UNIT TWO

CLIMATE OF AFRICA

2.1 OVERVIEW OF WORLD CLIMATIC REGIONS AND TYPE

- Global climate is a description of the climate of the Earth as a whole, with all the regional differences averaged.
- The world has several climatic zones.
- Geographers and climatologists defined climatic region based on different climatic elements.
- In fact, the Earth's climate is driven by energy from the sun which arrives in the form of radiation.

2.1.1 Climate Classifications

Meanings of climate

- Climate is the average of all weather conditions of an area over a long period of time.
- Climate classifications help people know what types of conditions a region usually experiences throughout the year.
- Rather than describing the full range of conditions observed in a region over each month or season of a year, a classification scheme can communicate expected conditions using just two or three terms.
- Knowing a region's climate classification can be useful when choosing building materials for protection and durability, or when considering what crops are likely to thrive in a region.
- For tourists, knowing a location's climate classification can help them select and pack appropriate clothing.
- There are various classification schemes used by climatologists for categorizing world's climate into different regions.
- Ancient Greeks:-who divided each hemisphere into three zones: torrid (tropical), temperate, and frigid.

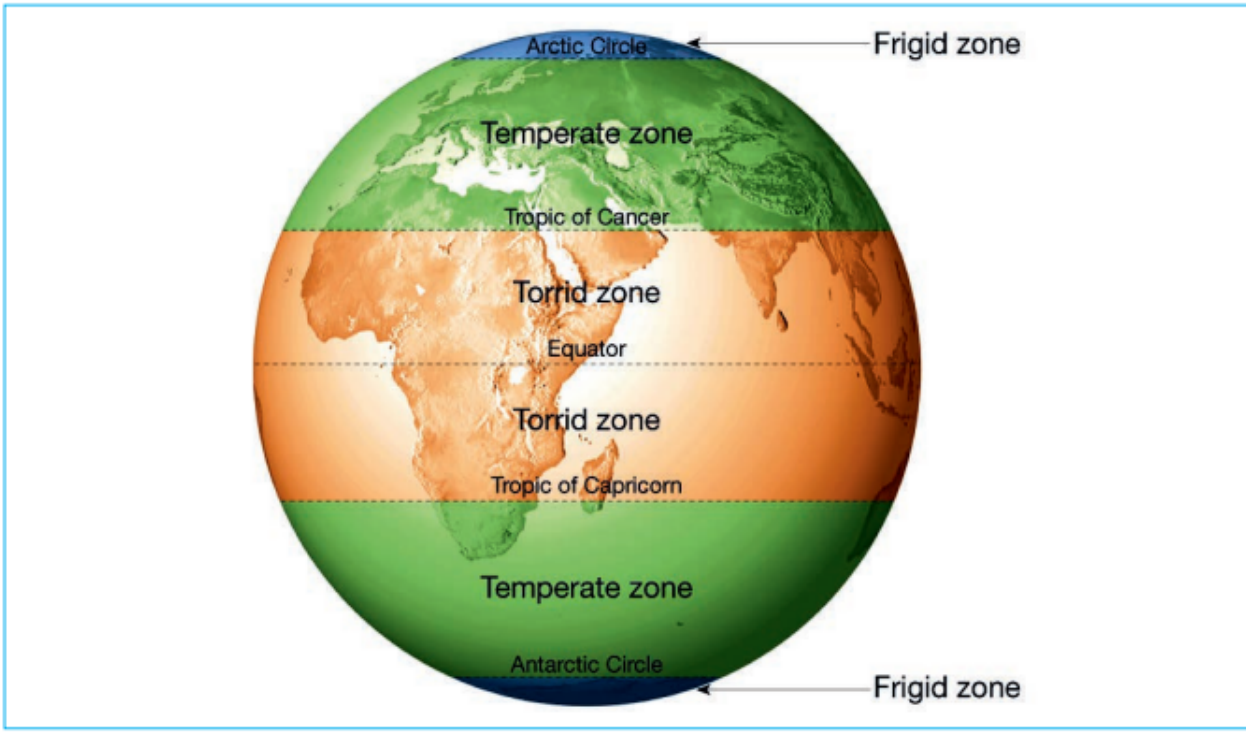


Figure 2.1: *World Climate Zones According to Ancient Greeks*

- Since the beginning of the twentieth century, however, many climate-classification schemes have been devised.
- Long-term records of temperature and precipitation reveal climate patterns across continents, delineating them into climate regions.
- Class names for classification systems based on weather patterns often include geographical names such as polar, tropical, continental, and marine.
- These terms are modified by terms describing temperature and moisture, or the intensity of weather during summer or winter.
- The descriptors that are used in this method of classification include moist or dry, warm or cold, and temperate or severe.
- Today, climate scientists split the earth into approximately five major types: tropical, dry, temperate, continental, and polar considering a variety of factors including altitude, air pressure, wind patterns, latitude and geographical characteristics such as mountains and oceans.

One of the most widely used classification schemes is made by the German Climatologist and Botanist Wladimir Köppen (1846-1940).

- He divided the world's climates into categories based upon general temperature profiles related to latitude.
- The Köppen classification uses easily obtained data: mean monthly and annual values of

temperature and precipitation.

- Köppen believed that the distribution of natural vegetation was the best expression of an overall climate.
- Köppen recognized five principal climate groups, each designated with a **capital letter**:
    1. A (humid tropical)
    2. B (dry)
    3. C (humid middle-latitude, mild winters),
    4. D (humid middle-latitude, severe winters), and
    5. E (polar), and H (highland).
- Four groups (A, C, D, E) are defined by temperature.
- The fifth, (group B), has precipitation as its primary criterion, while H is determined by altitude.

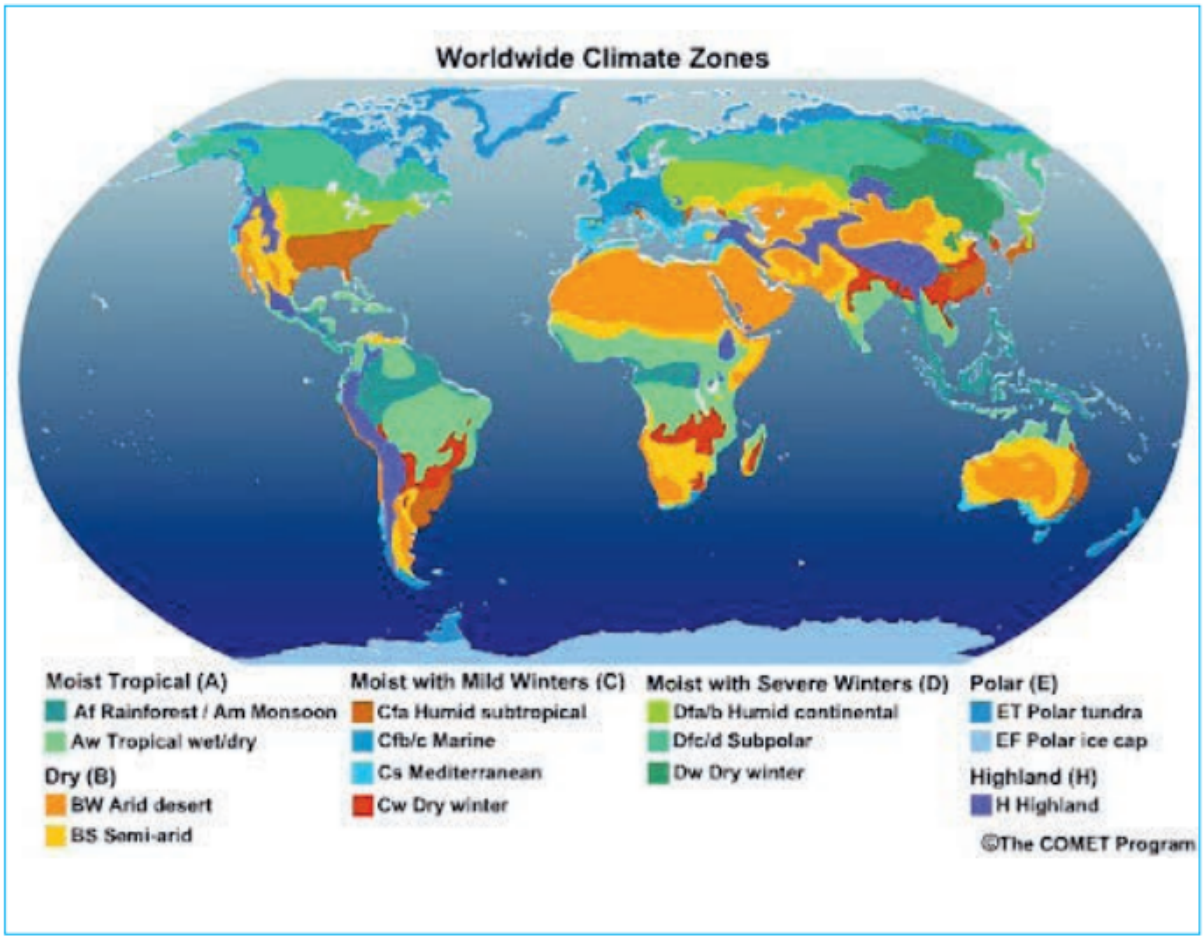


Figure 2.2: *Map of Köppen's Five Principal Climate Groups*

2.1.2 World Climate Zones and Regions

- ✓ Climate zones are areas with distinct climates, which occur in the east-west direction around the Earth, and they can be classified using different climatic parameters.
- ✓ Generally, climate zones are belt-shaped and circular around the poles.
- ✓ In some areas, climate zones can be interrupted by mountains or oceans.
- ✓ The world's climate pattern reflects a regular and dependable operation of the major climate controls.
- ✓ The solar radiation reaches the ground on different parts of the Earth at different angles.
- ✓ On the equator, the sunlight reaches the ground almost perpendicularly, whilst at the poles the angle of the Sun is lower or even under the horizon during the polar night.
- ✓ Throughout the seasons, the position of the Sun to the Earth changes and thus the angle of incidence of the sunlight also changes.

- ✓ The angle of the Sun at noon varies from perpendicular (90°) within the tropics up to horizontal (0° = Sun does not or only partially appear on the horizon) within the polar circle.
- ✓ Thus, the sunlight warms up the Earth around the equator much more strongly than at the poles.
- ✓ Due to temperature differences caused by the differences in radiation, recurring climatic conditions develop.

✍ There are four major global climate zones:

1. Tropical Zone from 0°– 23 $^{1/2^{\circ}}$ (between the tropics)

- ➢ In the regions between the equator and the tropics (equatorial region)
- ➢ the solar radiation reaches the ground nearly vertically at noontime during almost the entire year.
- ➢ Thereby, it is very warm in these regions.
- ➢ Through high temperatures, more water evaporates and the air is often moist.
- ➢ The resulting frequent and dense cloud cover reduces the effect of solar radiation on the ground temperature

2. Subtropics Zone from 23.5°– 40°

- ❖ The subtropics receive the highest radiation in summer, since the Sun's angle at noon is almost vertical to the Earth, whilst the cloud cover is relatively thin.
- ❖ These regions receive less moisture (see trade winds), which increases the effect of radiation.
- ❖ Therefore, most of the deserts in the world are situated in this zone.
- ❖ In winter, the radiation in these regions decreases significantly, and it can temporarily be very cool and moist.

3. Temperate Zone from 40°– 60°

- ☞ In the temperate zone, the solar radiation arrives at a lower angle, and the average temperatures here are much cooler than in the subtropics.
- ☞ The seasons and day length differ significantly in the course of a year.
- ☞ The climate is characterized by less frequent extremes, more regular distribution of the precipitation over the year and a longer vegetation period – therefore, it is named as "temperate".

4. Cold Zone from 60°– 90° -

- The polar areas between 60° latitude and the poles receive less heat through solar radiation, since there is very low angle of the Sun.
- Because of the changes of the Earth axis angle to the Sun, the day length varies most in this zone.
- For instance, in the summer, polar days occur.
- Vegetation is only possible during a few months per year and even it is often sparse.
- The conditions in these regions make life very challenging.
- The characteristics of the climate zones change with great altitude differences within a small area, like in mountain areas, since temperatures decrease rapidly with altitude.

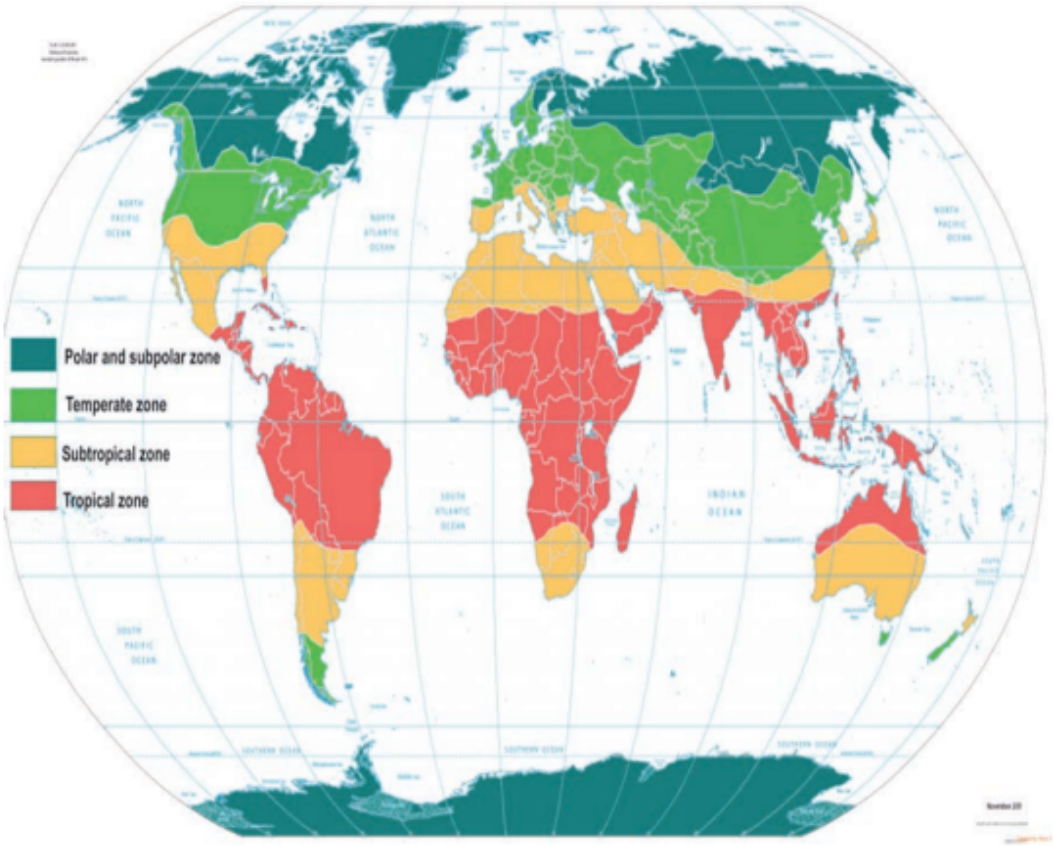


Figure 2.3: *World Climate Zones*

2.2 CLIMATE TYPES AND ZONES OF AFRICA

The climate of Africa is characterized by a range of climates such as the **equatorial climate**, the **tropical wet** and **dry climate**, the **tropical monsoon climate**, the **semiarid climate** (semi-desert and steppe), **the desert climate** (hyper-arid and arid), and the **subtropical highland climate.**

- Temperate climates are rare across the continent except at very high elevations and along the fringes of the continent.
- In fact, the climate of Africa is more variable in rainfall amount than in temperatures, which are consistently high.
- African deserts are the sunniest and the driest parts of the continent, owing to the prevailing presence of the subtropical ridge with subsiding, hot, dry air masses.
- Africa holds many heat-related records: the hottest extended region year-round, the areas with the hottest summer climate, the highest sunshine duration, and more.
- Owing to Africa's position across equatorial and subtropical latitudes in both the northern and southern hemisphere, several different climate types can be found within it.
- The continent mainly lies within the **tropical zone** between the **Tropic of Cancer** and the **Tropic of Capricorn,** hence its interesting density of humidity.
- Precipitation intensity is always high, and it is a hot continent.
- Warm and hot climates prevail all over Africa, but mostly the northern part is marked by aridity and high temperatures.
- Only the northernmost and the southernmost fringes of the continent have a Mediterranean climate.
- The equator runs through the middle of Africa, as do the Tropic of Cancer and the Tropic of Capricorn, making Africa the most tropical of all the continents.
- Africa's position is relatively unique in the sense that it almost has a mirror image of climate zones to the north and South of the Equator with regard to latitude.
- When considered in detail, the movement of air masses and their effects provide the basis for a division of the continent into eight climatic regions.
- These are:- 1. the Equatorial (Tropical Wet Climate) Region,
    2. the Tropical Wet-and-Dry Region,
    3. Semi-arid Climatic Region,
    4. Hot Desert Climatic Region,
    5. Humid Subtropical Climatic Region,
    6. Mediterranean Climate Region,
    7. The Warm Temperate East Coast Climate Region
    8. Warm Temperate Continental Climate Region
    9. The Mountain Climatic Region

2.2.1 Types and Characteristics of Climate Zones in Africa

- Climate is regulated by the apparent movement of the sun between the two tropics and the associated movement of winds.
- Meanwhile, north or south of the Equator the climate tends to change similarly.
- This gives rise to symmetrical climatic zones in Africa consisting of the central zone of equatorial climate, tropical zones, hot deserts, and Mediterranean zones.

I. The Equatorial Climate Region

- Is experienced in the lowland area between latitudes 5^0 N and 5^0 S of the equator.
- This covers mainly parts of Central Africa which includes the Democratic Republic of Congo, Gabon and Cameroon.
- It is also experienced in the Southern part of Nigeria, Ghana, Benin and Sera Leone.
- Highland and coastal areas, especially in Eastern Africa, experience modified equatorial climate where the temperature is much lower than it is experienced in the true equatorial climate.
- In the Equatorial climate, temperatures are very high throughout the year averaging about 26° C, the hottest months in the year are March and September when the sun is overhead at the equator.
- The diurnal temperature range is **very low, about 3° C.**
- There is often heavy cloud cover and the humidity is high throughout the year.
- This region mainly receives convectional rainfall.

II. The Tropical Wet-and-Dry Region

- Is often called the s**avanna climatic region.**
- This region covers a little less than half of the total surface area of the continent, extending toward the Equator from the semiarid areas.
- The great distinguishing feature of this climatic region is the seasonal character of its rainfall.
- During the period of high sun, the maritime air masses produce up to six months of rainfall, the length of the rainy season depending on the nearness to the Equator.
- The rest of the year is dry.
- In a few places, for example, on the coast of Mauritania and Senegal, there is also a little rainfall in the period of low sun.
- As in the desert and semiarid climatic zones, mean monthly temperatures show less variation than daily temperatures.

- In western Africa, the period of low sun corresponds to the harmattan season.
- The harmattan is a warm, dry, northeasterly or easterly wind that blows out of the southern Sahara and is frequently laden with large quantities of sand and dust.
- Regions with the equatorial, or tropical wet, type of climate, or variants, are the wettest in Africa.
- There are two peak periods of rainfall corresponding to the double passage of the inter-tropical convergence zone (ITCZ).
- Because areas with an equatorial climate are constantly covered by warm maritime air masses, variations in their monthly and daily temperatures are less pronounced than in the tropical wet and-dry regions.
- Marked variations in the **rhythm** of equatorial climate sometimes occur.
- For example, the rainfall may be monsoonal or the second rainy season may not exist at all.
- However, the most notable variation can be observed on the western African coast from around Cape Three Points in Ghana, eastward to Benin, where the bimodal rainfall regime prevails, and the total annual precipitation is less than 1,000 mm.
- Some of the explanations about these variations include: the presence of a cold body of water off-shore chills the lower of the maritime air mass and makes it stable; the body of cold air that forms offshore diverts the incoming airstreams to the west and east of the anomalously dry area; there is a strong tendency for the winds to blow parallel to the shore during the rainy seasons; the absence of highlands deprives the region of Orographic (mountain) rainfall; fluctuations in the offshore moisture bearing winds occur during the rainy season and reduce rainfall; and that local meteorological peculiarities of thunderstorms contribute to the reduction in rainfall.
- In Eastern Africa, the tropical climate type is experienced in **Sudan, Ethiopia, Kenya, Tanzania and Somalia.**
- Similarly, in Central Africa, it is experienced in **Zambia, Malawi, Angola, Namibia, Botswana and Zimbabwe.**
- In the northern and southern extremities of the continent, there is a dry summer subtropical, or the Mediterranean type of climate.
- Rain falls only in winter (December–January in North Africa, June–July in Southern Africa), although in some localities it may fall in autumn (September in North Africa, April in Southern Africa).
- Mean monthly temperatures are lower than in tropical climates, dropping to about 10 °C in winter, while summer (June–July in North Africa, and December– January in Southern Africa) temperatures may sometimes exceed those of tropical climates.
- Clear and blue skies are the common characteristics of this climate region.

III. Semi-arid Climatic Region

- ❖ This region fringes the desert areas and include the greater part of the land south of the Zambezi River.
- ❖ They differ from true desert regions in being just within reach of the ITCZ in the course of its seasonal movement and therefore receiving more rainfall.
- ❖ Temperatures are about the same as those in the desert regions.

IV. The Hot Desert Climatic Region

- ➢ Hot deserts are places where there is **little or no rainfall**.
- ➢ The hot desert region consists of the **Sahara and Kalahari deserts,** which are always under the **influence of dry continental tropical air masses**, and the northern Kenya–Somali desert, the aridity of which is principally caused by the stable nature of the maritime air masses that pass over it throughout the year.
- ➢ The stability of these maritime air masses is induced by their passing over the cool body of water offshore.
- ➢ In addition to aridity, the desert climate is characterized by high mean monthly temperatures; the diurnal (daily) temperature range is, however, greater than the annual range of the mean monthly.
- ➢ The daytime temperatures are extremely high; temperatures usually range between 30°C - 40°C, some places in the Sahara Desert experience above 40°C, the highest ever recorded temperature in the region, and also in the world, was 58°C in Azizia, Libya.
- ➢ At night, temperatures are very low, dropping to below 10° C.
- ➢ The skies are clear and because of this, the heat received from the sun during the day is quickly lost back into the atmosphere at night.

V. Humid Subtropical Climatic Region

- ☞ This climate type is found in Eastern side of continents between 20^0 and 35^0 north and south latitudes.
  - ✍ The humid subtropical climate is a transition between the **tropical** and **temperate** climates.
- ☞ In Africa this climate type is confined to the southeastern coast of South Africa.
- ☞ The region is characterized by a relatively **high temperature** with. **warm and wet climate**
- ☞ In Koppen's classification the humid subtropical climate is constitutes of two

climates (Cfa and Cwa)

VI. Mediterranean Climate Region

- This climate is also called **Warm Temperate Western Margin Climate** and it is experienced in very small areas of the continent.
- The Mediterranean climate is best developed on the shores of the Mediterranean Sea.
- It is also experienced in the South Western tip of Africa.
- Temperatures in the Mediterranean climate region range from 10º C in winter to about 21º C in summer.
- These areas lie in the path of westerly winds.
- In the summer season, winds blow from the land to the sea. Therefore, they are dry winds.
- Winters are wet because cool moist winds blow towards the land from the sea.
- The influence of moist westerly winds also makes the winters mild.
- The average amount of rainfall each year is about 500-750 mm.

VII. The Warm Temperate East Coast Climate Region

- The climate is experienced between latitudes 30º - 40º north of the Equator and 30º -40º south of the Equator.
- It is experienced along the Eastern coast of South Africa, especially in Natal and Cape Provinces, as well as in Mozambique.
- These areas are under the strong influence of the warm Mozambique current and the warm southeast trade winds.
- Summer temperatures are generally high with an average of about 26ºC.
- Winter temperatures are low, averaging about 10º C.
- Annual rainfall is between 1000 - 1500 mm per year but it decreases as one moves westwards into the interior.

VIII. Warm Temperate Continental Climate Region

- This climate is mainly experienced in the interior of South Africa, between the Drakensberg Mountains and the Kalahari Desert.
- The rainfall amount is generally low because the area is inland and the winds blowing from the sea reach here when they are already dry.
- Most of the rain falls during the winter season and averages about 700 mm per year.

- ➲ The Eastern areas are wetter than those in the West which are close to the Kalahari Desert.
- ➲ The annual temperature ranges from about 26º C in summer to about 10º C in winter.

IX. The Mountain Climatic Region

- ⇒ This climate region includes the high mountain areas of Kenya, Ethiopia and the lakes region of East Africa.
- ⇒ In some respects, the climate is similar to the warm temperate upland climate, except the temperatures are even lower and snow occurs on the tops of the highest peaks, such as Kilimanjaro.
- ⇒ The area receives more rainfall than the surrounding areas.
- ⇒ It mostly receives relief rainfall, formed as the warm moist winds are forced to rise up the highlands.
- ⇒ The highest amount of rainfall is received on the windward slopes.
- ⇒ At the lower slopes, the mountains are warmer and wetter.
- ⇒ The slopes facing away from the sea are called leeward or rain shadow slopes.
- ⇒ They receive little or no rain.
- ⇒ The winds here are descending and have a cooling effect.
- ⇒ Temperature decreases with an increase in altitude.
- ⇒ At the very top of high mountains, temperatures are below freezing point

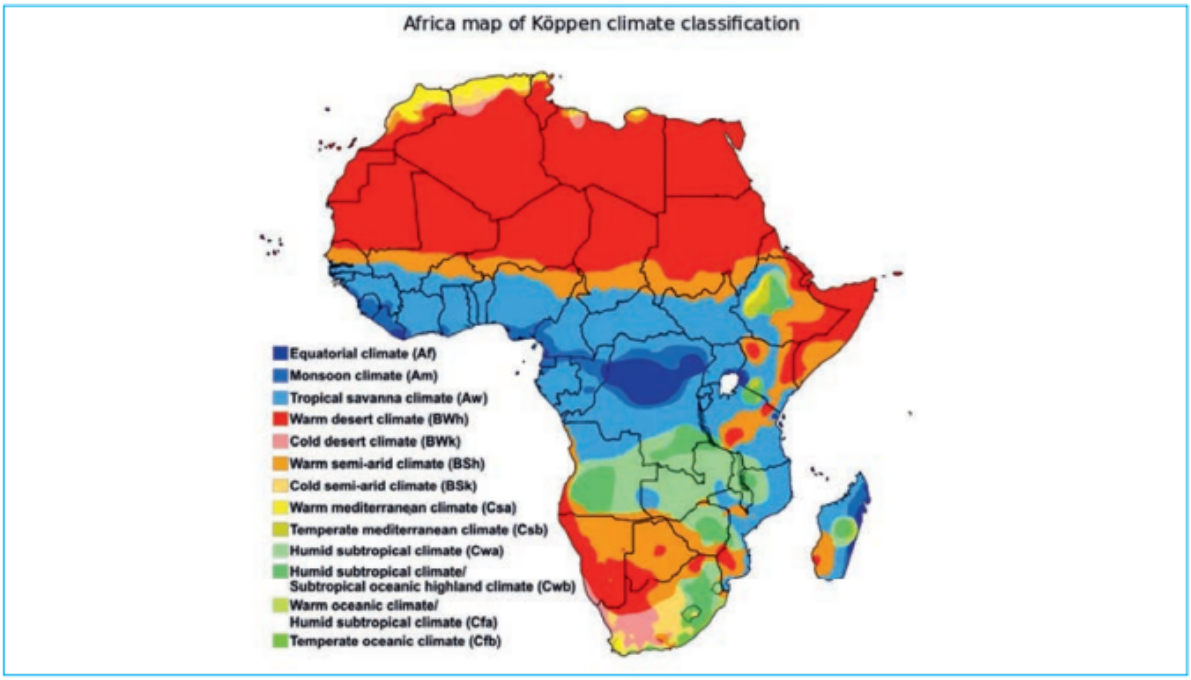


Figure 2.4: *Climate Zones of Africa based on Köppen's Classification*

2.2.2 Factors Controlling Climate of Africa

There are several factors that influence the climate of the African continent. These include angle of the sun, latitude, air pressure, wind system and the Intertropical convergence zone (ITCZ), major ocean currents, land and water (maritime versus continental) influence, and altitude. These factors determine the amount of temperature and precipitation.

I. Latitude and its influence on Solar Radiation received

- Africa straddles the Equator from **37º N to 34º S**, hence it lies within the tropics.
- Variations in the receipt of solar energy and temperature differences are largely a function of latitude.
- Temperature is high throughout the continent because of the continent's location relative to Equator.
- As latitude increases, the sun shines more obliquely and provides less energy.
- The equator, however, faces the sun's rays directly, so the climate is warm year-round.

II. Pressure Systems, Winds, and the Intertropical Convergence Zone (ITCZ)

- Located on about Latitude **30°North and south** of the Equator are Sub-tropical High Pressure Belts that dictate surface wind patterns and influence rainfall and temperature regimes on the continent.
- The Subtropical High-Pressure Systems on both sides of the Equator generate two wind

systems that converge on the equator in a zone termed as Inter-Tropical Converge Zone (ITCZ).

- From the **north, Subtropical High Pressure Belt zone blows the Northeast Trade Winds** (locally called Harmattan).
- The Harmattan is dry and cool and blows over Sub-Saharan Africa from about November to April.
- From the **south Sub-tropical High Pressure belt** zone blows the Southwest Trade Winds (locally called **Monsoon**)
- The Monsoon winds are moist and bring rainfall to the coasts of West Africa.
- The African continent does not extend much beyond 35^{o} of latitude from the equator.
- The implication is that the range of climatic conditions is limited and that the general direction of wind movement is towards the equator (or in more accurate terms towards the inter-tropical convergence zone - ITCZ).
- The ITCZ shifts with the seasonal movement of the sun across the tropics:
- In **June:** the northern summer season, the ITCZ is located at about 13 degrees of latitude in North Africa at the southern boundary of the Sahara.
- In **December**, the Northern winter season, the ITCZ moves southward along the West African Coast and to the northern and eastern margins of the Congo basin and continues to Madagascar.
- Movements in the ITCZ are closely related to the distribution of rainfall and climatic zones.
- The climatic zones assume symmetry around the equator, although the high altitudes in some parts of the continent and the adjacent disturb the symmetry.

III. Major Ocean Currents

- Winds that tend to blow persistently over the ocean tend to drag a thin surface layer of the water in their direction of flow.
- This layer of ocean water called Ocean Current dictates the temperature and moisture characteristics of the wind and the coastal regions over which the wind blows.
- When ocean currents blow from low latitudes (near to the equator) towards higher latitudes (towards the pole) the currents carry Warm ocean water into relatively cool regions.
- Such an ocean current is called Warm Ocean Current.
- Warm Ocean Currents supply moisture to winds blowing over them to develop rainfall on the adjacent coasts.

- In Africa, Warm Ocean Currents include **Warm Guinea Currents** - in West Africa, Warm **Mozambique Currents** – in Southeast Africa.
- The cool surface of Cool Ocean Currents causes moisture in winds blowing over them to condense and form fogs, etc.
- The winds are deprived of their moisture so they tend to absorb rather than deposit moisture at the adjacent coasts.
- Cool currents, therefore, cause dry conditions and in Africa the **Cool Canary Currents** - the western coast of the Sahara Desert, the **Cool Benguela Currents** – the Western coast of Kalahari Desert.
- The cool ocean currents tend to create rich fishing grounds.
- Rich fishing grounds exist along the Morocco and Spanish Saharan Coasts that are washed by the Cool Canary Currents.
- The Namibian coast that is washed by the Cool Benguela current also has rich fishing grounds.

IV. Distribution of Land and Water

- Large water bodies such as the Ocean and huge lakes modify climates in adjacent lands.
- In the continental interior, where there are no large bodies of water, temperatures get very warm in summer or during the day.
- The land is solid, so it heats up more rapidly during the day.
- The compact nature of the land means that only a thin surface gets heated.
- As a result, heat absorbed into the thin layer of surface rocks is released very rapidly.
- The land surface is, therefore, very cool at night and in winter.
- The interior location does not also allow rainfall to reach such places thereby creating warm, humid, hot and dry climates.
- These extremities in climate affect all states located in the interior of continents.
- Such climates are called Continental Climates as against Maritime Climates experienced on lands located along coasts.
- In places such as Timbuktu in Mali the diurnal and annual ranges in temperature are very high because of continentality.

V. Altitude

- Since energy from the sun is transformed into heat on the surface of the earth, air temperature decreases with altitude at an average rate of **6.4o C per 1000 meters.**
- This change in temperature with altitude is called the Lapse Rate.

- Because of this decrease in temperature with height, mountainous regions such as the Ethiopian highlands have very cool temperatures.
- Very high peaks such as Mountain Kilimanjaro located along the equator even have permanent snow cover.
- While these factors help to account for the broad climatic patterns of African continent, there are nevertheless numerous local variations to be found from place to place within the same climatic zone.

2.2 BENEFITS OF CLIMATE FOR LIFE OF PEOPLE OF AFRICA

Climate affects nearly every aspect of our lives from our food sources to our transport infrastructure; from what clothes we wear, to where we go for recreation. It has a huge effect on our livelihood, our health, and our future.

☞ **People's settlement** and **living** are hugely associated with **climate types**. Do you agree? Why?

Africa is a continent with a diversity of climate landscapes. The relationship between climate, physical resources, and socio-economic condition of people in Africa is briefly presented in the following section.

2.3.1 Climate and Agriculture in Africa

It is indisputable that agriculture is the **backbone of Africa's economy** and accounts for the majority of livelihoods across the continent. Agriculture is an extremely important sector on the African continent, on average accounting for **70%** of the labor force and over **25%** of the **Gross Domestic Product (GDP).** Agriculture has always been deeply dependent on the weather, with farmers needing a steady mixture of sun, warmth, and rains to reliably produce the crops they need.

A change in a climate, therefore, exacerbates the complexity of issues (such **as few technological inputs**, the majority of Africa's farmers working on **a small-scale or subsistence level** and have **few financial resources**, **limited access to infrastructure, and**, etc.) in the continent.

2.3.2 Climate and Health in Africa

☞ **Climate change** has widespread effects on human health by impacting both **environmental and social determinants.** Humans have understood the importance of climate to human health since ancient times. For instance, a flood can cause drownings, a drought can lead to crop failure and hunger, and temperature extremes pose a risk of exposure.

☞ In reality, however, all climate impacts on health are mediated by some combination of natural and human dynamics that cause individuals or populations to be vulnerable to the effects of a variable or changing climate.

☞ Africa is commonly described as a "climate-vulnerable" continent in which rainfall

variability, hydrological extremes, and anthropogenic climate change have the potential to inflict significant harm on a large population.

2.3.3 Climate and Water Resources in Africa

- **Water** is the most important of all natural resources. **Without water, life would not be able** to **thrive** on the Earth. It has been argued that the level of streams, flow of streams/rivers, the volume of underground water and the like all depend on types of climates and water availability.

2.4 CLIMATE CHANGE AND ITS CHALLENGES TO AFRICA'S DEVELOPMENT VISION

- In many cases **climate variability and climate change** are interchangeably used. However, there is a clear demarcation between the two. Variability may be due to natural internal processes within the climate system or to variations in anthropogenic (caused by human) external forcing.
- Climate change, on the other hand, is a change in the state of the climate system, identified by changes in the average conditions and the variability of its properties, that persists for an extended period, typically decades or longer, due to natural and/or anthropogenic processes and drivers
- According to the **Intergovernmental Panel on Climate Change (IPCC**), the vulnerability of Africa to climate change is driven by a range of factors that include weak adaptive capacity, high dependence on ecosystem goods for livelihoods, and less developed agricultural production systems. The risks of climate change on agricultural production, food security, water resources and ecosystem services will likely have increasingly severe consequences on lives and sustainable development prospects in Africa
- In general, African has been seriously affected due to the following reasons. First, the African society is very closely coupled with the climate system, hundreds of millions of people depend on rainfall to grow their foods. Second, the African climate system is controlled by an extremely complex mix of large-scale weather systems.

3.1.1 The Major Natural Resources of the world

The Earth is **blessed** with different natural resources. Natural resources provide fundamental life support in the form of both **consumptive use and public good services**.
Consumptive use is the use of resources in ways that reduce **supply**. Examples include mining and logging in a forest.

Public good is a good that benefits many people whether or not they have paid for it. Here is a list of natural resources that are extremely important to the existence of life on Earth.

I.Water

The first natural resource in the above list is water. Arguably, water is the most important of all natural resources. Without water, life would not be able to thrive on the Earth. About 71% of Earth's surface is water and the oceans hold about 96.5% of that water.

- ✓ **There is only about 2.5% freshwater from the total amount of water on Earth.** Most of the freshwater cannot easily be accessed since it is found **underground** or in a **form of ice and snow in remote areas.**
- ✓ **Water in seas and oceans is saline** hence, it cannot be directly used for household use and drinking purposes. Of course, there are systems in place to purify non-drinkable water into water safe for consumption through **filtration methods**.

Table 3.1: The Earth's Water Resources

Category	Total volume (km^3)	Percent of total	Percent of fresh
World ocean	1,338,000,000	96.5	
Groundwater (to 2,000 m)	23,400,000	1.7	
Predominantly fresh **groundwater**	10,530,000	0.76	30.1
Soil moisture	16,500	0.001	0.05
Glaciers and permanent snow	24,064,100	1.74	68.7
Antarctica	21,600,000	1.56	61.7
Greenland	2,340,000	0.17	6.68
Arctic Islands	83,500	0.006	0.24
Mountain areas	40,600	0.003	0.12
Ground ice (permafrost)	300,000	0.022	0.86
Lakes	176,400	0.013	
Freshwater	91,000	0.007	0.26
Salt water	85,400	0.006	
Marshes	11,470	0.0008	0.03
Rivers	2,120	0.0002	0.006
Biological water	1,120	0.0001	0.003
Atmospheric water	12,900	0.001	0.04
Total water	1,385,984,610	100.00	
Freshwater	35,029,210	2.5	100.00

In addition, climate change is affecting freshwater by reducing its availability for humans. Due to the changes in weather and increase in ice melt in the poles, precipitation patterns have been changing and reserves of freshwater are quickly disappearing.