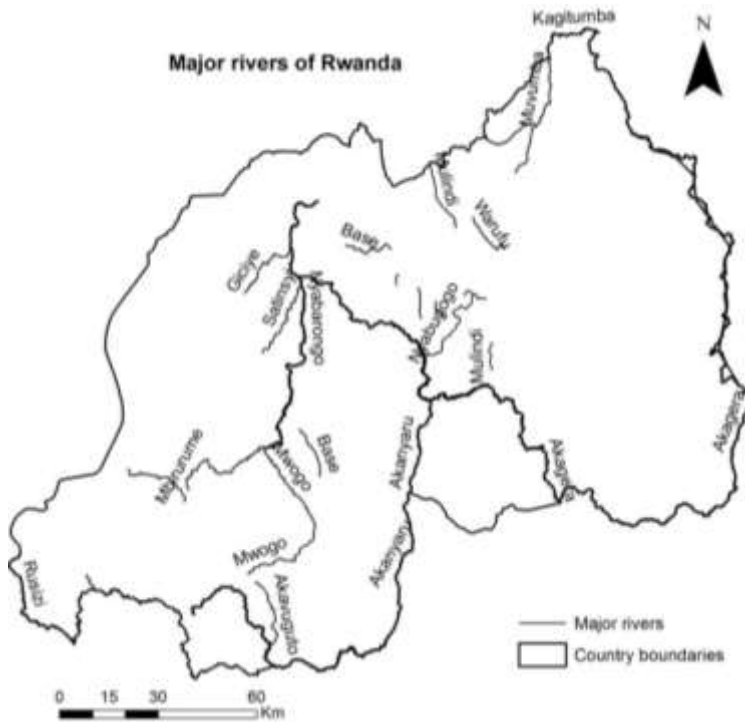


Figure 13: Major rivers of Rwanda

### 1.9.2 Major Lakes and their mode of formation

Rwanda has two major types of lakes. These are lava-dammed lakes and deposit lakes.

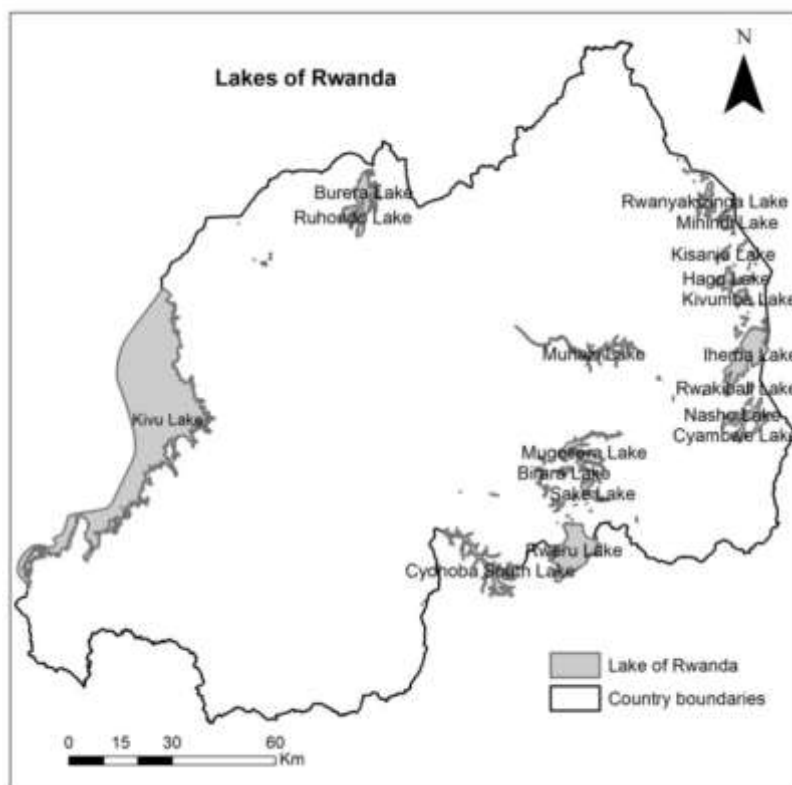


Figure 4: Lake of Rwanda

- i. **Lava-dammed Lakes:** These are lakes formed when flow of lava blocks a river valley. This causes



a lake to form. Examples of lava-dammed lakes are Kivu, Bulera and Ruhondo.

- **Burera and Ruhondo lakes:** Their origins as well as their formation are associated to the establishment of volcanoes in the north. Volcanoes have obstructed Burera and Ruhondo rivers to form the two lakes. Burera is the most elevated lake of the country at 1862 m. It has a pouring basin of 490 km<sup>2</sup> and a total surface of 55 km<sup>2</sup>. Today, there is no more communication links between Bulera and Ruhondo. Only artificial hydroelectric pipes were established between the two lakes. Ruhondo is located at 1764m of altitude with a pouring basin of 660km<sup>2</sup> and a total surface of 29km<sup>2</sup>
- ii. **Rift valley lakes:** These are lakes occupying grabens or rift valley formed due to tension forces that the western part of Rwanda has undergone, a clear example is Lake Kivu found in the western arm of East African rift valley.
- **Lake Kivu:** Lake Kivu was formed in superior Pliocene when the establishment of volcanoes blocked the northwards out-flow hence filling the graben (rift valley basin). Kivu rift was then filled progressively by barred waters until they flowed toward Tanganyika Lake. The overflowed waters gave birth to Rusizi River. Kivu can also be considered as a graben lake due to its establishment in the rift. The maximum depth of the lake is of 496 m. It has strongly cut beaches. It contains the methane gas whose reserves are evaluated at 55 billion of m<sup>3</sup>.
- iii. **Deposit Lakes**
  - **Deposit lakes** are formed when a meander of a river on a flood plain is cut off to form a lake. **Lakes of Bugesera:** Lakes that we find in Bugesera are Mugesera, Cyohoha, Rweru. There are other small lakes located in Akanyaru and Nyabarongo marshlands. Their origin seems to be the submersion of Bugesera valleys following a deposit barrage or a heightening of the region. The hypothesis of their recent formation and their disappearance in the near future seems to be confirmed by North Cyohoha Lake which dried up progressively since 1981 and disappeared completely in 1984.
  - **Oxbow-lakes or Lakes of Akagera :** These lakes are located in the valley of Akagera whose length is 90km and the width of 110 km. Lakes of Akagera originates from meanders of Akagera River. They were later on surrounded deposits. This justifies their weak depth and the continuing relations existing between them and the river through surrounding papyrus swamps. Among these lakes, we can observe: Lakes communicating directly with Akagera like Lakes Rwampanga, Rwakibali, Ihema, Mihindi and Lakes separated from the river by prairies of papyrus which communicate with river Akagera by natural channels or by infiltration under the prairies. These are Lake Nasho, Cyambwe, Kivumba, Hago,



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Rwanyakizinga.

- iv. Crater Lakes:** These are lakes formed on a volcanic caldera after the volcano stopped its eruption activities. Crater lakes of Rwanda are located on volcanoes like Bisoke, Muhabura and on the side of Karisimbi.

### 1.9.3. Importance of water bodies in Rwanda

- They allow farming on fertile flood plains and swamps
- They develop recreational facilities like swimming
- Lakes may favor the development of inland port particularly in deed sheltered waters. And favor transport development along rivers and lakes.
- Rivers generate HEP (e.g: Mukungwa HPP, Rukarara HPP, Rusizi HPP etc)
- They may encourage the development of tourism
- They favor development of fishing
- They may encourage mining of valuable mineral such as Peat and coal, Methane gas from Lake Kivu etc
- They provide water for irrigation, industrial purposes and for domestic activities.

### 1.9.4. Challenges to obtain sustainable and clean water in Rwanda

- People lack comprehensive information and awareness on the importance of careful use of water resources. They lack also adequate infrastructure to harvest and store water.
- Climate change has contributed to degradation of water bodies with a decrease in amount and quality of water.
- The conversation of wetlands to agriculture farms has increased rapidly due to scarcity of farmland.
- With agricultural intensification, excessive fertilizers run into lakes and rivers.
- The discharge of untreated waste (both domestic and industrial) directly into water bodies causes water pollution.
- Increased infrastructural and housing developments associated with urbanization have led to lowering water infiltration and increasing run off.

### 1.9.5. Conservation and management methods of water bodies in Rwanda

- Water management is the effective planning and control of the processes and activities that are likely to cause worsening of water resources
- Increasing capture and storage of rainwater to ensure availability of water during the dry season, particularly roof harvesting at household level.
- Organizing focused awareness campaigns that simplify the need for sustainable use of water



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resources, in a language that is clear to people particularly those in rural areas.

- Involving water users including gender groups, administrator and non-governmental organizations in water resources management.
- Enforcing laws against destruction of water resources.
- Enforce recycling/ water re-use
- Protecting water catchment areas
- Treating disinfected community wells and boreholes during drought and floods events to maintain water quality
- Removing invasive plants/waterweeds

### Review questions for unit 1 (Physical Geography of Rwanda)

1. Explain how a sedimentary rock becomes a metamorphic rock
2. Examine the factors that influence the climate of Rwanda
3. With help of examples discuss the significance of the relief features to the development of Rwanda.
4. a) Describe the any three main causes of sheet erosion.  
b) Suppose you are appointed to be an agricultural extension officer in your district, show how you would conserve soils.
5. Our country, Rwanda, is in a region which is tectonically active and subjected to earthquakes events. The more documented earthquake is the one which occurred on 3rd and 4th February 2008. It occurred on Sunday about 09h31 with the magnitude of 6.1 and 5, and on Monday the 4th February 2008 and affected mostly Nyamasheke and Rusizi Districts, Western Province. 37 people died, and 643 injured including 367 traumatized. Many houses were destroyed in these two Districts where 1,201 families were rendered homeless: Knowing the causes of the earthquake, explain how Rwandans can cope with its impacts and other resulting natural hazards.
  - (a) Basing on the knowledge acquired your previous studies; examine the causes and effects of the earthquakes that occur in the region of the western rift valley of Africa where Rwanda is located.
  - (b) Describe any 5 measures to control the effects of earthquakes in your country.
6. (a) Examine the main triggers of soil erosion that use to occur in north- western part of Rwanda. (b) Explain how the community work (umuganda) contributes to reduce soil erosion in your area.
7. “Rocks are good and bad to the society of Rwanda” Discuss
8. Describe the distinctive characteristics of igneous rocks, metamorphic rocks and sedimentary rocks and the places where they used to be found in Rwanda and why such location of them.



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9. Basing on your experience on soils and topography, compare the effects of severe soil erosion in provinces of Rwanda and then analyze the appropriate measures taken by the local community to conserve soil.
10. Carry out a personal individual/group research and establish a relationship between the following concepts in Rwanda:
  - i. Climate change    ii. Global warming    iii. Green house phenomena    iv. Desertification
11. (a) Basing on the knowledge acquired in the first unit of geography of Rwanda, assess the causes, consequences of climate change in Rwanda, and then suggest possible measures to control it.
  - (b) With supporting arguments, explain why causes of climate change and green house differ in rural and urban areas like Kigali.
  - (c) Rwanda needs to develop at high rate with its industrialization processes which are among most causes of greenhouse effects. Suggest the mitigation measures for climate change in that regard.
12. (a) Examine the phenomena that led to formation of various drainage features in Rwanda.
  - (b) Discuss why there is need to conserve drainage systems in Rwanda (Give convincing reasons).
  - (c) Visit a river or lake shore in your local environment and identify what the people around it have done to protect water bodies.
  - (d) Explain the strategies to mitigate natural hazards associated with drainage system.
13. Assess the significance of folding. Faulting, warping and volcanicity to relief and drainage systems of Rwanda.
14. To what extent has vulcanicity shaped the nature of landscape of Rwanda?
15. Assume that you are appointed as Director General of Rwanda Environmental Management Authority (REMA), what are measures that you should reinforce in order to conserve the basin lakes and wetlands found in Eastern province of Rwanda.
16. Basing on the knowledge and skills acquired from your studies, differentiate soil porosity in Eastern Rwanda from those of Northern Rwanda.
17. (a) Visit a weather station near your school to identify instruments used to measure and record weather conditions.
  - (b) Briefly describe the characteristics of Rwandan climate
  - (c) Explain the factors influencing the climate of Rwanda.
18. “Human activities depend upon climate and weather conditions of an area” with relevant examples in Rwanda, support this statement.
19. “Most of entrepreneurs look for climatologists and meteorologists to advise them when locating their firms”, Discuss the statement in the regard of your country.





20. Discuss the distribution of natural vegetation in Rwanda.

## **UNIT 2: POPULATION OF RWANDA**

### *2.1.1. Population distribution*

The population of Rwanda was estimated to be 11,225,190 people with an average of 426 people per square kilometer in 2015 and in 2019. According to the 4th General Census, the total population of Rwanda was 10,515,973 in 2012 whereby only 2,630,904 (23.4%) were living in urban areas. This is a big increase in population living in the urban areas. It was 4.6% in 1978, 5.5% in 1991, and 16.9% in 2002.

In 1900, Mgr Hirth estimated the population of Rwanda to be two million people. Before 1930, there were no reliable tools to fully appreciate the population phenomenon. The population stood at 1,595,400 people in 1934. It rose to 1,887,000 people in 1948, with a population density of 77 people per km<sup>2</sup>. It reached 2,694,990 people in 1960. Thirty years later, the general population census held on 15th August 1978 established that it had reached 4,819,000 people, with a population density of 183 people per km<sup>2</sup>.

There were 7,157,551 people in Rwanda as per general population census of 1991. The socio-demographic investigation carried out in 1996, after the 1994 genocide, put it at 6,167,500 people. The general population census of August 2002 gave the total number of people in the country to be 8,162,715. The population of Rwanda is projected to rise to 11,284,000 people by 2012.

The current Rwandan population is estimated to be approximately **12,626,950** people in 2019 (According to WORLDOMETERS and UN Data October, 2019).

### *2.1.2. Population density*

Population density is a measure of population per unit area. The area may be in square kilometers, hectares or acres. This is a way of considering population size in relation to the land.

There are two types of densities. The first one is physical density. This considers the population divided by the total surface of the area. These include inland waters. The second one is physiological density, which considers the population divided by the land area excluding inland waters. What is considered here is the area actually available for population settlements.





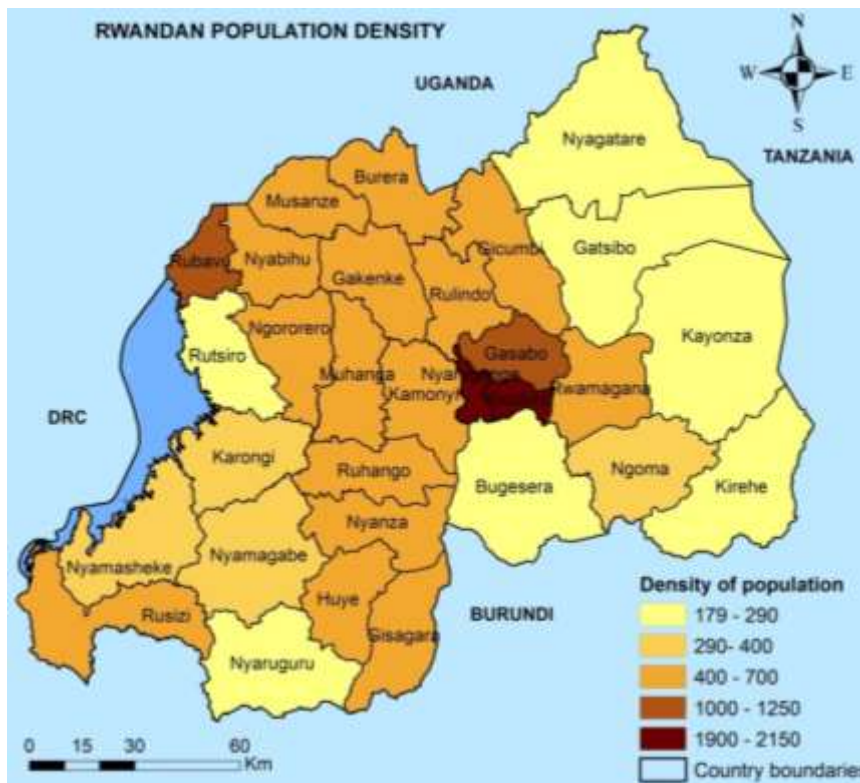
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In 2012, Rwanda had a physical population density of 415 persons per km<sup>2</sup>. The today's population density of Rwanda is estimated to be **479** people per Km<sup>2</sup>. Neighboring countries had the following densities: Burundi (333), Uganda (173) and Kenya (73). Therefore, Rwanda has the highest density in the region (World Statistics, 2013).

Population density varies from one district to another. The least densely populated districts are found in Eastern Province. These are 178 persons per sq. km in Kayonza and 280 persons per sq. km in Bugesera. The most densely populated districts are found in Kigali City: Nyarugenge (2,124), Kicukiro (1,911) and Gasabo (1,234). Rubavu in Western Province has the highest population density outside Kigali City, with 1,039 people per square kilometers.



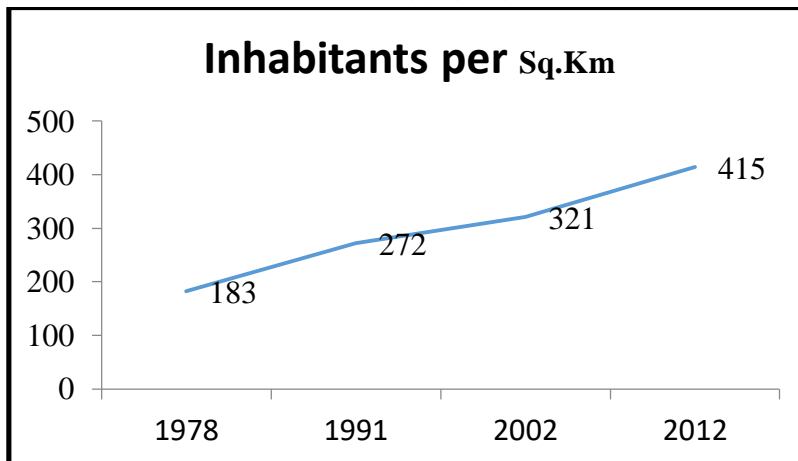
**Figure 15: Population density of Rwanda in 2012**

The population density has more than doubled since 1978 as it is shown in table below:

**Table 1: Trends in population density, 1978-2012**

Year of census	Inhabitants per km <sup>2</sup>
1978	183
1991	272
2002	321
2012	415

**Source:** NISR, Rwanda Population and Housing Censuses 2012, Kigali 2014



**Figure 16: Trend in population density, 1978-2012**

### *2.1.3. Factors influencing population distribution in Rwanda*

Factors Influencing the population distribution in Rwanda can broadly be regrouped into physical, historical, social and economic factors.

- **Climate:** Climate influences the spatial distribution of population through temperature conditions, amount of precipitation and length of growing season. The northern part of Rwanda which receives a good amount of rain fall and cool temperatures is also the highest densely occupied region of the country. Also, areas of the country with high temperatures and low rainfall amount are not favorable for the settlement of the population. This is the real case in the eastern parts of Rwanda reputed to be often dry.
- **Soils:** The attractiveness of a region for human settlement may depend partly upon the quality of the soil. Areas of Rwanda with fertile soils like in the volcanic mountains, marshlands surrounding rivers of Nyabarongo, Akanyaru and Rugezi attract people to come and settle nearby.
- **Landforms:** The factors like altitude, slope, drainage, subsoil water table have been affecting population distribution more clearly at local level. The areas characterized by difficult terrain have conspicuously sparse population. Ever since the earliest civilization, valleys have been the chief attraction of human settlement, while slopes and hill tops have scrupulously been avoided. Wherever the landform is hospitable, population has tended to cluster. In case of Rwanda, regions with high mountains are often less fertile, thus constitute the pushing factor for population settlement. The settlement in the high mountains the Western Province of Rwanda tend to be concentrated on plateaus and plains surrounding the less fertile high mountains in that region.



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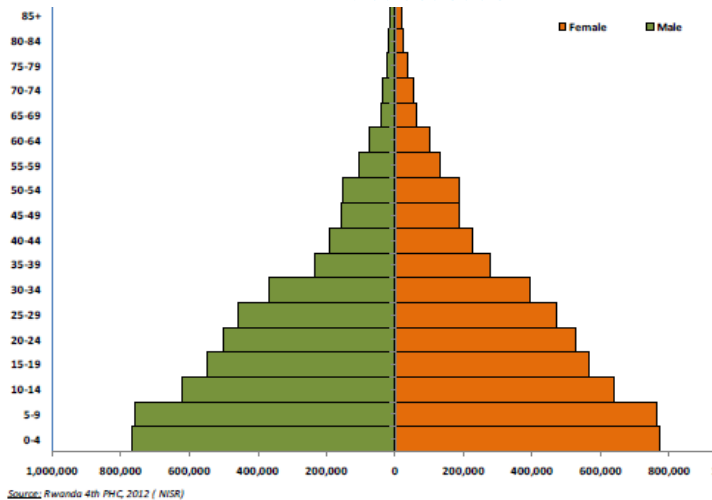
- **Availability of minerals resources:** Energy resources and mineral raw materials have recently gained an influencing power as far as population distribution is concerned. This is due to the ever increasing process of diversification of economy in all regions of the world. In case of Rwanda, some regions of the country which were less populated in the past are now attracting people after the discovery of mineral resources. Examples of these regions include Bulera, Gatumba, Rwinkwavu, Rutsiro, etc.
- **Historical factors:** There are some regions of the country densely populated because they have been early settled. It is currently believed that the high population density identified in the Southern Province of Rwanda is justified by the fact that the region has been occupied by the traditional Rwandan kingdom palaces for a very long period of time. Also regions of Umutara and Bugesera less reputed to be less populated because formerly these regions were infected with tsetse flies.
- **Transport and communication:** The establishment of roads and communication facilities attracted people to build their residences in the nearby. As an example, the construction of the Kigali-Muhanga-Ruhango-Nyanza-Huye has attracted people to build houses at its sides for residence and commercial purposes.
- **Energy Resources:** With the current efforts by the government to distribute electricity and water to the population settled in “Imidugudu”, most of people are being attracted by those basic infrastructures and come to build their new homes in the nearby.
- **Industrialization:** Well industrialized centers located in various parts of the country like in Kigali and other main cities of the country have been often the pull factor for the population settlement in these locations.
- **Political factors:** Various governments the country has known initiated different policies encouraging the population settlement in the particular areas. It is in this regard that in the past, people moved from the Northern overpopulated regions of the country to settle in Bugesera and Umutara, two regions which have been often less inhabited.

### *2.1.4. Population structure of Rwanda*

Rwandan population is currently young with 67% of the total population below the age of 25. According to the general population census held in 2002, people of less than 18 years of age represented more than a half of the total population (52.0%) against 45.1% for adults (18 to 64 years). The percentage of the population aged 65 years and above was only for 2.9%. The age-sex pyramid shown below explains more:



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**Figure 17: The Sex-age pyramids of the Rwandan population in 2012**

The 2012 population census revealed that the Rwandan population was dominated by youth category. 62% of the population was under 25 years, with 41% of them under 15 years. Persons aged 65 and above constituted around 3% of the total population.

### *2.1.5. Factors influencing population growth in Rwanda*

The main factors influencing population growth in Rwanda are:

#### **(i) Fertility**

Fertility is the ability of a woman to give birth to a live child. The frequency at which a woman gives birth is referred to as fertility rate which vary greatly among the women in different regions. The higher the fertility rates, the higher will be population growth. Rwanda experienced a high fertility rate since 1960s which stopped in 1990. The Fertility Synthetic Indication (FSI), which expresses the number of children per a woman aged between 15 to 49 years. FSI was 7.7 children per Rwandan human in 1970 which decreased to 6.2, 5.8, 6 and 5.5 children in 1992, 2000, 2005 and 2008 respectively.

In Rwanda, fertility is influenced by the following factors:

- **The level of education:** The level of education leads to many years of schooling and this reduces reproductive life span of people. The more people get educated, the more they desire higher standards of living which they strive to maintain by having fewer children. In Rwanda, the level of education in Rwanda is still low and that's the reason why they resort to early marriage which leads to uncontrolled birth rates.
- **Cultural influence:** In the traditional African society, high birth is due to the disapproval of smaller families since children are considered to be a source of pride, labor and society. The same situation is likely to prevail in Rwanda where parents in the countryside consider many children as a source of



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protection.

- **The high infant mortality:** Rwanda is still experiencing a high rate of infant mortality. That is why there are families in Rwanda wishing to have many children in order to secure some of them when others die precociously.
- **The big population of women who are between 15 and 35:** Their proportion to men is quite large and since they have no professional occupation, they tend to spend most of their time producing children.
- **Improved nutrition:** With slight positive changes in the Rwandan family life, improved diet has resulted to better nutrition. This has limited the number of people dying but also led to emergence of healthy people with high fertility.
- **Family planning:** Currently the government of has embarked on a sensitization campaign to use modern family planning methods. Although these modern family planning methods started to produce good results in slowing the birth rates, in developing countries like Rwanda, they are still shunned in rural areas because of the negative attitudes towards them.
- **Religion:** In Rwanda, Various religious groups have a direct effect on fertility. This is because some of them advocate against artificial methods of birth control. They instead emphasize natural methods such as abstinence which is not effective in birth control.

**(ii) Mortality rate**

Mortality refers to the death of persons within a given population while mortality rate is the average number per 1000 death. This may have a negative effect on the population growth because when it occurs; it reduces the number of people in a population.

The mortality rates, in Rwanda like in other areas may be influenced by the following factors:

- **Demographic determinants:** Demographically, the risk of death is more in middle and high age-group as they are involved in work of risk while some of diseases are common in young and old age. Mortality rate also differ among the male and female, this is because varying resistance power. The female mortality rates exceed the male mortality rates (in developing countries) due to a variety of reasons like malnutrition, high maternal mortality rate under poor conditions of medical care, subordinate status to women, neglect of female children and a pious feeling of sacrifice among the females for their spouses and children.
- **Social factors:** The medical facilities, nutrition, housing, sanitation and literacy are also the important factors influencing the mortality. The level of education is an important factor influencing the mortality in the way of people at taking care of themselves. Religion has been found to be influencing mortality rates by way of inhibiting the people from accepting or refusing the modern medicines and medical technology. In the context of urban and rural population, in the developing countries the urban mortality

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is lower than the rural mortality, in the developed the mortality rate is higher in urban than in the rural areas.

- **Economic factors:** Among the economic determinants of mortality, the income of an individual may be considered as the most significant. The type of economy like industrial activity cause environment problems, pollution, accidents, health hazards which account of high mortality. The agriculture economy which provide clean environment, good food, etc attributes for lower mortality.
- **Other factors:** Apart from these factors mentioned above, it has also been made of natural calamities, wars, epidemics, food-shortage, which may cause large scale deaths at times. These factors, of course, were more prominent in the historic past and now the world is tightening its grip over the abnormal deaths caused by such factors. However, these factors have been kept in mind wherever an assessment of mortality in any area is to be made.

Due to some of the above mentioned factors, Rwanda registered good results in decreasing the mortality rate among Rwandans for the last sixty years. From the 1950s, the death rate in Rwanda decreased by 50%, and is currently estimated at 1.7%. This decrease portrays a reduction in infant mortality and a gradual increase of life expectancy, which is estimated to stand at 50 years.

### (iii) Migration

Migration refers to the movement of people from one place to another. In the study of population, migration implies a permanent change of home. It may also include temporary change involving seasonal and daily movement. The people involved migration process is known as migrants. The following are the major types of migrations in Rwanda.

- **International migrations:** These are movements of people from Rwanda to other countries. External migrations have occurred at different times in the history of Rwanda. Displacements of population in Rwanda were observed under several shapes whose importance varied in the time. For example, in the 1920s, there have been migrations of Rwandans into neighboring countries like the Democratic Republic of Congo, Uganda and Tanzania were encouraged by the colonial authorities. Large populations in the then Ruanda-Urundi colony served as a reservoir for manpower for the Kivu and Uganda coffee plantations, the Congo-Belgium mining exploitation, including Copper mines of Katanga.

For the period 1959-1960 and 1973, there were often temporary or definite migratory fluxes, whereby an estimated 40% of the emigrants are believed to have settled in these neighboring countries. Later on, thousands of Rwandans were forced into exile fleeing massacres, insecurity and ethnic bases or regional based discrimination.





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The most recent and biggest movement of the population was witnessed in 1994 following the war and the genocide perpetrated against Tutsis.

Rwanda has in the recent past recorded people from other countries coming to Rwanda. According to the 2002 population census, a big volume of international immigrants came from the neighboring countries notably the Democratic Republic of Congo, followed by Uganda, Burundi and Tanzania.

- **Rural to rural migration:** These are movements of people within the country. People move in search of agricultural land and jobs and these movements are still taking place up to date especially towards eastern Province of Rwanda where there is low density of population.
- **Rural to urban migration:** With the rapid urban-industrial development taking place in various areas of the country, i.e. Kigali, Musanze, Muhanga, Nyanza, Karongi, Rubavu, etc, these areas generate pulling migratory tendencies among the people who are jobless in rural areas. In rural areas on the contrary, the appalling poverty, unbearable unemployment, low and uncertain wages and lack of facilities for education, health, recreation and other services work as the constitute the push factors to the cities.
- **Urban to urban migration:** In Rwanda, the people move from one urban centre to another with view to improving their employment prospects.
- **Urban to rural migration:** With the current establishment of new master plans for Rwandan cities, the neighboring rural areas were incorporated in urban zones where city residential zones have been established. With the high living costs in the heart of the cities, people tend to establish themselves in the neighborhood of the cities where the life is still cheaper.
- **Miscellaneous migrations:** In the efforts of resettling the population, the government of Rwanda is encouraging the population to move from their usual residential areas to settle in new predetermined zones known as “Imidugudu” in order to accede easily to basic infrastructures like schools, hospitals, water, and electricity.

The above mentioned types migrations may be short-term or long-term migrations: Short-term migrations occur in the form of transfers to other places or holidays for students or employees on annual leaves. Long-term migrations, on the other hand, are prolonged resettlement to other regions of the country.

### *2.1.6. Consequences of population growth in Rwanda*

The high population growth has the following effects on the socio-economic development of a country like Rwanda.

- **Inadequate food supply:** For Rwanda, the high population growth means that there is a lot of pressure on land where agricultural activities are limited due to land fragmentation. The small parcels currently





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run by households cannot produce enough food to feed the steady growing population of Rwanda. Such situation may result in food shortage hence inadequate food supply.

- **Unemployment:** The high population growth in Rwanda can lead to unemployment or underemployment. When there are too many people chasing few available job vacancies, the remaining population remains jobless.
- **High crime rate:** With the rapid growing population, the unemployed people may engage in self-employment for their survival. Some may embark on Illegal activities like drug abuse and theft.
- **Rural urban migration:** In rural areas of Rwanda, sparsely populated areas lack most of the social services and people, mostly the youth; tend to move from rural areas to urban centers where they expect to get those services.
- **Housing and Health:** With the rapid growth of population in Rwanda, standards of living in become low and housing conditions are often poor and overcrowded. Standards of hygiene and nutrition are also low and this leads to health problems such as malnutrition, and the spread of diseases.
  - **High dependence rate:** With the high birth rate and unemployment, a larger percentage of the population relies on a few working population. This often leads to a high dependency ration and less development because the few available resources are used to sustain other family members who are not working. At national level, the high birth rate often resulted to social economic dependency on other countries in terms of food resources, capital and other resources.
- **Environmental degradation:** The rapid population growth leads to a high demand of energy resources. It further leads to the need for more land for settlement. These results into encroachment on the country's scarce forest resources. The natural forest of Gishwati in the Northern part of the country is a clear example of the environmental degradation due to the rapid growth of the population In Rwanda.
- **Inadequate social amenities:** The rapid growth of the population puts a strain on social amenities like schools, hospitals, and water, transport and sewerage systems. In Rwanda we are currently experiencing the overcrowding in schools, in hospitals. In the capital city Kigali, huge crowds and queues are a characteristic of transport terminals as people struggle get to and from the work.
- **The slow economic development:** The high population growth in Rwanda Imply that a larger percentage of the government resources are channeled toward improving the living conditions of the population. The government resources are stained hence very little in reserves left to do the general development of the country. This result in slow economic development rate.

### 2.1.7. Solutions for the Rwandan rapid population growth

The rapid population growth is one of the major threats the socio-economic development of Rwanda. Matters concerning population growth and distribution must be approached cautiously because they determine how resource allocation and services provision in the country are done. Policies and development programs need to be adopted and implemented to promote the quality of life for Rwandans. Some of the

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policies and programs which may be adopted to alleviate problems associated with the rapid growth of the population in Rwanda:

- Controlling the birth rate: This is the most practical solution as it effectively cuts down the rate of population increase. However, it often meets objections from religious and traditional groups. Birth control can be done through family planning.
- Making the basic reproductive health care and child health care services available to the entire population
- Making school education up to 18 years of age free and compulsory for all because an educated population can easily assess benefits of family planning.
- Bringing down the incidence of school drop outs to less than 5% for both boys and girls.
- Effectively rising the age of marriage to the legally prescribed age of 21 or more, because this delays the age of bearing children
- Expanding to the entire country the information and services related fertility regulations.
- Expanding to the entire population vaccines for preventable diseases.
- Preventing and control all communicable diseases.
- Bringing down the maternal mortality rate.
- Developing natural resources: A more positive step should be taken to develop the country's natural resources such as minerals, power, forestry and agriculture so that more people can be supported.
- Higher food yields: existing farm land can be made to produce higher yields if experiments and research are carried out to bring about improvements in the following fields: farm technology, plant breeding, farm mechanization, fertilizers and insecticides. Swamps too can be drained and deserts irrigated to provide more land for farming.
- The government of Rwanda needs to laws limiting the number of children legally accepted per couple.
  - Integrating the system of medicines into the reproductive health and child health care service delivery system.
- The role of religion: Christian churches and other faith congregations need to encourage the policies related to family planning.



## 2.2. Rural and urban settlements

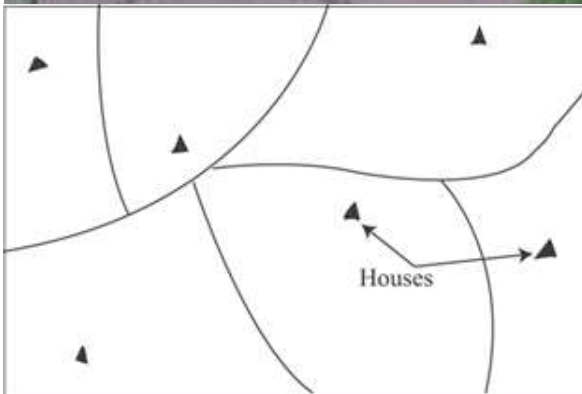
### 2.2.1. Rural settlement

The rural settlement is a name given to any village settlement in a wide piece of land. Rural settlement is the most common types of settlements in the world especially in the country sides.

### 2.2.2. Types and characteristics of rural settlement in Rwanda

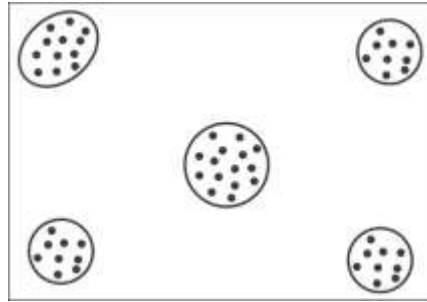
For Rwanda, patterns of rural settlement refer to the shape assumed by a settlement. Several settlement patterns can be identified in rural areas of Rwanda. The most common settlement patterns found in Rwanda are highlighted below:

- **Dispersed (scattered) settlement pattern:** These are scattered individual houses across an area. They are located a distance apart from each other. In such settlement, every family lives on its own pieces of land, which are usually acquired through inheritance (isambuy'umuryango)



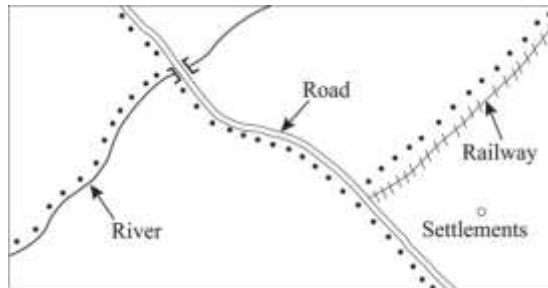
**Figure 18: Dispersed settlement**

- Nucleated settlement pattern:** Nucleated settlement is also known as clustered or grouped settlements. Such settlements, which came to be known as the Imidugudu, are being established as an effort of the government to reverse the situation of scattered settlement. The rationale was to focus on group settlement and, in so doing, solve the problem of land scarcity and environment management at the same time. At the same time, it becomes easier for the government to provide such services as education and health more efficiently.



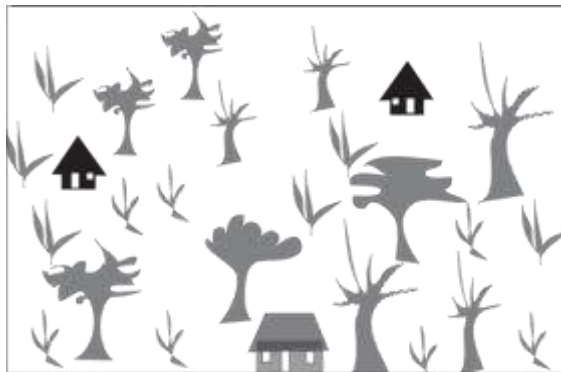
**Figure 19: Nucleated settlement**

- **Linear settlement:** this is where houses are well planned. They are built along the road, river or along the coast.



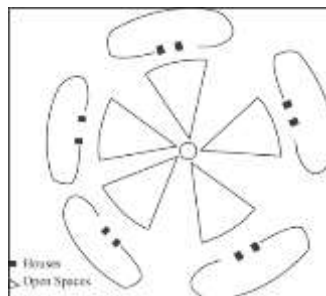
**Figure 20: Linear settlement**

- **Isolated settlement:** this is where a few people live away from other people. These people could be hunters in a forest.



**Figure 21: Isolated settlements**

- **Ring settlement:** in this type of settlement, houses make a circle. There is an open ground at the centre.



**Figure 22: Ring settlements**

- **Planned settlement:** houses are built in a certain pattern. The planning could be as directed by the government.





**Figure 23: Planned settlements**

### 2.2.3. Factors influencing rural settlements

A good number of factors influence the location and the situation of rural settlements in Rwanda. Those factors include:

- **Water supply:** water is the most elements necessary for human needs. In Rwanda, most of settlements were established in the neighborhood of sources of water like rivers, lakes,
- **Land fertility:** Rwandan farmers often choose to settle at points where the land is suitable for their traditional crops.
- **Secured zones:** Traditionally, Rwandans used to settle on the top of hills for defense reasons.
- **Shelter:** The availability of building materials, either wood or stone is another factor pulling the population in the nearby settlement.
- **Good climate:** In Rwanda, area characterized by a cool climate favor the settlement whereas in other areas characterized by extreme climatic conditions, they constitute a pushing factor for settlement.
- **Availability of infrastructure:** With the current policy of nucleated settlements with basic infrastructures like roads, schools, hospitals, such areas are attracting population.





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- **Presence of minerals:** Mining areas of Rutongo, Rwinkwavu, Gatumba and Rutsiro have attracted people who came for employment opportunities hence the establishment of settlement patterns like staff quarters, markets and schools.
  - **Government policy:** The government of Rwanda is currently intervening in the resettlement of the population with the aim of solving the problem of land scarcity and providing basic infrastructure to them.
  - **Relief:** Rwanda is characterized by the relief made of mountains, plateaus, plains, and marshlands. These play an important role in location a settlement. Sloping, mountainous and eroded areas are less attractive to settlement, while the plateaus and plain areas are likely to attract settlement.

### 2.2.4. Problems affecting rural settlements

Since the colonial period up to 2000, Rwanda lacked a human settlement development framework. This has largely contributed to the expansion of unplanned residential areas. With the scattered settlement in rural areas, people face many problems which include:

- Limited access to the basic infrastructures such as water, electricity, roads, etc.
- Limited access to the social services such as hospitals, schools and markets.
- Land conflicts: With land fragmentation, people fight for land for settlement and agriculture.
- Spread of disease like dysentery, cholera, and malaria due to poor hygiene and compaction of individuals.
- The environmental degradation due to high demand for building materials, firewood, charcoal which further result into soil erosion reduction in rainfall and landslides.
- Poor hygiene in congested areas leads to spread of diseases like dysentery, cholera and malaria.
- Difficulties of mobilization to the community works.

### 2.2.5. Urbanization in Rwanda

Urbanization is a process in which an individual or a proportion of a country's population is transformed from rural based agricultural and pastoral lifestyle to urban based lifestyle.

### 2.2.6. Characteristics of urban centers in Rwanda

The concept of urbanization is a relatively recent phenomenon in Rwanda. It was the Germans who encouraged the creation of city centers through the establishment of military stations as follows: Ruhengeri in 1903, Gisenyi in 1907, Kigali in 1907, Gatsibo in 1913 and Cyangugu in 1914. These stations served as administrative, commercial and religious centres.



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Few cities were established under the Belgians colonialism. It was not until 1973 that the government came up with a sustainable urban policy, which saw the creation of the districts of Ngoma (Butare) and Nyarugenge (Kigali). At the same time 12 urban circumscriptions (10 sieges of prefectures plus Nyabisindu and Rwamagana) were clearly defined.

Most of these circumscriptions were occupied by a small number of people. Only three of them had high population densities. The number of people in each was as follows: Kigali-85,000; Butare-11,000; Ruhengeri-8,000; Gisenyi-10,000; Nyabisindu-4,500; Gitarama-3,500; Cyangugu-5,500; Gikongoro-2,400; Kibungo-2,000; Byumba-2,000; Rwamagana-3,100; and Kibuye-1,700.

Currently there are about 18 major urban centres in Rwanda. They Kigali, Huye, Nyamagabe, Rusizi, Karongi, Musanze, Rubavu, Muhanga, Gicumbi, Ngoma and Kayonza. Others are Nyagatare, Kabuga, Nyanza, Ruhango, and Rwamagana.

### 2.2.7. Factors influencing urbanization in Rwanda

Urbanization is a socio-economic and demographic changes of an areas or a region of country which that take place with time. Factors which influence urbanization in Rwanda include:

- Population increase: Rural to urban migration has over years resulted into population concentration into towns in Rwanda. As people moved to towns, the existing social infrastructure were overstretched. Consequently, towns were forced to expand their territories, put up more houses and other social amenities in order to cope with the rising population.
- The improvement in transport facilities which enable the exchange of goods and services easily.
- The increasing proportion of population employed in a wide variety of tertiary activities
- Industrial development: People are often attracted by employment opportunities offered by industries. Workers therefore have to live nearby their working places and this leads to the increase in population hence emergence of the industrial cities and towns.
- Improvement of medical services, sanitation and general standards of living
- Development of light industries (electrical, electronics, garments, printing and publishing, advertisement, etc.)
- The presence of administrative services. Most people come to cities in search of administrative services



### 2.2.8. General problems of urban centers in Rwanda

Although cities in Rwanda are actually having remarkable records in terms of spatial and economic development, many of them faces a good number of problems which include: .

- **The loss of culture identity of the society:** This is as result of the interaction of different cultures from different people including foreigners.
- **The pollution of land, air, water and noise:** This is because of poor disposal of garbage and the existence of very many vehicles and industries.
- **The shortage land for agriculture:** As towns expand, land for agriculture is reduced in favor of settlement and this in turn may result into a decline in food production.
- **Unemployment and under employment:** this is because of the high urban population that competes for the low employment opportunities.
- **Urbanization creates congestion** especially during rush hours when people go to or come from the work.
- The big number of population in urban centers can leads to the problems of insecurity. The security personnel can be overwhelmed by the rising crime rates.

### 2.2.9. Solutions to the urban center problems in Rwanda

In order to overcome problems related to the development of urban centers in Rwanda, both the government authorities and the inhabitants of those cities need to cooperate to find the appropriate solutions. Here are some of the solutions to the problems faced by cities:

- The problem of accommodation can be solved or reduced by the construction of skyscrapers or stored houses which occupy little space on the ground and can accommodate very many people.
- Enlargement of roads by constructing high ways and subways for vehicles and pedestrians in addition to strict laws governing traffic.
- Enforcing tight security and punishing law breakers like those involved in robbery theft murder and prostitution.
- Government policy of in acting goes back to land policy by extending the services which are in urban centers to rural areas such that rural urban migration can be reduced.



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- Garbage within urban cities should be cleaned by forming cleaning association and be dumped in particular places where they are burnt or recycled into other useful products.
- Attracting foreign investors to establish more industries both in rural and urban centers to provide employment to the majority and where necessary to form labour organizations.
- Good urban planning strategies to avoid further slum development, digging water tunnels to direct water and replacing semi-permanent structures by permanent structures.

### 2.3. Agriculture and livestock farming

Agriculture and livestock farming are the art and science of growing crops and rearing animals respectively. It is the most common human activity from which human needs like food, clothing and shelter are provided. Livestock farming is the rearing a large number of livestock on a permanent farm. The animals kept include cattle, goats, sheep, pigs, rabbits, poultry, etc.

#### 2.3.1. Overview of agriculture in Rwanda

The Rwandan agriculture is dominated by food crops namely: bananas, which occupy more than a third of the country's farmland, potatoes, beans, rice, sweet potatoes, cassava, wheat and maize. Coffee and tea are the major cash crops for export. Reliance on agricultural exports makes Rwanda vulnerable to fluctuations in the prices. Animals raised in Rwanda include cows, goats, sheep, pigs, chicken, and rabbits, with geographical variation in the numbers of each. The occurrences of extreme weather events like droughts and floods, although not frequent, affect food production in many parts of the country.

#### 2.3.2. Crop cultivation in Rwanda

##### 2.3.2.1. Subsistence cultivation in Rwanda

###### (i) Characteristics of subsistence agriculture

Subsistence cultivation practiced in Rwanda is also known as sedentary subsistence agriculture. With the population growth which put pressure on land, sedentary subsistence agriculture is therefore a more advanced form of subsistence farming. This kind of agriculture refers to the growing of food for domestic consumption. It is characterized by the following elements:

- Every bit of arable land is put under agriculture
- Multiple cropping: Several crops are grown on the same land during the year. This include double and treble coping
- Farms are small, barely a few hectares of land remain under cultivation due to the high population densities,



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- Farms are often fragmented in scattered plots.
- Use of simple tools: Much of the farming is done using simple implements like ploughs, hoes, machetes and spades
- Use of farm manure and fertilizers: Farmers make use of all available manure like farm wastes, rotten vegetables in order to sustain the soil fertility and ensure high yields.

Subsistence crops cover about 90% of all the cultivated farmlands. Banana occupies more than a quarter of this area, followed by beans at 21%, sorghum 10%, sweet potatoes 12% and cassava 8%. The agricultural production in Rwanda does not meet the food requirements of the population fully. On average, a person needs 2100 kilocalories, 59 grams proteins and 40 grams of lipids per day. In 2001, these requirements were met at the rate of 83%, 73% and 17.5% respectively.

### **(ii) Problems faced by subsistence agriculture in Rwanda**

Subsistence agriculture in Rwanda faces the following problems:

- Shortage of land for cultivation because of the increase in population in almost all parts of the country.
- Traditional customs that hinder the development of subsistence farming. It is not easy for farmers to change from the traditional way of farming.
- Farming is largely influenced by climatic changes. In a tropical country like Rwanda, heavy rains often cause soil erosion. High temperatures during the dry seasons destroy crops. Famine may result from this.
- Farmers do not have the capital required to develop their farms.
- Most of the farmers lack skills necessary to carry out farming that would yield good produce. At the same time, most of them are illiterate.

### **(iii) Advantages and disadvantages of improved subsistence crop cultivation**

Improved subsistence crop cultivation which is also known as intensive crop cultivation is a kind of agriculture where the dense population calls for very intensive farming where a small plot of land has to support a big number of people.

Improved subsistence crop cultivation has the following advantages:

- It provides adequate food for the dense population found in the areas where it is practiced
- Little capital outlay is required to establish and maintain the farms
- Multiple cropping and intensive farming ensures maximum utilization of land
- Small farm sizes ensure the ease control of pests and diseases
- The well maintained small plots lead to low incidence of soil erosion

Improved subsistence crop cultivation has also the following disadvantages:

- It encourages the overuse of land leading to soil exhaustion
- The system is severely affected in case of climatic hazards like insufficient and unreliable rainfall.

### **2.3.2.2. Plantation farming in Rwanda**

Plantation farming is the scientific and commercial cultivation of crops on large tracts of land called estates.

#### **(i) Major plantation crops in Rwanda**

The main plantation crops in Rwanda include coffee, tea, sugar, pineapples, pyrethrum and maize. These

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crops were brought into the country during the colonial period.

- **Coffee:** It is the most successful of all the cash crops that were introduced in Rwanda. The missionaries brought to the country, with seeds imported from Karema in Tanganyika. The earliest experiments on coffee farming were carried out in Save in 1902, and later in Kabgayi in 1907. Robusta coffee was introduced in 1924 in Kabgayi, Rwamagana, Rwaza, and Kigali missionaries. The Guatemalan variety (Arabica) was grown in Save and Nyaruhengeri. In 1930, growing of Arabica was introduced in the whole country. Coffee accounts for 70% of the country's exports.
- **Tea:** Tea is a more recent cash crop in Rwanda compared to coffee. During the colonial time, it was grown in two private farms of Gicumbi and Rulindo; Motrmans plantations (1946). There are vast tea plantations in Murindi. The growth of tea increased steadily from 1,930 hectares in 1967; 3,597 hectares in 1972; 6,895 hectares in 1972; 9,220 hectares in 1981; 9,752 hectares in 1983; 10,300 hectares in 1984 and 11,727 hectares in 1988. Tea plantations are found in Gisakura, Gishwati, Gisovu, Kitabi, and Gaseke. Tea accounts for 20% of the country's exports.
- **Pyrethrum** is grown in Nyabihu, Musanze, Burera and Rubavu Districts. The crop is grown in the highlands. These are areas with cool temperatures, high rainfall, fertile and well drained soils. Pyrethrum is used to make insecticides for killing mosquitoes.
- **Cotton:** Cotton was introduced in Rwanda as an extension of the Burundi plantations by the Belgians. The production of cotton reached its peak in 1958. From 1962, its planting recessed. It was completely abandoned in 1972 and was replaced by rice.

### (ii) Necessary conditions for plantation agriculture in Rwanda

The following are the necessary conditions for plantation agriculture in Rwanda

- The availability of large pieces of land covering over 1,000 hectares.
- The disposal of large sum of money to run the plantations.
- The availability of enough skilled manpower
- The Well established and good transport and communication networks.
- The large internal and external markets for plantation products.

### (iii) Characteristics of plantation farming

The following are the necessary conditions for plantation agriculture in Rwanda:

- Availability of large pieces of land over 1,000 hectares.
- Large sums of money to run the plantations.
- Availability of enough skilled manpower.
- A well-established transport and communication networks.
- Availability of markets for plantation products

### (iv) Advantages of industrial agriculture

Plantation farming plays a big role in the development of Rwanda. Below are some of its advantages.

- It is a major source of foreign exchange.
- It is a source of employment for many people.
- It contributes to the development of basic infrastructure like roads, schools and health centres. These are built where the farms are found. It leads to the economic and social development of these regions.
- High quality foods are produced. This leads to good health of the people.
- Workers gain skills, which they then use to improve farming in their homes.
- It contributes to urbanization in the areas where it is located.





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**(v) Problems affecting plantation farming in Rwanda**

The following problems are found in plantation farming in Rwanda:

- The growing of one crop on large areas can lead to soil exhaustion. This is because the crop takes away the soil nutrients. A good example is the growing of tea at Murindi tea plantations.
- Land fragmentation, especially in Rubavu, Nyabihu and some parts of Gicumbi, Huye and Muhanga. The land is so subdivided that it is now not possible to practice large scale farming.
- The climate, especially heavy rains or unreliable rainfall limit plantation farming. In Rwanda, for example, prolonged droughts lead to withering of many coffee trees and sugar cane.
- There are problems associated with physical features. These include unfavourable relief in the northern part of Rwanda, thick vegetation on the slopes of Birunga mountains, marshlands and swamps of Akagera. Use of machines is not possible.
- Lowland plains and river basins often experience floods, which destroy crops. For example, the plains of rivers Nyabarongo, Akanyaru, Akagera are often flooded during the rainy seasons.
- Plantation crops are often attacked by diseases, for instance, leaf curl in tea.
- There is stiff competition in the international market. This leads to unstable and low prices of produce.
- The limited number of skilled and trained workers in plantations affects production.
- Poor transport networks linking plantation farms to the factories. This is true for sugar cane at Nyamata along river Nyabarongo to Kabuye Sugar Works.

**(vi) Ways of improving agricultural production in Rwanda**

Agriculture in Rwanda can best be improved by modernizing it. This is achieved by:

- Using modern methods of farming like use of fertilizers, planting improved seed varieties, keeping of high quality animal breeds and crop rotation.
- Bringing large numbers of farmers under cooperative societies or associations.
- Practicing irrigation in areas that receive unreliable rainfall.
- Practicing crop production and animal keeping together.
- Economical use of water and better swamp management.
- Improvement of commodity prices.
- Using the latest technology to improve production.
- Sensitizing the people on the benefits of investing in agriculture.

**2.3.2.3. Livestock farming**

Livestock farming is the rearing of animals for subsistence or commercial purposes. In Rwanda, livestock farming falls under traditional pastoralism and dairy farming. The government placed a ban on nomadic pastoralism and instead encouraged the people to keep cattle in sedentary ranches and farms.

**2.3.2.4. Traditional livestock farming (Pastoralism)**

This is the traditional way of rearing animals. People moved from place to place with their animals in search of water and pasture. It is no longer practiced in Rwanda following the shortage of land. As the population continued to rise, people settled permanently on their own pieces of land. This type of livestock farming is no longer allowed in Rwanda.

**(i) Characteristics of pastoralism in Rwanda**

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In Rwanda, the main characteristics of pastoralism or traditional livestock farming are:

- It is carried out in areas that receive low and unreliable rainfall.
- The rearing of large herds of animals.
- Pastoralism is often carried out in areas where the dominant type of vegetation is savannah grasslands.
- Pastoralism is carried out in areas which are relatively flat.
- Animals are grazed communally on lands that are not fenced.
- Animals often travel long distances for pasture and water.
- Nomadic pastoralists practice bush burning, especially during the dry season in preparation for fresh pastures at the outset of the rains.

### (ii) Problems affecting traditional livestock farming in Rwanda

Traditional livestock farming is mainly affected by:

- Droughts, during which the vegetation dries up leading to shortage of pasture and death of animals.
- There is also a shortage of water during the dry season.
- Pests such as tsetse flies that transmit diseases to animals. Others such as locusts destroy the pastures.
- Diseases such as foot and mouth, and pneumonia.
- Poor and insufficient veterinary services.
- Poor animal breeds which yield low milk and meat.

### (iii) Contribution of pastoralism to the economic development of Rwanda

Although pastoralism is not practiced as it used to be in the past, it contributes a lot to the economic development of Rwanda in the following ways:

- Indigenous cattle provide milk and meat to the people.
- Pastoralism is a source of foreign exchange through the exportation of commodities such as hides and skins.
- Pastoralism is a source of employment to the rural people.
- The cattle provide cow dung, which is used as manure.
- The cow dung is also used to generate biogas, which is used as a source of energy.
- Cattle are used as bride price in almost all communities in Rwanda.
- Pastoralism makes good use of land that is unsuitable for farming.

#### 2.3.2.5. Modern livestock farming

This is the rearing of a large number of livestock on permanent farms. The animals kept include cattle, goats, sheep, pigs, poultry, rabbits, etc.

##### Dairy farming in Rwanda

This is the specialized rearing of cattle to produce milk and other dairy products like cheese, butter and cream. In Rwanda, dairy farming mostly involves the rearing of exotic breeds and crossbreeds between the Zebu and the Ankole cattle.

Dairy farming in Rwanda is characterized by:

- **The limited movement of cattle:** There is minimal movement of animals from one area of pasture to another and ranchers live on permanent farms
- **The scientific management:** Dairy farming In Rwanda resorts to modern farming methods and the



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ranches are scientifically managed through selective breeding, use of hybrid species, research and control of animal diseases, etc.

- **Commercial oriented farming:** Animals are reared purely for commercial purposes and some products such as milk and meat are produced for the export market.
- **Large number of herds:** Since the farms are quite extensive, large herds of animal are kept with minimal or no impact at all on the ecosystem.

In Rwanda, dairy farming production has been improved by "one cow per poor family" set by the government of Rwanda along with other programs in place which have the objective of increasing the number of livestock e.g. KWAMP intervention In Kirehe district.

However, dairy farming is facing a good number of problems which hinder its effective development in the country:

- A high capital investment is required to establish and maintain farms
- Animals In farms are delicate and highly vulnerable to diseases
- Milk being a perishable good, farms holders in the country face challenges of milk transportation because they still lack modern containers allocated to milk transport and conservation.
- Exotic cattle are often sensitive to climatic changes in the country.

### 2.3.2.6. Rearing of smaller animals in Rwanda

Smaller animals include goats, pigs, rabbits and poultry. In many parts of Rwanda, smaller animals are kept for domestic purposes. Smaller animals in some instances are kept for sale by individuals who have organized themselves into cooperatives. The rearing of smaller animals is mostly carried out by low income earners.

#### (i) Factors influencing the keeping of small animals in Rwanda

Smaller animals are kept because of the following factors:

- **Low income:** Low income earners cannot afford bigger animals such as cows.
- **Shortage of grazing land:** The increase of population means reduced land for grazing, cultivation and settlement. Smaller animals are preferred because they require little space.
- **Availability of market for smaller animals:** Smaller animals such as poultry, rabbits and pigs are consumed in large quantities in towns.
- **Fast maturity:** Animals such as chicks, rabbits and goats mature and multiply faster than cows.
- **Fewer complications:** Smaller animals are not adversely affected by diseases and parasites as are bigger ones.

#### (ii) Importance of keeping smaller animals in Rwanda

Smaller animals are important for Rwandans in the following ways:

- They are a source of income for the poor.
- They lead to economic development through trade between rural areas and urban areas.
- They lead to small-scale industrial development like meat canning in urban centres.
- Keeping smaller animals helps to diversify the home economies since it reduces the reliance on farming.



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- Smaller animals improve standards of living for the people in rural areas through education of their children, improvement of nutrition and health.

### 2.3.2.7. Importance of livestock farming in Rwanda

Livestock farming is generating high income to farmers involved in this activity, hence leading to the economic growth of the country. Particularly:

- The production in livestock farming ensures a high and steady income for the farmer hence enabling him/her to be self-sufficient in food requirement.
- Livestock farming helps the farmer to diversify income.
- Livestock farming leads to the maximum utilization of land.
- Exports products from livestock farming earn foreign exchange to the country.
- Livestock farming may promote Industrial development through the establishment of animal products processing industries
- Livestock farming help In the provision of food in the form livestock products such as meat and milk
- Livestock farming produce manure which is used in the fertilisation of agricultural lands

### 2.3.2.8. Solutions to problems affecting livestock farming in Rwanda

Problems affecting livestock farming can be solved in the following ways:

- Introducing improved breeds through cross-breeding and artificial insemination.
- Introducing paddocks in pastoral areas.
- Tapping underground water by constructing boreholes and valley dams to trap rainwater.
- Setting up milk collecting centers with cooling and refrigerated facilities to encourage commercial animal rearing.
- Initiating educational programs to herdsmen and farmers. This can be done through providing medical and veterinary services.
- Introducing regular pest controls measures through research, spraying, dipping and vaccination.
- Introducing quick maturing crops and grass, which can be stored as hay to feed the animals during the dry seasons.

## 2.4. Fishing in Rwanda

Fishing can be defined as all the activities involved in harvesting aquatic life in the seas and inland waters all over the world. Fisheries on the other hand are all the water resources which form the habitat from which fish is harvested. These include oceans, rivers, ponds and lakes.

### 2.4.1. Major fishing grounds of Rwanda

The major fishing grounds in Rwanda are located in regions of the country possessing lakes and big rivers. These regions include mainly the Eastern Province of the country where the majority of the country's lakes are located. Fish farming can easily be practiced in lakes like Muhazi, Ihema, Nasho, Mugesera,



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Rwanyakizinga. In the Western Province of the country, Lake Kivu constitutes a very large and interesting ground for fish farming.

However, Rwanda being a country endowed with a lot river valleys; it is very easy to create fish ponds in any part of the country as it is being done in Muhanga district with the valley of Rugeramigozi.

### *2.4.2. Factors favoring fishing industry in Rwanda*

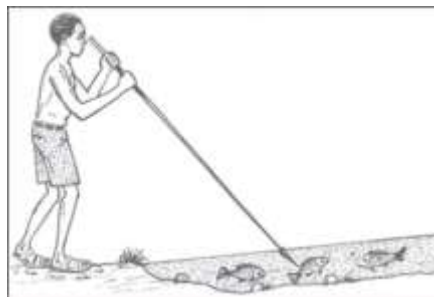
The basic requirement for any type of fishing to take place is the availability of a water body, an environment in which fish and other edible aquatic life thrives. However, in the context of Rwanda, there are certain specific factors which influence the fishing Industry In the country.

- **The presence of planktons:** Plankton is a term which is used collectively to mention millions of microscopic organisms found in shallow waters and which forms the basic natural food for fish. There are two types of planktons, i.e. phytoplankton (tiny plant organisms drifting at or near the water surface) and zooplanktons (microscopic animals fed on by fish). In the case of Rwanda, planktons thrive in shallow waters where sunlight can penetrate and in derived minerals. That's why mineral regions where salt minerals are brought to the lakes by rivers constitute preferable environments for fish farming in the country.
- **Indented coastlines:** Many lakes of Rwanda with sheltered inlets and estuaries enjoy ideal conditions for the establishment of fishing environments.
- **Environmental influences:** Rwanda is a country made of rugged mountains which somehow limit agricultural activities. In response to this situation, fish farming can be encouraged as substitute to the low productive agricultural lands.
  - Presence of high rainfall. This adds fresh water in lakes and rivers, and provides good conditions for growth of fish.
  - Increase in the demand of fish due to increase in number of hotels and restaurants.
  - Reduced size of land for farming. This drives some to do fish farming.

### *2.4.3. Methods of fishing in Rwanda*

In Rwanda, different methods of fishing are used in catching fish in different parts of the country. But most of them are still traditional or small scale fishing methods. They Include:

- **Harpooning:** This is the simplest and most traditional method of fishing. It Involve the use of a spear, an arrow or a sharp ended stick. It is applied where the waters are relatively clear, shallow and calm. The fish is caught a few meters from the shores especially in the morning hours when the water is calm.



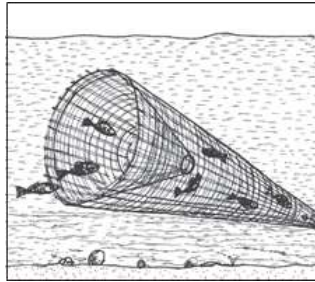
**Figure 0-14: Fishing using harpooning method**



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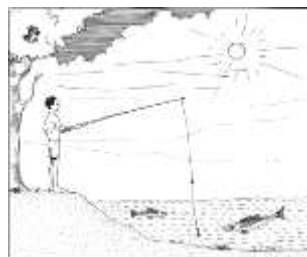


- **Woven basket:** This method uses baskets made of papyrus reeds. The basket fitted with bait is lowered in shallow waters with the mouth facing the direction from which the water is flowing. At the mouth of the basket, a narrow inlet is left open. On the entry of the fish, the outward escape movement is restricted. The basket is held in a position with ropes, stones or stick to prevent it from being swept downstream by the water currents. It is left in that position for some time for fish to make entry. Later, the basket is removed for the landing of fish.



**Figure 25: Fishing with woven basket**

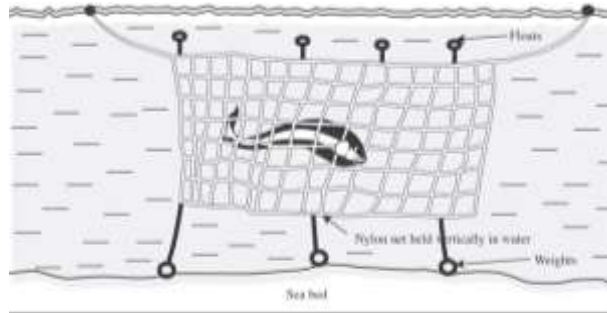
- **Hand lines:** It is the simplest method of catching a single fish at a time. A special string is tied to a single hook. This is then attached to a long rod which is held by the shore. The string has float to serve as an indicator. The hook is then baited and cast into water. When the fish swallows the bait, the float sinks and the rod is pulled backwards to obtain the fish.



**Figure 26: Fishing with Hand lines**

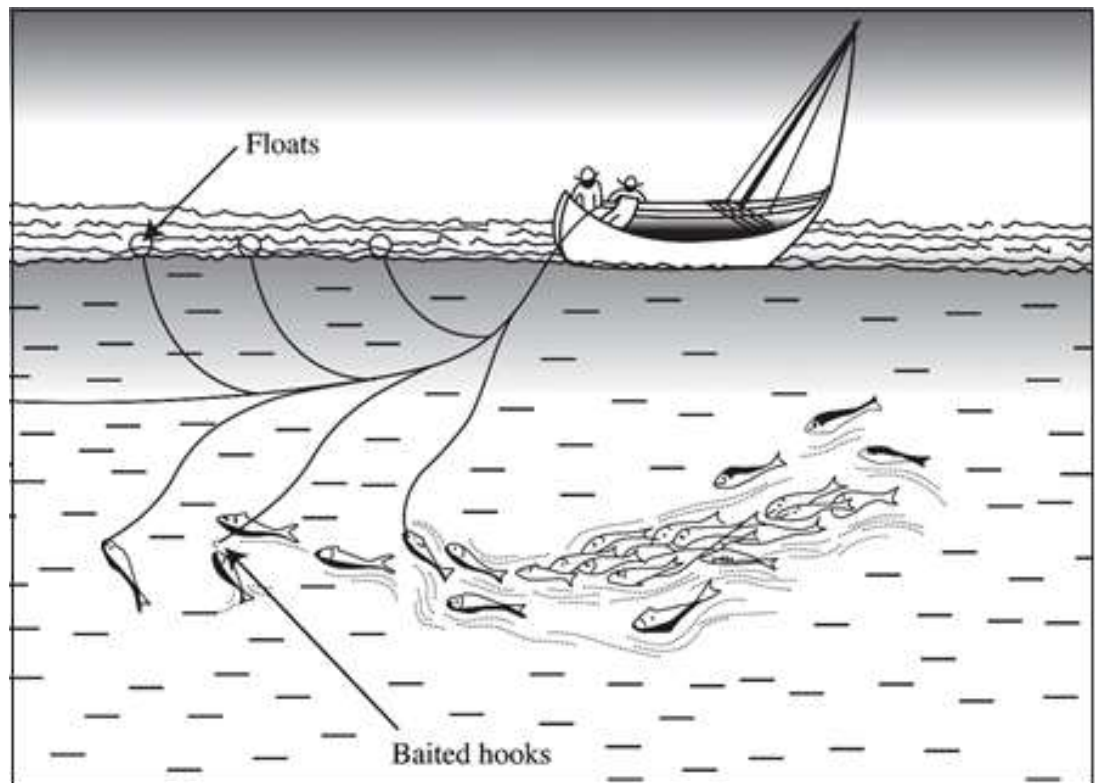
- **Drifting method:** This method involves hanging tennis-like nets vertically in waters to catch the fish. The nets are maintained vertically by float on the upper parts and weights on the lower side. On both sides of the edge of the lower net, it is anchored by large stones which extend up to the lake beds. The net is left overnight. When fish swim into the net, they are entangled by their gills hence are unable to move either backward or forward. Once the fish is caught, the net is hauled to the drifters back to the shore for landing.





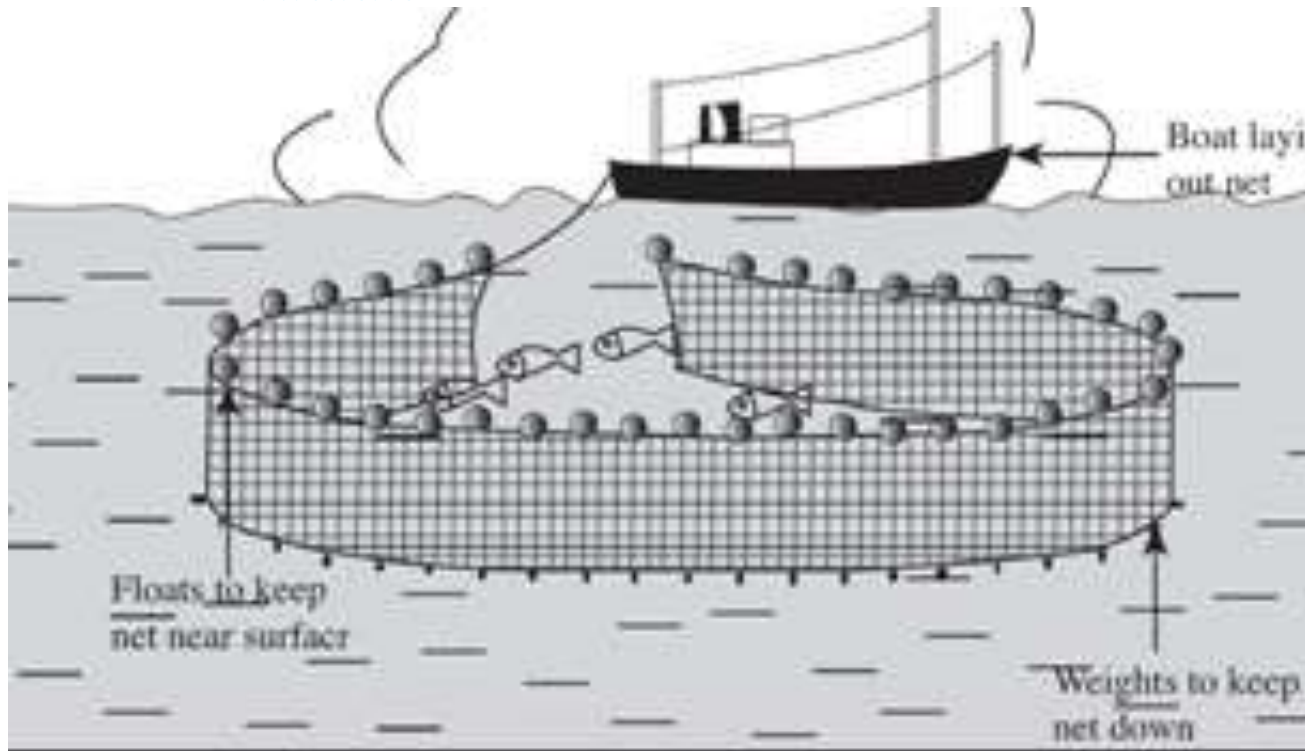
**Figure 7: Fishing using drifting method**

- **Long lines:** This method involves the use of several hooks spread out on long lines. The hooks are attached a few metres apart and bouyed at each end. They are baited and cast into water from a moving vessel. The fish are caught on the baited hook as they try to feed.



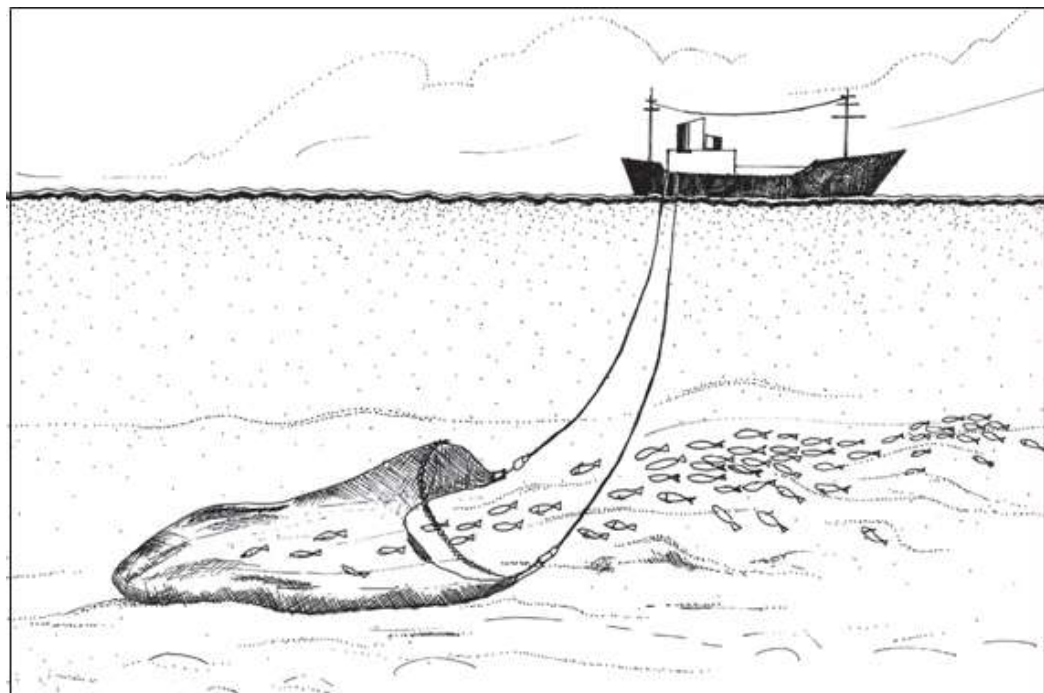
**Figure 28: Fishing with long lines**

- **Haul seine:** The net is kept floating in the lake by corks on top and weights below. A long strong sisal string is tied on both sides of the net and it extends to the beach. After laying in water, the net is slowly dragged using these ropes at the same time to the beach. As the net moves, it collects fish along its path. At the beach, the fish is gathered.



**Figure 29: Fishing with haul seine**

- **Trawling:** the trawl net, a bag-shaped net whose mouth is kept open by otter boards or head-beams is by far the most efficient method of catching demersal fish like cod, haddock, plaice or sole. Its mouth has floats at the top and weights at the bottom, and the net is made stronger at the 'cod end' in which the fish are caught.



**Figure 30: Fishing with trawling method**



#### 2.4.4. Importance of fishing industry for Rwanda

Although fish farming is still at the low level in Rwanda, it is playing a significant role in the economic development of the country. Its importance can be seen in the following areas.

- **A Source of employment:** Fishing industry generates job opportunities either directly or indirectly. The direct employment comes when people do for fishing to earn a wage. Likewise, the processing of fish products attracts labor. Employment is also offered by related industries such as boat making and net making.
- **A rich food product:** Fish, a product obtained from the fishing industry is important in the provision of protein to the consumers. It is also important in the supply of essential minerals such as iron, calcium and iodine to the body.
- **A medically valued product:** Fish is used in the production of Cod Liver Oil and Scott's Emulsion. These are rich in vitamins A and D and they are useful in alleviating chest problems in babies. Cod Liver Oil also improves the body's calcium intake and also the development of bone structure. These relieve joint pain occurring at old age.
- **Income generation:** People engaged in fishing have generated income through their direct sales to cooperatives, middle people and local consumers. This has helped in raising their standards of living.

#### 2.4.5. Problems affecting fishing and their solution

Despite many benefits of fishing for the country and the population of Rwanda, the fishing industry in Rwanda is experiencing a number of problems. Amongst these is:

- **The low level of technology:** With the use of baskets, dugout canoes, sail boats in fishing, this limits the undertaking of fishing to subsistence level. Commercial fishing is therefore limited.
- **Limited market:** Many people in Rwanda are yet to consider fish as an acceptable food in their diet. Only a small population of the country, especially those living around the lake regions, are good fish eaters. This limits the consumption of fish to the internal market, thus hindering the development of the fishing industry.
- **Aquatic weeds:** Weeds such as water hyacinth have been a great hindrance to fishing activities. The weeds hinder the movement of the fishing vessels, block the landing beaches and destroy the fishing nets. They also endanger aquatic life by harboring dangerous animals like snakes, crocodiles. Their continued presence leads to siltation and disappearance of fisheries.
- **Pollution:** Rivers and lakes of Rwanda are being polluted through discharges of toxic effluents from factories, raw sewage and oil spillage from motor garages, etc. This leads to the death of aquatic life, hence the decline in fish resources.
- **Overfishing:** This is the indiscriminate harvesting of immature fish through the use of undersize nets and uncontrolled trawling, which has led to the depletion of various fisheries, leading to the exhaustion of fish resources.
  - Use of **traditional methods of fishing.** Young fish are caught and killed.
  - Lack of high **quality species of fish.**
  - **Poor methods** of conservation of fish.
  - **Reduction of water** levels during the dry season in many water bodies.
  - **Small quantity of fish** in lakes and other water bodies.



#### 2.4.6. Methods of fish conservation

- **Banning the indiscriminate fishing:** This can be done by regulating the size of the fishing nets used during fishing. Fishing schedule may be regulated where the government prohibits fishing during certain periods of the year to allow fish to breed.
- **Restocking overfished waters:** Where overfishing has taken place, there is need to restock the fisheries by introducing new fish species which are fast maturing. This may also be enhanced by encouraging fish farming.
- **Legislation:** The government should enact laws that prohibit the discharge of Industrial wastes into fisheries and other forms of pollution.
- **Increased surveillance:** There is need to increase surveillance on the country's fisheries through the use of patrol boats to help track down the use of Illegal fishing gears. This would also help to monitor the pollution of fisheries.
- **Regrouping people involved in the fishing Industry into cooperatives** in order to advance to them important loans to Invest in the fishing industry. Those cooperatives may also assist in the marketing of fish.

#### 2.4.7. Fish preservation methods used

The term fish preservation refers to all ways that enable fish and fish-products to be stored for a prolonged period before being taken to the market or to be consumed. As fish is perishable, it needs to be preserved as soon as it is caught to increase its storage life. There are four stages of fish preservation and these include the following:

➤ **Salting**

After fishes have been clean, salt is displayed on them especially between the layers of fishes.

➤ **Smoking**

The fish is dried using fire. This method involves hanging the cleaned fish above the fire, purposely to remove moisture. This method enables the fish to dry perfectly and therefore, enabling it to be preserved for a reasonable time.

➤ **Deep frying**

This involves the cleaning the fish and dissecting it. Then, the pieces of fish are put in boiling cooking oil. This removes moisture from fish. When it is confirmed that now the fish is dehydrated, it is removed and put in dry packages

➤ **Sun drying**

The fishermen clean the fish, scales and intestines are removed. The cleaned fish or pieces of fish are displayed on a stretcher or stall under the sunshine. The sunshine removes the moisture. After some days of sun drying, they are packed in a clean place well-spaced to allow air pass through.

➤ **Refrigeration**

This is a method that has taken a strong significant place in fish preservation. Fish is cleaned and dissected into filets. Sometimes, scales and intestines are just removed and the whole fish is subjected to low temperatures using deep freezers. The primary purpose of this method is to store fish in its fresh form for a reason period. Fishes may be put in packages before it is refrigerated.



### ➤ **Fish canning**

Fish is cleaned. It is then subjected to recommendable heat, it then, put in containers and sealed tightly under strictly hygiene conditions.

The sealed fish in a container is further heated to destroy the micro-organisms that make the food spoilt. The sealing is primarily done not to allow air entering which may contaminate the packed fish.

## **2.5. Mining in Rwanda**

Mining is the activity of removing such substances as metal from the ground. Minerals are in the form of gas, liquid or solid. The process of getting them depends on the mode they occur in.

### *2.5.1. Types and distribution of major minerals extracted in Rwanda*

The main minerals exploited in Rwanda are tin, wolfram, gold, natural gas, peat coal, coltan, tungsten and limestone.

- **Tin:** This is a metallic mineral. It is used in making tin cans. Tin or cassiterite is mined in Rwinkwavu, Musha, Bugarama, Rutongo, Gatumba, Mwaka, Rutsiro and Bisesero.
- **Coltan:** Coltan is found in Kabaya and Rutsiro. There are also deposits in the western region of Rwanda. It is also found in Ngoma, Nyagatare, Gatsibo, Rubavu and Rusizi.
- **Wolfram:** It is a metallic mineral. It is mostly found in areas like Rwinkwavu, Gatumba and Rutongo.
- **Gold:** Gold is a precious and valuable mineral. In Rwanda, it occurs in small quantities in Gicumbi, Rusizi, Nyamasheke and some parts of Muhanga.
- **Methane gas:** It is used in the brewing industry in Bralirwa. It is extracted from Lake Kivu. The government of Rwanda plans to extract it in large quantities in order to use it as a source of energy in the country.

**Note:** Rwanda has non-metallic minerals like silicon sand, used to make glass; clay, used to make earthenware, kaolin, travertine, marble and mineral water.

### *2.5.2. Methods of mining practiced in Rwanda*

When extracting mineral ores from underground/ground deposits in Rwanda, there are various methods that can be used. These methods depend greatly on the mode of occurrence of the mineral ore, of the value of the mineral, and the size of deposit. The most common mining methods used in Rwanda include the following:

- **Open cast mining:** This is the easiest and the cheapest way of mining minerals that occur close to surface. This simply involves the removal of the overburden that is the earth or other rock bands lying above the mineral-bearing strata. Then, the extraction of the ore in successive layers is done until the





mineral content becomes exhausted or inaccessible/ too small for economic mining. Equipment like caterpillars and excavators are used to create exposure of the mineral ore bearing rocks. In most case when the overlying burden (soils and rocks covering the mineral bearing rocks) is soft, then digging is used. When the overlying burden is hard, explosives are used. The purpose of using explosives is to loosen the rocks for easy removal. Open cast method can be carried out in two ways: Stripping and hill slope boring.

**(i) Stripping method:** This is simplest and cheapest method of mining. It is used where minerals are very close to the surface of the earth.

**(i) Hill slope boring:** This is used in the extraction of minerals such as coal which may outcrop from the hill side. A gently sloping shaft is dug into the hillside to reach the mineral. The augers are used to drill out large pieces of coal and haul them to the surface from where they are taken to the processing plants by trucks.

Minerals extracted using the method include tin, wolfram, coltan and limestone rocks.

- **Underground mining:** When the ore lie deep below the surface, the overburden is too thick to be removed by mechanical shovels and underground mining methods have to be used.. This mining method involves creation of network of both vertical and horizontal tunnels. These follow the mineral bearing rocks. The vertical tunnels are called shafts. The mined ores are transported along the shafts using conveyor belts on which lifts, or cages are affixed. The cages move up and down the shaft. The cages also assist the miners to move along the vertical tunnels.

There are circumstances where the mineral ore bearing rocks occur in a horizontal manner. In this case horizontal tunnels are created to have access to the mineral ore extraction. Such tunnels are called Adit or crosscut opening. There must be proper ventilation to allow the miners have clean and safe air, the roofs of the tunnels must be supported with strong pillars and strong wire mesh.

The following are different underground mining methods:

**(i) Drift or adit method:** This is whereby the minerals are extracted from the sides of a hill or a valley. The mineral bearing veins or seams are found protruding on the side of the valley or hills.

**(ii) Shaft method:** this is used to extract minerals found in deep or very steep inclined seams. Vertical shafts are sunk underground. From these, horizontal tunnels or galleries are dug to reach the mineral bearing rock. Minerals extracted using this method are tin, wolfram, gold and tungsten.

- **Alluvial mining:** When minerals occur in alluvial deposits they are usually recovered by placer mining methods. This is done by mixing the alluvium with great deal of water and tilting or rotating the gravels until the lighter particles (sand, mud, dust, stones) are washed off, leaving behind the heavier ores, e.g. gold, tin, chromium, platinum, which have a higher specific gravity. This method is used in parts of





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Gicumbi, Rusizi and Nyamasheke in mining Gold.

The following are the main alluvial mining methods

**(i) Placer mining:** This method is used in cases, where the original bearing rock is broken down by natural processes and it is transported and redeposited by running water. Placer mining involves excavating alluvial deposits such as sand, gravel, silt and clay. Screens and sluices are used to separate the minerals from alluvial materials. The gravel bank is loosened by a high-pressure stream of water distributed through a large nozzle called a hydraulic giant.

**(ii) Panning:** This method is used by small scale miners. This involves mixing of water with mineral bearing deposits scooped from riverbeds. The mixture is then lifted into a pan. The pan then is rotated vigorously and later tilted to incline on one side. The lighter material of sand, mud, dust and stone debris are left behind stuck on the wet drier side of the heavier material consisting of the mineral is found at the bottom of the water.

**(iii) Dredging:** In this method expensive equipment referred to as a dredger is used to dig out the alluvium. The dredger floats on water and it has a series of traps through which the alluvial deposit are channeled. The traps usually intercept the heavier alluvial materials that bear the minerals

**(iv) Hydraulic mining:** This is use of water sprayed from powerful pumps on the sides of valleys or slopes to bring down the alluvial deposits once the alluvial deposits have landed on the floor of the valleys, they are collected.

**(v) Solution method:** This is done from the surface of the earth. Shafts are sunk down into the mineral deposits. Pipes are installed to link the deposits.

- **Gas drilling:** This method is used in the extraction of non-sold minerals such as oil and natural gas from the ground. It involves the use of equipment known as the **derrick**. This is used purposely to create deep holes into the ground up to the depth of where the mineral to be extracted is situated. This equipment holds a drill stem on which drilling pumps are attached. After the drill reaches the mineral, pumps are inserted to transport the oil or gas to the collecting and refinery centers. This method is used in the extraction of natural gas. Natural gas (Methane gas from Lake Kivu) is often associated with petroleum deposits. The natural gas yields hydrogen, sulphur and helium. It is mined by sinking pipes into the earth's crust until the gas ores are reached.

### *2.5.3. Factors affecting the exploitation of minerals in Rwanda*

The factors that influence the exploitation of minerals in Rwanda are:

- **The size of deposits:** Rwanda has few mineral deposits. This makes mining quite expensive. Little



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money is obtained compared to that used in mining. Research on the minerals available in Rwanda is continuing.

- **Mineral quality:** Some mineral resources of Rwanda are of low grades. Others like gold and methane gas are of high value.
- **Types of minerals:** High value minerals like gold occur in small quantities; low value ones like tin, wolfram and coltan are found in larger quantities.
- **Capital requirements:** Mining often requires expensive equipment. Rwanda lacks the necessary equipment to exploit the mineral reserves to the maximum. That is why the country largely depends on foreign investors.
- **Transport:** Some mineral ore deposits in the highlands remain unexploited. This is because of lack of means to transport them.
- **Skilled labour:** The country depends on experts from abroad to carry out mining. It is expensive to hire such experts for mineral deposits that can hardly sustain them.
- **Price fluctuations:** The price of minerals on the international market is set by the developed countries. This has a big effect on mineral exploitation since low prices mean less mining and vice versa.
- **Competition:** This is mainly from developed countries, which have the means to extract minerals. They have an efficient means of production. Their prices are also lower than, say, that from Rwanda.
- **Exhaustion of minerals:** Some minerals get finished after continuous mining. This explains why tin and wolfram in Rutongo and Musha have almost run out.

### *2.5.4. Importance of mining to the economy of Rwanda*

Rwanda benefits a lot from mining activities. The following are the contributions of mining to the economic development of Rwanda:

- Mining has led to the creation of employment opportunities for the local population.
- Mining encourages the development of infrastructure in areas it is carried out.
- Minerals earn the country foreign exchange.
- Mineral resources generate revenue through taxes imposed to mining companies.
- Mining helps improve the economy by reducing the over-reliance on agriculture.
- Mining has led to the development of commercial centers and urban centers in places like Bugarama, Gatumba, Rutongo and Musha.
- Mining has resulted in the establishment of social amenities such as schools, health centres and recreation centres. These facilities benefit those working in the mines and the local population as a

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whole.

- Mining has led to the promotion of international cooperation through trade, migrant labour supply and foreign investment.
- Income from mining has helped to raise the people's standards of living through improved houses, education and health services.

#### *2.5.5. Problems affecting mining industry*

There are a number of problems facing the mining industry in Rwanda. Among these problems are:

- Lack of capital, which limits the amount of mining that is done.
- Poor infrastructure to places where minerals are found. There are no roads to these areas.
- Communication is also a problem.
- The existing mineral deposits in the country occur in small amounts. This makes their exploitation uneconomical.
- Lack of skilled personnel in minerals and mining. The country has therefore to rely on foreign experts, who are expensive.
- Pollution of the environment where mining has been done.
- Lack of power supply in the remote areas where minerals are found limits mining.
- Most of the mining activities are done by foreign companies. As a result, much of the revenue from export benefits these foreign countries.
- Accidents do occur in mines. People are either injured or die as a result.

#### *2.6.6. Effects of mining on the environment*

Mining has major effects on the environment. These include:

- **Landslides:** when mining is done in hilly regions, explosives may cause heavy movement of earth materials. These materials bury human settlements, cause deaths and destroy properties.
- **Pollution:** Mining is a great pollutant of the air and water. During mining, harmful gases are released into the atmosphere. This is dangerous to both humans and plants.
- **Soil degeneration:** Mining interferes with the chemical composition of soils. This affects the fertility of the soil.
- **Destruction of biodiversity:** Biodiversity is the number and types of animals and plants found in an area. As mining involves clearance of large tracks of land, it causes the destruction of plant and animal



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life.

- ***Disruption of water table:*** During mining, the rock structures are interfered with. This affects surface and underground flow of water. The end result is lowering of the water table.

***2.5.7. Solutions to the mining problems***

- Cleaning up abandoned mine sites: Companies and government can be held accountable for abandoned sites and be required to carry out an environmental cleanup.
- Government can require mines to adopt increasingly effective environmental procedures and invoke penalties for failure to comply.
- Mines can be designed so that they produce less waste or use less toxic chemicals.



## 2.6. Power and energy in Rwanda

In Geography, energy refers to fuel or any other resource used to operate machinery. Energy is used in the entire production process in which goods and services are produced, processed and transported.

### 2.6.1. Major sources of energy used in Rwanda

The sources of energy used in Rwanda can be classified as either renewable or non-renewable:

- **Renewable resources** these are also known as *inexhaustible*. These are those sources of energy that do not get finished with continued use. They include water, wind and solar.
- **Non-renewable resources:** These types of energy cannot be reused when exhausted. Examples include Petrol and natural gas.

#### 2.6.1.1. Renewable energy

These are sources of energy with the capacity of replenishing themselves after being used. They thus do not get exhausted with continuous use over time. They include water, wind, solar, plants and animal. The types of energy obtained from these sources are:

- **Hydroelectric power:** This is the energy produced from running water. Usually a dam is constructed along a river to store water. The water is then made to fall over a steep gradient. It then passes through a turbine hence spinning the blades of the turbine. The rotation of the blades causes the turbine to turn an electric generator that produces electricity.

**Hydroelectric power distribution:** The production and distribution of electricity is under control of a public corporation known as Rwanda Energy Group (REG) which owns Energy Development Company Ltd and Energy Utility Company Ltd that were created to manage energy production and energy maintenance respectively. Rwanda has around 10 Hydro-electric power stations across the country which produce around 250 MW. The hydro-electric power stations include Gihira, Gisenyi, Jabana, Gatsata, Gikondo, Mukungwa I, Mukungwa II, Ntaruka. The power stations also include the solar energy station located in Jali (Gasabo) and the Methane Gas station located in Lake Kivu. There are also other small hydroelectric centers which are under construction or to be constructed in nearer future e.g. Kilinda, Runyombyi, Murunda, Rusumo, Nyabarongo in Mwaka, Rukarara I, II, III, Mukungwa II, Rugezi, Satinskyi, Akanyaru II.

- **Geothermal energy:** there is a huge amount of heat in underground which makes the temperature increase with depth. This heat within the earth is called geothermal energy. Rwanda possesses



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geothermal resources in the form of hot springs along the belt of Lake Kivu with a power generation potential of about 170-320 MW. Preliminary technical exploration studies are currently being conducted.

- **Solar energy:** This is radiation from the sun which supports all life on the planet earth. It may be obtained in various ways including the use of solar cells which transforms sunlight directly into electricity.
- **Biomass energy:** This is energy from dead animal and plant material which is used as fuel. Biomass is used in the form of firewood, charcoal or agricultural remains. About 94% of energy needs in the rural areas are met using biomass.
- **Wind energy** at Jali in Gasabo-Kigali city

### 2.6.1.2. Non-renewable energy

These include coal, peat, petroleum and natural gas.

- **Oil:** Oil is imported and Rwanda depends totally on imports. As a source of electricity, hydrocarbons power diesel generators (known as **thermal energy**).
- **Kivu Methane Gas** It is found in Lake Kivu. It can produce up to 700 MW, which can last for over a period of 55 years at an extraction rate of one billion cubic meters of methane per year.
- **Peat coal:** This is found in the swamp of Kamiranzovu, Kagera, Gishoma and Cyabararika. It is extracted as a coke or as a dried peat. Rwanda has peat reserves estimated at 155 million tons. This is enough to replace wood, charcoal and fuel oil. A third of it can be used as a source of heat or for production of electricity. The peat potential at Gishoma is about 20,000 tons per year. It is the equivalent of 8,000 tons of petrol oil.
- **Firewood and charcoal from trees.**

### 2.6.2. Factors favoring power production in Rwanda

The following factors favor power and energy production in Rwanda:

- Market: there is a large and ready demand for hydroelectric power.
- Technological knowledge and skill in power production is available.
- The absence of coal and petroleum means increased dependence on waterpower.

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The following factors affect hydroelectric power production:

- High quantities of water. There is heavy, reliable and fairly distributed rainfall throughout the year.
- High altitude with steep slopes. These ensure that water flows at high speed.
- Presence of rapids and waterfalls. These favor development of hydro-electric power by increasing the speed of water flow.
- Narrow steep-sided valleys that allow for construction of dams.
- Hard rocks that form firm foundation for dams.
- Presence of lakes and spaces where water collects.
- Absence of coal and petroleum. This makes hydroelectric power generation a must.

### *2.6.3. Importance of power in the development of Rwanda*

It is impossible to think of development without power. This is because power is a key driver of development. It is important in the following ways:

- It is used for cooking, lighting and heating. This is both in the rural and urban areas.
- Power is used to run industries that make different items. Electricity and petroleum are the main sources of energy in industries.
- Petroleum is used to run vehicles. This is important for transportation of people and goods.
- In agriculture, solar energy, petroleum and electricity are used to run water pumps. This is mostly in dry areas and ensures higher production of food.
- Electricity is used in schools, hospitals, offices and in the printing industries.

### *2.6.4. Problems limiting power production in Rwanda*

- Limited capital to invest in power production.
- Lack of oil and coal.
- Reduced wood fuel due to deforestation.
- Lack of skills in power production.

### *2.6.5. Prospects for power production in Rwanda*

The demand for power continues to rise. This is because there are more and new uses for it. Also, the population that needs it is ever rising. The following should be done to meet these needs now and in future:

- To look for alternative and cheap sources of energy.



- To lay more emphasis on renewable energy like solar power, wind energy, geothermal, biogas and sea energy.
- The government to improve public transport so as to reduce the need to use personal vehicles. This will help to reduce the use of petroleum, which is imported.
- To learn to conserve energy at all times. This can be done by making electrical appliances like refrigerators, television, electric cookers that use power more efficiently.

## 2.7. Industrial sector of Rwanda

Industry is defined as an establishment set up to process and transform simple and ordinary raw material to more complex material of great value. Industrialization refers to a process of social and economic change in which there is move from a pre-industrial to an industrial state. It involves the creation and development of conditions necessary for the organization of the national, human and natural resources in order to raise the standards of living of the population. Industrialization is linked to technological advancement.

### 2.7.1. Overview of industrialization in Rwanda

Industrialization development is one part of the Government of Rwanda's strategy for achieving the Vision 2020. Products manufactured in Rwanda include cement, agricultural products, small-scale beverages, soap, furniture, shoes, plastic goods, textiles and cigarettes. The assessments conducted in 2001 showed an increase in the establishment of a wide variety of small scale commercial and industrial operations particularly garages and artisanal mining operations in the country. The industrial sector grew by only 10 % in 2007 as compared to 11 % in 2006. Its contribution to GDP was 15% in 2015.

### 2.7.2. Main types of industry found in Rwanda

Industries of Rwanda can be divided into two main categories namely medium scale industries and small scale industries.

#### (i) Medium scale industries

Medium scale industries in Rwanda include:

- **Agro-based industries:** Specialised in the transformation of agriculture products into processed food, sugar, juices. Examples include SINA Gerard-Entreprise Urwibutso located at Nyirangarama (Rulindo District), Kabuye Sugar Works located at Jabana (Gasabo).
- **Chemical industries** specialised in the on the production of cosmetics and savageries like SULFO



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Rwanda Industries

- **Construction industries** specialised in the fabrication of construction materials like TOLIRWA, SAFINTRA, Biqueterie de Ruliba.
- **Textiles industries** specialised in the fabrication of clothes like UTEXIRWA
- **Breweries like BRALIRWA**

**Table 2: Localisation of some medium scale industries in Rwanda**

Zone centers of industries	Name of industry	Products
Kigali city		
Old Gikondo industrial area	TOLIRWA	Iron sheets
	MABATI RWANDA	Iron sheets
	RWANDAFOAM	Mattress
	MIRONKO PLAST	Plastic products
Kicukiro industrial area	TABARWANDA	Cigarettes
	SONATUBE	Water pipes
	BRALIRWA	Soft drinks
	V.R.P.I (Rwanda Plastic industry)	Plastic products
	COVIBAR	Soft and spirits drinks
	AMEKI-COLOR	Paints
Nyarugenge industrial area	SULFO RWANDA	Soaps and other cosmetic products
	AFRIFOAM	Mattress
Musanze industrial area	ETIRU	Wheat flour
	Sopyrwa	Insecticides
Rusizi industrial area	CIMERWA	CEMENT
	SONAFRUIT	Maracuja-juices
Rubavu	BRALIRWA	Alcoholic drinks
Nyabihu industrial zone	Nyabihu-Rubaya Tea processing	Tea
GASABO Industrial zone	Various industries (UTEXIRWA, AZAM,etc)	Different products

It is worth noting that most of industries have be relocated to Kigali Special Economic Zone and Bugesera industrial zone

**(ii) Small scale industries**

A small-scale is a project that is created on a small budget. It is created for a small group of people.



Examples are brick making, pottery, bakery, carpentry, embroidery, blacksmithing and brewing.

### *2.7.3. Factors affecting the location of industries in Rwanda*

There are a number of factors that determine the location of industries in Rwanda. These are geographical, historical, political and economic as outlined below:

- **Availability of raw materials:** Industries are built near the source of raw materials. Examples of industries located close to raw materials are Cimerwa in Rusizi, tea factories in Kinyihira and Mulindi, and Kabuye sugar factory in Kigali.
- **Energy sources:** Most of the industries in Rwanda are located near sources of energy, for example, Kigali city.
- **Transport means:** Transportation is necessary for the delivery of raw materials to the industries and finished products to the market or consumers. Therefore, most investors in Rwanda put up their industries close to the main roads.
- **Market availability:** Goods produced are meant for sale. Rwanda, like other developing countries has a high demand for manufactured goods. These are consumed mainly in the large towns, while others are exported. Examples are coffee, tea, flowers and minerals.
- **Availability of human resources:** Human resources are divided into skilled and unskilled labour. The country has for long suffered from unqualified local human resources, but the government had introduced various programs aimed at equipping the country with personnel that meet international standards.
- **Government policy:** The government of Rwanda has put industrialization as one of its top priorities. To achieve this, it has created an enabling environment for investment, provided capital in the form of loans to boost industrial investment, protected emerging industries from foreign competition and taken the lead to negotiate for markets on behalf of the local industries.
- **Land availability:** Rwanda's territorial size and relief are not ideal for the establishment of large industries.

### *2.7.4. Factors influencing industrial development in Rwanda*

The following are the factors affecting the industrial development in Rwanda:

- Industries with enough raw materials develop faster.
- A large urban population.
- A good transport and communication network.
- Improved labour through training.
- Available banking facilities.
- Availability of power such as hydro-electric power and gas methane.
- Flat areas allow for building of industries.
- Water is available throughout the year.



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- The government encourages the growth of industries

### *2.7.5. Importance of industrial development in Rwanda*

Rwanda does not have many and big industries. However, the available ones are important in the following ways:

- They create jobs for many people.
- Locally produced items are cheaper than imported ones.
- Products that are exported earn the country foreign exchange.
- Industrial development raises the standards of living of the population.
- Industrial development reduces too much dependence on agriculture.
- Industrial development helps the growth of other sectors of the economy like agriculture, livestock keeping and mining.
- Industries encourage the construction of basic facilities like schools and hospitals. Roads are also built and well maintained.

### *2.7.6. Problems affecting industrial development in Rwanda*

Development of industries in Rwanda faces many problems. These include the following:

- Low investment as a result of lack of capital required to put up and run industries.
- There is a shortage of skilled labour. The number of people who are well trained or skilled to run industries in Rwanda is low. This results in reduced production and use of resources. Getting manpower from other countries is expensive.
- Market for industrial products is not very big. The buying capacity of the population in Rwanda is low. This means that they buy few of these products.
- Rwanda experiences a shortage of technological development. This is brought about largely by lack of capital.
- Many industries, especially metal work industries import raw materials from abroad. These materials are highly taxed, meaning that the price of the finished goods is high. Few people can afford them.
- Rwanda is a landlocked country. This causes to delays in the delivery of raw materials to the industries. The raw materials are got from the ports of Dar-es-Salaam or Mombasa.
- Rwanda faces competition for markets from such neighbours as Uganda, Kenya and Tanzania.

**Problems resulting from Industrial development include:**



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- Air pollution and destruction of the environment.
- Employing foreigners in industries can lead to loss of traditional values as new ones are introduced.
- Low quality products may be made in an effort to rapidly replace the imported ones.
- Industrial development can make other sectors such as agriculture to suffer. This is where too much time and effort are spent on industrializations.

### *2.7.7. Solutions to industrial development in Rwanda*

The following are some solutions to the problems faced by industrialization:

- Protection of local industries from imports. This is by way of putting a high tax on imported products.
- Giving loans to people who want to invest in industries at low interest rates. They can also be given long-term loans.
- Making every effort to reduce pollution as much as possible. This can be by treating waste before releasing it or recycling it.
- The government should encourage the building of industries in the rural areas.
- The government should create a good environment to attract foreign investors.
- Formation of large regional trading organizations.
- Necessary training to run industries should be offered in institutions of learning.
- Improvement of road, water and air transport should be done.
- Developing energy sources such as solar and hydro-electric power.
- Research should be carried out so as to develop necessary technology.

## **2.8. Transport and communication**

### *2.8.1. Meaning of transport and Communication*

Transport refers to the physical movement of people and commodities from one place to another over a given distance. Any kind of transport can help to:

- Bring people and their various needs together (materials, facilities and services).
- Minimise scarcity of commodities: For example foodstuffs to avoid food shortage.





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- Reduce wastage, increase the value of goods and services, encourage the spread of new ideas.
- Exchange surplus production through exports; facilitate the exploitation of natural resources, for example, forests and minerals.

### 2.8.2. Types of transport

#### 2.8.2.1. Road transport

Roads are the most universal form of transport and they vary from one kind to another. They range from the forest paths to the latest motorways. There are various modes of transport, for example, automobiles that are powered by the internal combustion engine like cars, buses, coaches, trucks, vans, trailers and taxis.



**Figure 31: Road transport in Rwanda**  
**Advantages of road transport**

The road is a popular mode of transport for both freight and passengers in many parts of the world. Road transport has the following advantages:

- Roads are found in areas that are inaccessible by other means of transport like railway.
- Road transport is flexible, meaning that goods can be delivered any time or they can reach almost every part of the region.
- Road transport is cheaper and faster for short distances.
- It is used to carry a wide variety of goods ranging from parcels to large loads.
- Road transport is suitable for delivering perishable goods, for example, vegetables, milk and fruits over short distances.
- Road transport does not require a large capital base for its successful construction compared to railway and air transport.
- Vehicles that use roads do not need to run on time schedules like in the case of railway and air transport, where time is strictly observed.
- It is available in steep gradients that railways would normally avoid.

#### **Disadvantages of road transport**

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- It usually handles specific and limited quantities of goods and this may not be economically viable.
- Heavy trucks or Lorries are slow in delivering loads compared to air and railway transport.
- As a result of a fixed timetable, vehicles return empty after they have delivered cargo. This is not economical.
- Weather conditions tend to disrupt road transport, especially during the rainy seasons.
- It is highly susceptible to attacks by highway robbers.
- Traffic congestion or traffic jams especially in the urban centers cause delays and increase costs as a result.
- Road accidents that result to deaths and loss of property are common.

### 2.8.2. Water transport

Water transport refers to movement on water using certain vessels. The vessels include dhows, boats, ships and ferries. A ferry is a boat or ship used to carry (or ferry) passengers and goods across a body of water. People travel on water in rivers, lakes, seas and oceans. Water transport is the cheapest means of transport. It is also the one that is used to carry the bulkiest goods.



**Figure 32: water transport**

#### **Advantages of water transport**

- Provides a link between continents unlike road and railway transport.
- It is the cheapest mode of transport especially of bulky goods.
- Usually little time is wasted in the traffic control as in the case of other modes of transport.
- It is suitable for the transportation of fragile or goods that break easily, for example glass.



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- Usually costs of collection and delivery are minimized, especially where the ports of dispatch are on the same waterside.
- Is considered safer than the other modes of transport.

### Disadvantages of water transport

- Is slow and not preferred in the transportation of perishable goods.
- Water fluctuations during the dry seasons affect transport on rivers.
- Its use is limited to the availability of water.
- Storms and winds sometimes greatly interfere with the shipping schedules.
- There are threats from animals like crocodiles and hippopotamuses. There is also the danger of pirates.

### 2.8.3. Air transport

This is transport by use of objects that fly in the air. Examples of such objects are aeroplanes, jets and helicopters.



**Figure 33: Rwanda air buses used in air transport**



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**Figure 34: Air transport (at Kigali International airport)**  
**Advantages of air transport**

- It is the fastest means of transporting passengers and goods. It is suitable for transporting perishable goods or commodities.
- It is considered a safe.
- It is reliable as it operates on a strict schedule.
- It is comfortable and less tiresome especially when travelling over long distances.

**Disadvantages of air transport**

- Usually has limited storage space and therefore not ideal for the transportation of bulky and poorly packaged goods.
- Not used to transport commodities such as highly inflammable products like petrol, paraffin and diesel.
- Usually affected weather conditions such as fog or mist.
- The construction of airfields is expensive and this has an impact on the price of air tickets.
- Considerable time is spent in air traffic control at airfields like checking and booking.

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- It is a target for terrorist attack.

#### **2.8.4. Human-powered transport**

Human-powered transport is the transport of person(s) and/or goods using human muscle power. Human-powered transport has existed since time immemorial in the form of walking, running and swimming. Modern technology has allowed machines to enhance human-power. The animal portage can be also put in the same category as human-powered transport from the acts that the animals use also their own power and energy. Although motorization has increased speed and load capacity, many forms of human-powered transport remain popular for reasons of lower cost, leisure, physical exercise and environmentalism. Human-powered transport is sometimes the only type available, especially in underdeveloped or inaccessible regions.



**Figure 35: Human powered transport**

#### **Advantages of human-powered transport and animal portage**

- It doesn't contribute to any type of pollution.
- It takes up far less space than other means of transports. Therefore, it doesn't require the construction of infrastructure like roads, railways, etc.
- It can be used in any place even in mountainous areas.
- It doesn't require parking garages and parking lots.

#### **Disadvantages of Human-powered transport and animal portage**

- It is used for a small luggage.
- Adverse weather conditions effect the transportation.
- It is a slow process.

#### **2.8.5. Factors influencing the development of different types of transport**

The factors affecting transports are physical, social and economic. These are as discussed below:





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- **Relief:** This refers to the nature of the landscape. Steep slopes make the construction of roads and railway lines expensive. On the other hand, valleys have swamps, contain water logged soils that are too soft to allow heavy objects like trailers, lorries and trains to move on them.
- **Climate:** This is the average weather conditions of a place measured and recorded over a long period of time. Too much rainfall results into floods and landslides, hindering transport on the ground. On the other hand, accumulation of fog and clouds reduce visibility hence affecting air transport.
- **Vegetation:** This refers to plant cover on the earth's surface. Thick vegetation cover makes construction of road and rail networks difficult because it requires uprooting big trunks of trees. Furthermore, thick vegetation modifies climate through evapo-transpiration hence affecting air transport. Areas with thick vegetations are invested with wild animals that pose danger to the people.
- **Capital:** The construction of roads, railway lines and airports is expensive. At the same time, a lot of money is required to buy ships, trucks as well as aeroplanes.
- **Political instabilities:** Wars lead to the destruction of roads, wagons, airports and ports, making transport extremely difficult.
- **International restrictions based on international boundaries:** These affect transport in that they restrict amount of freight. The same applies to road transport.
- **Economic factor:** The structure and nature of transport costs are examined, together with service quality and methods of pricing and charging.
- **Political and social factors:** These include political motives for transport facilities; government involvement in capital, monopolies competition, safety, working conditions and coordination between modes, transport as an employer and social consequences of transport developments.

### *2.8.6. Importance of transport to the development of countries*

Efficient transport is a critical component of economic development, globally and nationally. Transport availability affects global development patterns and can be a boost or a barrier to economic growth within individual nations. Transport's contribution to economic development includes the following:

- **Physical supply of products:** transportation carries necessary raw materials to factory for production of goods and supplies finished goods to consumers
- **Encourages the specialization of activities:** transportation facility encourages division of labor and specialization on geographical or regional basis. Production of goods may center at such place where the environment is the best and production cost is minimum. This makes maximum utilization of local resources possible, which is both economically and socially necessary.





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- **Mobility of labor and capital:** transportation facility provides mobility to labor and capital. If more labor force is available at any place, transport helps to carry it economically to necessary place. The means of transport carry labors from one place to another. This encourages labor and capital to use and invest in more productive sectors.
- **Social, political and cultural network effects:** It establishes social and utility by narrowing geographical distance. It consolidates social and cultural utility and strengthens national integration. It helps to establish relationship with foreign countries.
- **Reduction of cost and time:** reducing cost and time for existing passenger and freight movements increase transport's contribution to economic growth.
- **Stabilization in price:** Transportation helps to bring stability in price of different products. It transports goods from more supplied places to scarcely supplied areas. This establishes coordination between demand and supply, and brings stability in prices. It helps to supply necessary goods regularly to the consumers. Besides this, consumers get necessary goods at lower prices, because it encourages competition among producers and makes mass production at lower cost possible.
- **Reliability:** improves time performance and reduces loss and damage, thus reducing economic drag.
- **Market size:** access to wider markets adds to economies of scale in production, distribution, and consumption, thereby increasing economic growth.
- **Productivity:** transport increases productivity gained from access to a larger and more diverse base of inputs such as raw materials, parts, energy, and labor, and broader markets for more diverse outputs.

### *2.8.7. Problems/challenges affecting different types of transport*

The following are the problems affecting transport activities:

- **Inadequate capital:** Most developing countries experience a problem of weak economies and few industries. They thus have insufficient funds needed to construct and maintain transport facilities such as roads, airports, ports, and railway lines.
- **Natural barriers:** Most of the regions have pockets of hostile environment such as deserts, forests, and rugged and mountainous terrain. These have hindered the establishment of transport facilities.
- **Political instability:** Some countries have undergone periods of political instability. With long periods of fighting in these countries, transport facilities were targeted for destruction while new lines were not established.



## ***2.9. Communication***

Communication is the sending and receiving of messages between people. The message is either spoken or written. The following are different means of communication in Rwanda:

- Radio
- Television
- Newspapers
- The Internet
- Mobile phones

### ***2.9.1. Factors influencing the development of communication in Rwanda***

Factors influencing the development of communication are:

- The number of subscribers
- The financial resources invested in the sector
- The rules and regulations in place
- Technological innovation
- The performance of the operators

### ***2.9.2. Importance of communication in Rwanda***

Communication is both inside Rwanda and with the outside world. Communication is important as it:

- The government and people are able to share information.
- Reaching many people at the same time makes administration easy.
- It is easy to know what is happening around the world.

### ***2.9.3. Problems affecting communication and solutions***

The problems that affect communication system in Rwanda are numerous and among them are:

- Poor infrastructures that do not facilitate to satisfy the demand for communication especially in telecommunication
- High cost of communication that low income earners cannot afford.



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- **Inadequate capital:** Most developing countries experience a problem of weak economies and few industries. They thus have insufficient funds needed to construct and maintain communication facilities.
- **Inadequate technical know-how:** This has hindered the growth of telecommunication since most countries have to rely on expatriates whose payments are very high.
- **Natural barriers:** Most of the regions have pockets of hostile environment such as deserts, forests, and rugged and mountainous terrain. These have hindered the establishment of communication facilities.

*2.9.4. Possible solutions to the problems affecting communication*

Drawing from the problems facing communication discussed above, it is evident that most of them can be overcome by way of reversing them.

- Investing in communication and where capital is not available, looking for ways of getting it.
- Countries should invest more on training their people so as to equip them with knowledge to handle the ever-changing technology. It is cheaper to train home-grown personnel than to hire expatriates.
- Promotion of the interactions between people having different experience.
- Use the recent technology radio, telephones, television, and internet to improve the standards of communication.
- Communication is the link between knowledge and information. Therefore, there is need to provide knowledge of the people to be able to communicate properly.
- Attract the investors in communication sector.
- Development of basic infrastructures for communication throughout the country.



## 2.10. Environmental conservation and Tourism

### 2.10.1. Environmental Conservation

The environment is the surroundings or the natural world either as a whole or in a particular geographical area. To conserve is to protect something from harm or destruction. Therefore, environmental conservation entails all the actions by human beings in an attempt to protect the surroundings that include the atmosphere, biosphere, hydrosphere and lithosphere from harm or destruction.

#### 2.10.2. Reasons for environmental conservation

Human beings depend on the environment for their survival. It is therefore important that measures are taken to conserve natural resources for use by the present and future generations.

Natural resources include animals, plants, water, air and the soil. The following are the reasons for environmental conservation:

- Tourists pay to see wild animals. This money is used to improve such facilities as roads and hospitals. That is why it is important to conserve the animals and where they live.
- Game reserves are usually found in areas that are not good for agriculture and settlement. Therefore, these areas are put to good and beneficial use.
- Many people are employed where the environment is conserved. They work as game rangers, tour guides and in hotels.
- Animals and plants are conserved for ecological balance. This makes life to be as it should as every living thing has an important role to play.
- The environment is the source of all raw materials used in industries. Destroying the environment is dangerous as even food production will be affected.
- A clean environment is good for the health of people, animals and plants. Nobody would want to live where the water and air are polluted.

#### 2.10.3. Ways of conserving the environment

Wildlife is an important part of the environment in Rwanda. The government adopted a policy aimed at protecting animal and plant life. This is done by:

- **Establishing game parks.** People visit, research is done and the history of the country is preserved. Examples of game parks are Akagera, Birunga and Gishwati.
- **Establishing game reserves.** This is an area separating human settlement and national parks.



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Animals running away from the national parks are looked after here.

- **Establishing game sanctuaries.** These are places where animals that are faced with extinction are looked after. Such animals are so few that if they are not given good care, they will die out from the surface of the earth.
- **Banning poaching.** Poaching is the illegal hunting of wild animals for food and sale of their products. There are laws in place to punish poachers.
- **Afforestation and re-forestation.** Afforestation is the planting of trees in areas where none existed before. Re-afforestation is the planting of trees in areas where they have been cut down.

### *2.10.4. Problems encountered in conservation environment*

The following are the problems that are encountered in the conservation of environment in Rwanda:

- Most of the national parks are located near the international boundaries. This makes it difficult to control animals escaping into the neighboring countries and poachers coming from there.
- Wildlife resources are located in areas that are not easily accessible by road. The number of tourists who visit them, therefore, is reduced.
- The level of development in the country dictates that there are insufficient funds for environmental preservation.
- The region has for a considerable period of time experienced political instability, which has greatly hampered the efforts made in conserving the environment.
- Arguably the biggest problem is rapid population growth, which is responsible for increased human-wildlife conflict.

### *2.10.5. Solutions to the problems of environment in Rwanda*

- Create enough infrastructures to promote the development of tourism by making all tourist attractions easy to reach.
- Promote the new master plan related to housing and show clearly the places for recreation parks, zoos, etc.
- Include the conservation agenda in budget and planning at the local authority level.
- Integrate conservation efforts with income generation.
- Provide education and awareness campaigns for those living near wildlife areas and expand the number and size of protected areas.
- Increase penalties against illegal activities within protected areas.

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- Avoid environmental pollution in the face of rural development and industrialization, and to promote the use of energy in the most economical matter.
- Establish and conserve forests.

### *2.10.6. Tourism in Rwanda*

Tourism involves travelling to places of interest. One can visit places within the country or other countries. Rwanda has a reservoir of tourist attraction like rainforests, volcanoes and waterfalls. The country is home to such animals like hippos and mountain gorillas. Up to the 1990s, tourism was the second foreign exchange earner, but the industry was greatly affected by the war as many animals were killed and others ran away. It is worth noting, however, that tourism has made significant steps towards recovery since then.

#### *2.10.6.1. Tourist attractions in Rwanda*

There are a number of things that attract tourists in Rwanda. They include the following:

- **Historical sites** such as Gasabo, which has a rich history of the kingdom of Rwanda. Another site is Nyanza, which was for long was the capital of the kingdom of Rwanda.
- **Natural reserves** like Nyungwe National Park, Mukura natural forest and Gishwati natural forest.
- **Genocide memorial sites** where the victims of the 1994 genocide are buried. The sites include Ntarama, Nyanza, Murambi, Nyamabuye and Gisozi.
- **Pleasant tropical climate**, which is warm throughout the year. This climate attracts tourists from Europe during winter in their countries.
- **Rwandan culture**, including dressing and traditional dances like intore, amakaraza and amaraba.
- **Relief and general landscape**, for example, volcanoes in the north at Karisimbi, Muhabura, Bisoke and Sabyinyo. It is for this that Rwanda is commonly known as “a country of a thousand hills”.
- **Water bodies**, for example Lakes Kivu, Muhazi, Ihema, Sake, Bulera and Ruhondo. Rivers include Akagera, Muvumba and Nyabarongo.
- **Waterfalls** such as Ntarka, Rusizi, Rusumo and Mukungwa.
- The **national museum** in Huye.
- **Hospitality and political stability**.
- **Caves** of Gicumbi; **rocks** of Ndaba in Rutsiro, and Kamegeri in Ruhango.





### ***2.10.6.2. Factors affecting development of Tourism in Rwanda***

- Infrastructure development is a basic prerequisite to the tourism sector and good access to tourist products.
- The capacity building is needed to increase the skills for tourists guide. This will improve the qualification of staff in the sector.
- Land access and tenure in Rwanda has to be promoted since a vast majority of Rwanda's tourism products is land dependent.
- Good environmental sustainability is a key priority for the development of tourism sector.
- Quality investment and financing the tourism sector is a key factor that will contribute to its development.

### ***2.10.6.3. Importance and prospects of tourism in Rwanda***

Rwanda's tourism industry is a major source of foreign revenue. Also, it plays a big role in creating jobs. Conservation of the environment and related development by way of tourist and recreation sites is the product of tourism.

Ways of improving tourism include the following:

- Setting aside more money to promote the tourism industry.
- Creating tourism corridors to linking Kigali City and Destination Management Areas (DMAs). These areas include the volcanoes, Akagera, Gisenyi and Kibuye.
- Promoting sports and cultural events that attract people from outside Rwanda.
- Offer high quality goods and services for use by tourists. More focus should be put on value for money rather than price.

### ***2.10.6.4. Problems facing tourism in Rwanda***

Problems facing tourism in Rwanda include:

- Competition from other East African countries. This is because they have similar tourist attractions.
- Most of the tourists are from Europe. They mostly come during winter in their home countries. This means there are few tourists the rest of the year.
- Wild animals in the temperate regions suffer from diseases. These diseases claim the lives of people and animals. For fear of these diseases, tourists stay away from these places.



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- Poor roads discourage tourists from visiting.
- The 1994 genocide against the Tutsi affected the tourism industry in Rwanda in a big way. Animals were killed and others fled to neighbouring countries. Trees were also cut down and burnt.
- Poaching leads to a reduction of animals. The fewer the animals, the fewer the number of tourists.

### *2.10.6.5. Solutions to the problems facing tourism industry in Rwanda*

Tourism is an important industry in Rwanda. Efforts are made to find solutions to the problems facing it.

These include:

- Providing training to those working in the industry. This is so as to improve standards.
- Sensitizing people living close to reserved areas on the need to take care of the environment.
- Investing in activities that promote tourism.
- Encouraging private investment in the tourism sector. This is by, for example, giving them licenses.
- Dealing with poaching by training anti-poaching police units.
- Marketing or advertising tourism within and outside the country.
- Ensuring political stability and security. This makes tourists to feel safe when and where they visit.

### **Review questions for unit 2 (Human and Economic Geography of Rwanda)**

1. Account for population distribution in Rwanda.
2. Examine the factors influencing population growth in Rwanda.
3. Describe the population distribution in Rwanda in terms of density.
4. Explain the factors influencing movements/migration in Rwanda.
5. Discuss the reasons why the environment should be conserved.
6. With a help of examples give different ways of conserving the environment in Rwanda.
7. Explain the challenges encountered in conservation environment and propose solutions to address those challenges.
8. Describe and locate the hit tourist attractions in Rwanda
9. Suggest the measures to be taken to improve tourism sector in Rwanda
10. Distinguish rural settlement from urban settlement.
11. Identify the major problems affecting (a) rural areas, (b) urban areas in Rwanda.
12. Explain why Rwanda Housing Authority should implement Master Plan in settling Rwandans
13. Describe the evolutionary situation of urbanization in Rwanda
14. Explain the problems of plantation farming in Rwanda.
15. Discuss the ways of improving plantation farming in Rwanda.
16. Explain what characterize the Rwandan's livestock.
17. Identify the challenges facing the Rwandan's livestock and suggest the ways to overcome them.
18. Discuss the role of livestock in Rwandan economy.
19. In village Tyazo, the local population gets their livelihood from fishing. They are failing to market their fish and fish-products because the market centers are far away. Wherever they try to transport their products, they get spoilt before reaching the market.
  - (a) Advise the people from Tyazo village on the ways they have to conserve and preserve their fishes in order to transport them without getting spoilt.

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- (b) Show how some of the fish preservation methods affect negatively the environment.
- (c) Describe how sustainable fishing can be implemented in the above-mentioned village
20. Identify the types of minerals extracted in Rwanda.
  21. Differentiate open casting and underground mining from alluvial mining as methods of mining in Rwanda.
  22. Account for the factors that affect the exploitation of minerals in Rwanda.
  23. Identify products from minerals that are available in Rwanda.
  24. Discuss the importance of minerals to the country's economy.
  25. Discuss the problems related to mining exploitations in Rwanda and suggest solutions to overcome those problems.
  26. Mention the factors favouring fishing in Rwanda.
  27. Describe different methods of fishing in Rwanda.
  28. Identify the challenges facing Rwandan fishing and suggest the ways to overcome them.
  29. a) Differentiate between Impelled Migration and Seasonal Migration.  
b) Explain the negative effects of migration to the country of destination.
  30. Explain the reasons for establishment of village settlement schemes in Rwanda.
  31. Suppose you are appointed to be an agricultural extension officer in your district, show how you would conserve help the farmers in protecting against soil erosion.
  32. (a) Differentiate between industrialization and urbanization.  
(b) With the aid of examples, discuss the effects of urbanizations to socio-economic developments of Rwanda.
  33. Discuss the setbacks hinders the development of energy production in Rwanda.
  34. Explain the factors that influence the power production in Rwanda.
  35. Analyze the factors that hinder the potential exploitation of rivers in Rwanda in production of power and energy.
  36. Analyze the importance of power and energy in the development of Rwanda.
  37. Differentiate renewable from non-renewable energies
  38. Describe briefly different types of communication in use in Rwanda.
  39. Explain the factors influencing communication in Rwanda.
  40. Outline the importance of communication in the development of Rwanda.
  41. Explain the problems affecting communication in Rwanda and the ways to overcome them.
  42. Discuss the advantages and disadvantages of road and air transports.
  43. Identify the major factors influencing the development of transport in Rwanda.
  44. Discuss the problems associated with transport in Rwanda and suggest ways to solve them
  45. Identify the factors affecting the location of industries in Rwanda.
  46. Mention factors influencing industrial development in Rwanda.
  47. Give the importance of industrial development in Rwanda.
  48. Identify problems affecting industrial development in Rwanda and suggest solutions to the mentioned problems industrial.



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