

UNIT: 20 LOCAL WINDS

- Local winds are the kind of winds that blow for a short period of time and affect a smaller area.
- They are caused by the immediate influences of the surrounding relief or topography.
- These are small-scale convective winds of local origin arising from small-scale pressure differences
- Examples of local winds are Fohn, Santa Ana, Chiperoni, Harmattan, Leveche, Chinook, Sirocco, Zonda, Bora, Mistral, Brickfielder, Pampero and Burster

General characteristics of local winds

- a. They blow over a smaller area
- b. They tend to be short-lived lasting, typically several hours to a day
- c. They change direction and speed over a short period of time

Differences between local winds and prevailing winds

- i. Local winds are caused by the immediate influences of the surrounding topography or relief while prevailing winds are mainly caused by large scale global pressure systems
- ii. Local winds affect small area while prevailing winds affect very large areas.
- iii. Local winds are named after the local names in areas, which they exist while as prevailing winds, have global names such as trade winds, westerlies and polar winds.

LAND AND SEA BREEZE

- Land and sea breeze are caused by differences in the heating and the loss of heat of land and sea.
- a. **Sea breeze**

- A sea breeze is a wind blowing from the sea towards the coast. It happens during the day.

Occurrence of a sea breeze

- During the day, land heats up much quicker than water. As the land heats up, it warms the air close to the ground. The warm air becomes less dense and begins to rise and low pressure is created. While over the ocean, air remains cool and thus denser and pressure is higher than over the land. The wind will blow from the higher pressure over the water to lower pressure over the land to replace warmer rising air as sea breeze

Effects of sea breeze

- i. It keeps the coastal communities cooler than other locations inland during the day and during summer
- ii. Many tourists choose these areas as travel destinations during summer for heat comfort
- iii. At certain locations, converging sea breezes can cause air to rise and form rainfall. This is helpful for farming
- iv. The sea breeze aids sailors in moving towards the land during the day

- b. **Land breeze**

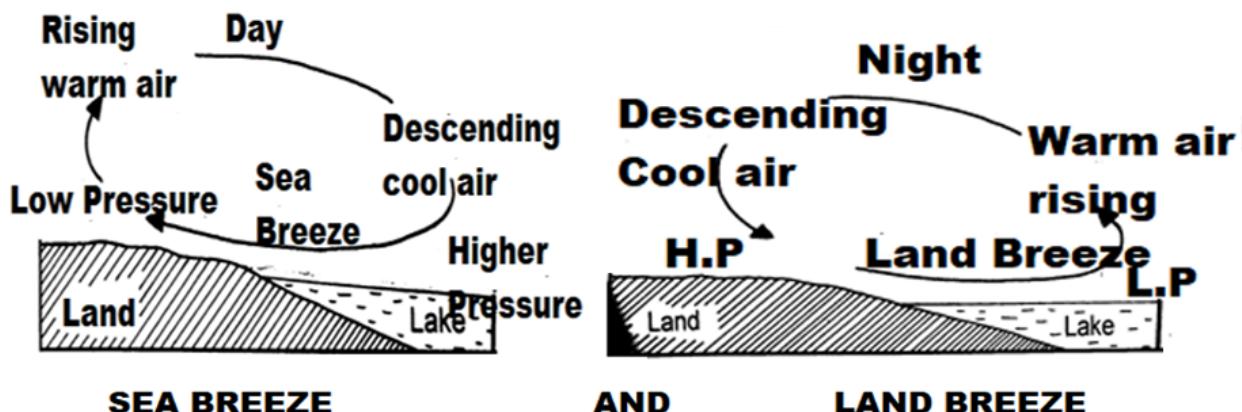
- A **Land breeze** is the type of wind that blows from the land to the sea, and usually occur at night

Occurrence of land breeze

- During the night, land cools off much quicker than water. The water will be warmer than the land. The air over the water slowly begin to rise, low pressure is created over the water. Then cold and dense air over the land move towards the water surfaces to replace the rising warm air as land breeze

Effects of land breeze

- Land breezes assist fishermen to go to the sea at night in their small fishing boats
- The land breeze can also help move pollutants out to sea
- The land breeze has a cooling effect over the ocean surface

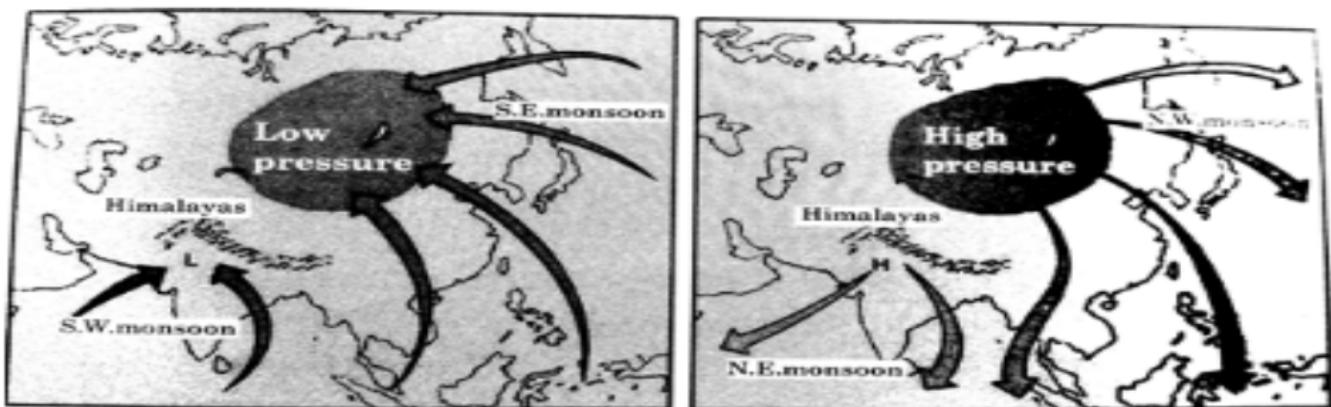


Why water surfaces gain and lose heat more slowly than land surfaces?

- Water is transparent and sun rays penetrate more deeply than they can on the land.
- More energy is required to heat a given amount of water than the same amount of soil due to the fact that the molecules of soil are closely arranged than those of water.
- Water moves which makes the heat to be distributed than the land which does not move.
 - For these reasons, the land absorbs heat faster than water but the land also loses the heat absorbed faster than water.

THE MONSOON WINDS OF ASIA

- The monsoon winds of Asia are giant sea and land breezes produced by seasonal changes in pressure systems.
- During summer, the continent of Asia heats up more than surrounding oceans; this creates an intense low pressure area over North-central Asia and India, and a comparatively high pressure zone over the cool ocean surfaces. Winds therefore blow from the oceans into the land.
- During winter, the flow of air reverses. The continent cools rapidly forming a high pressure over land. Now the drier cold air of the continent blows toward the ocean



**Summer
MONSOON WINDS OF ASIA**

Winter

MOUNTAIN AND VALLEY BREEZES

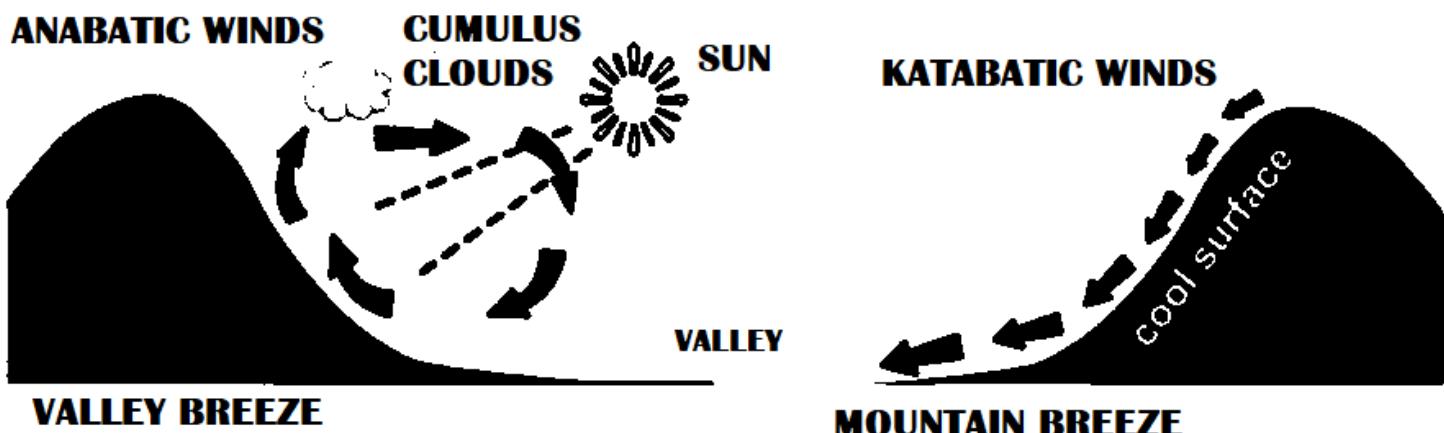
- Mountain and valley breezes are related local winds common in regions with great topographic relief
- They occur one after the other on a daily cycle through a process similar to sea and land breezes

A. VALLEY BREEZE

- A valley breeze is gentle wind blowing up a mountain slope during the day.
- When the sun rises, it is the top of mountain peaks that receive first, and as the day progresses, the mountain slopes take on greater heat load than the valleys. This results in rapid warming of the air over the mountain slopes, causing it to rise.
- The cool air from the valleys gently moves up-slopes to replace the warm rising air, hence, valley breeze
- The air current that moves uphill is called **anabatic wind**; from the Greek word '*anabatos*', verbal of meaning '*moving upward*'

B. MOUNTAIN BREEZE

- A Mountain breeze develops during the night when air along the slopes begin to cool quickly
- As the air cools, it becomes denser and begins to flow down-slope into the valley. However, if the mountain slopes are covered with ice and snow, the surrounding air becomes cold and dense, causing the mountain winds to blow during the day into the warmer valleys.
- The air current moving down a slope by gravity is called **katabatic wind**; from the Greek word *katabatikos* meaning, '*going downhill*'

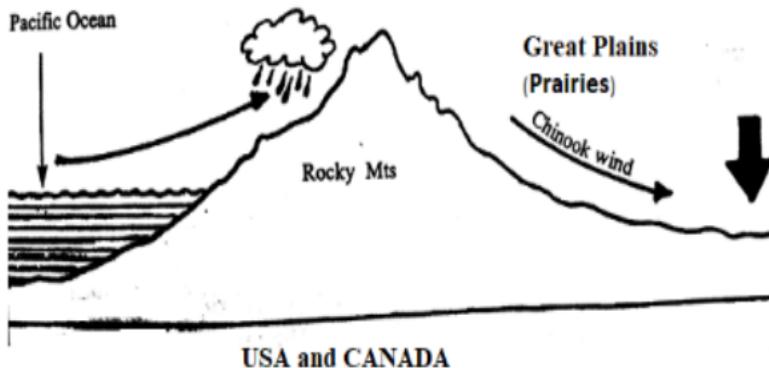


DESCENDING/DRAINAGE WINDS

- They result when strong regional winds passing over a mountain range are found to descend on the leeward side with the result that the air is heated and dried, e.g. the **Chinook** and **Föhn**
- Drainage winds are more generally known as **katabatic winds**. Examples of drainage winds include the **Bora** in Northern Adriatic Sea Coast, the **Mistral** in Southern France, and **Santa Ana** in Southern California. Mountain breezes are also drainage winds

a. CHINOOK (Snow-eater)

- It originates from the Pacific Coast. It blows across the Rocky Mountain in Canada and USA and bring heavy rains on the western part of the Rockies
- The warm, dry air then descends the eastern slopes of the Rockies as the Chinook winds



Characteristics of chinook winds

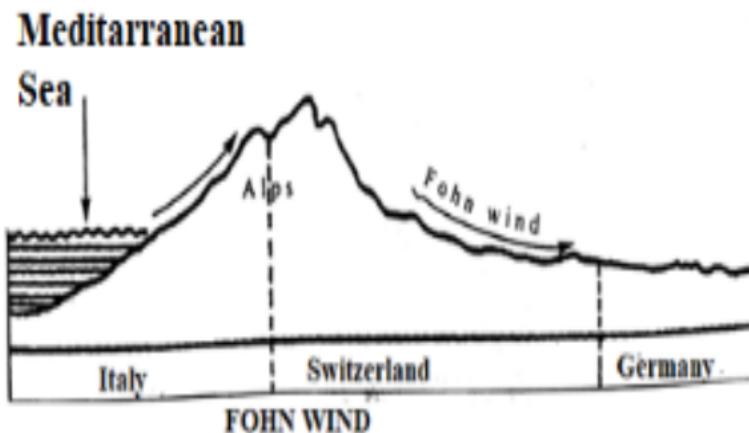
- i. They often move at high speed and are warm
- ii. They are very common in spring and winter
- iii. They bring rains to the west of the Rockies
- iv. They are extremely dry since it had dropped moisture on the windward side
- v. Temperature rise as they descend over the eastern side of the Rocky Mountains
- vi. They blow from the western side of the Rocky Mountains on the Pacific coast, and descend on the eastern side of the mountain
- vii. It is accompanied by a band of flat rainless cloud up high in the sky

Effects of the Chinook

- a. Their temperature rises by 19°C within a period of 15 minutes. As a result, they can melt and dry winter snow. It is for this reason that they are called '**snow eater**'. These winds are thus of economic value in pastoral regions such as areas from Southern Colorado (USA) to Mackenzie River (Canada)
- b. Strong and frequent Chinooks mean that winter is mild, and pasture is available
- c. Rapid melting of ice due to the temperature results into widespread avalanches and floods
- d. The risk of fire increases with occurrence of Chinook winds
- e. Abrupt temperature changes can cause pneumonia, septicaemia and shipping fever in cattle

b. FÖHN WINDS

- The Föhn is a type of down-slope wind that occurs in the leeward of Alps Mountains in Europe
- It occurs when moist winds from the Mediterranean Sea blow over the mountains



Characteristics of Föhn winds

- They are warm, such that it can raise temperatures by as much as 30°C in just a matter of hours
- It is dry as it results from air which has dropped most of its moisture on windward slope

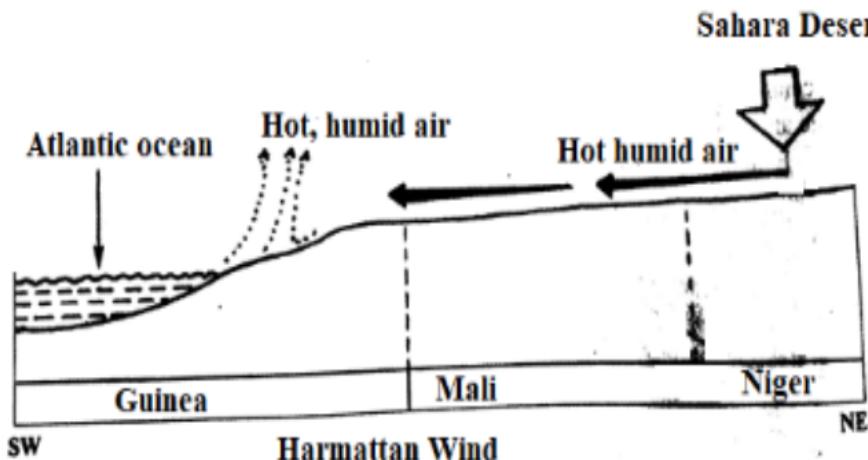
- They blow down the leeward slope of Northern Alps Mountain

Effects of Föhn winds

- They bring warmer and dry weather
- The winds are capable of melting snow because they raise temperature by 8°C to 14°C (snow-eater)
- As they melt snow, they can cause avalanches and floods
- Snow melting makes pastureland ready for animal grazing
- Residents of surrounding areas suffer from a variety of illnesses like migraines and psychosis
- The higher temperatures also help the grapes to ripe early
- They bring drought, dry up plants and farmlands, and exacerbate forest fires

c. HARMATTAN WINDS

- The Harmattan is a wind that blows from Sahara Desert to the western coast of Africa



Characteristics of the Harmattan winds

- They are hot, dry and dusty
- They blow from Sahara Desert to the western coast of Africa
- They blow in the cool, dry season between October and February

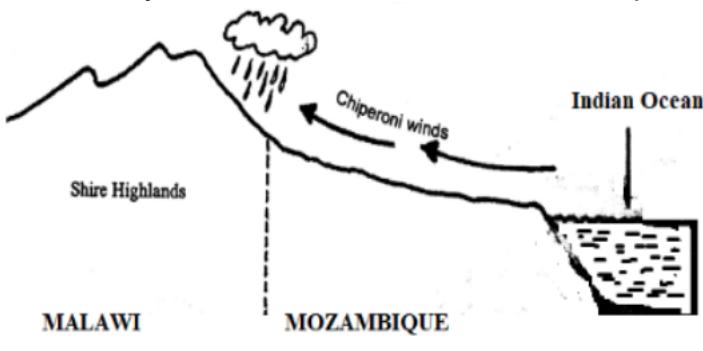
Effects of the Harmattan winds

- When it reaches Guinea coast it provides a welcome relief from the moist heat for it is cool wind to that area since it encourages evaporation hence cooling. For this, it is called **doctor wind** in Guinea Coast
- It is a serious health hazard, particularly eye infection due to the dust

- iii. It accumulates some amount of moisture and gives rainfall in West Africa region, providing relief to the inhabitants of the area
- iv. They increase the risk of fire
- v. They are capable of splitting trunks of trees and also damaging crops

d. CHIPERONI WIND

- Chiperoni is a term used in Malawi to refer to a kind of drizzle. The name is derived from Mt. Chiperoni in Mozambique. When the wind blows inland from the Indian Ocean, they are forced to rise over Mount Chiperoni



Characteristics of Chiperoni

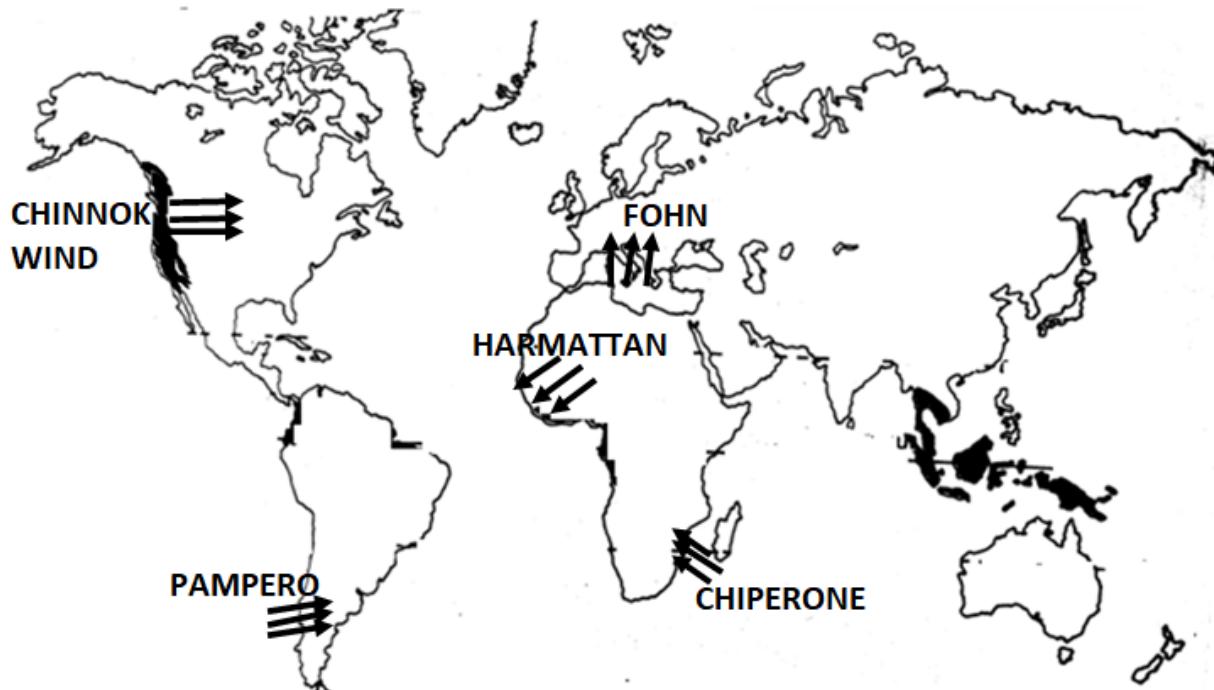
- i. They originate from Mozambique
- ii. They are warm and moist
- iii. It is accompanied by cold rainy

conditions over the Shire Highlands and surrounding areas

- iv. It is associated with Mwera on Lake Malawi, which disrupts fishing activities in the lake
- v. It occurs during cool, dry season between May and August

Effects of Chiperoni winds

- i. They bring persistent clouds which lead to a form of precipitation called **drizzle**. The precipitation is experienced in Southern region of Malawi, particularly Mulanje, Chiradzulu, Thyolo and Blantyre. This is good for the growing of winter crops
- ii. It lowers the temperature such that cold conditions are experienced
- iii. The Mwera it brings on Lake Malawi disrupts fishing activities

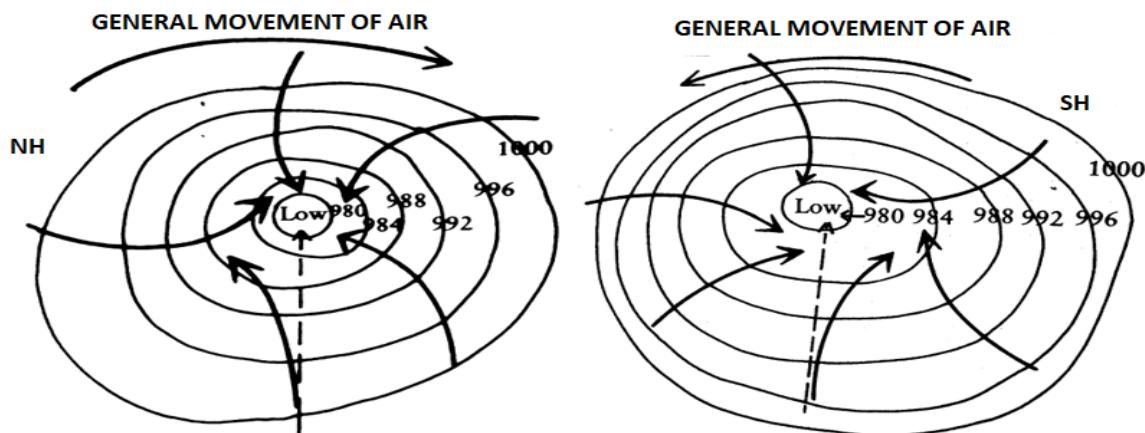


A WORLD MAP SHOWING LOCAL WINDS

UNIT 21: CYCLONES AND ANTICYCLONES

Cyclones

- A cyclone is mass of air whose isobars form a circular shape where air pressure is low at the centre and increases outwards
- A cyclone is a system of wind rotating around a centre of low pressure, turning clockwise in the southern hemisphere and anti-clockwise in the northern hemisphere
- **Buy's Ballot's Law:** this law states that cyclones are deflected to the right in a clockwise direction, in the southern hemisphere, and to the left in the northern hemisphere



MOVEMENT OF AIR IN A CYCLONE IN NORTHERN AND SOUTHERN HEMISPHERE

They are of two types

- **Temperate cyclones and Tropical cyclones**

A. TEMPERATE CYCLONES (DEPRESSIONS)

- Arise in the westerly winds belt at the polar front (temperate low pressure belt)

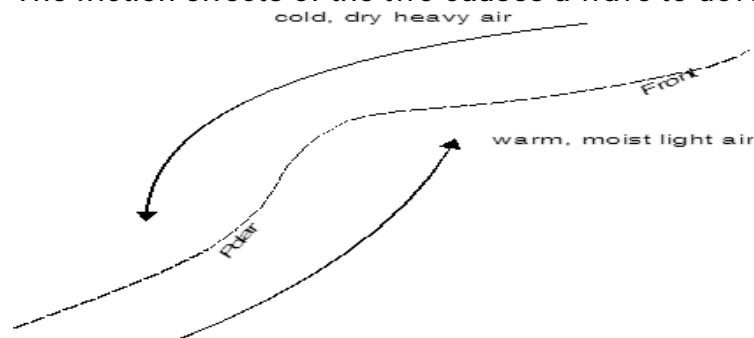
- Are caused by the mixing of cold air from the polar region with warm, humid air from tropical regions
- Consists of swirling masses of air that circulate anti-clockwise in the northern hemisphere and clockwise in the southern hemisphere
- Affect large areas
- Bring prolonged rain to coastal regions and often very windy weather

DEVELOPMENT OF TEMPERATE CYCLONES

(DEPRESSIONS)

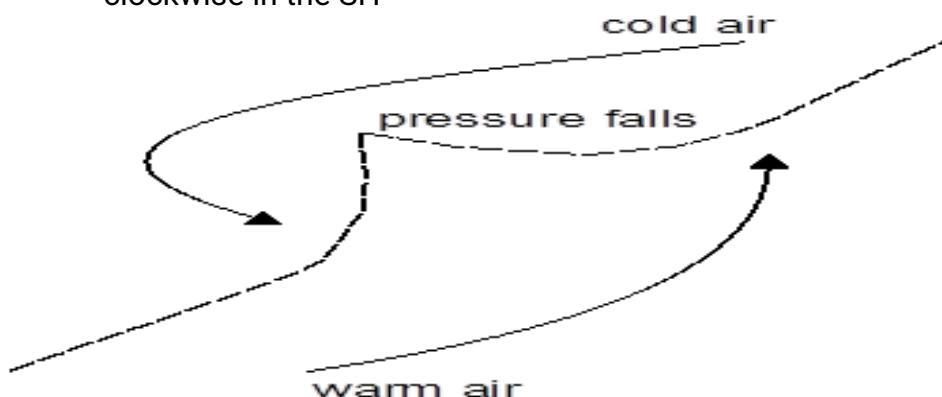
Stage 1

- Depressions develop along the polar front where cold polar air and warm tropical air converge.
- Cold polar air moves in a general westerly direction and warm tropical air moves in general easterly direction.
- The friction effects of the two causes a wave to develop



Stage 2

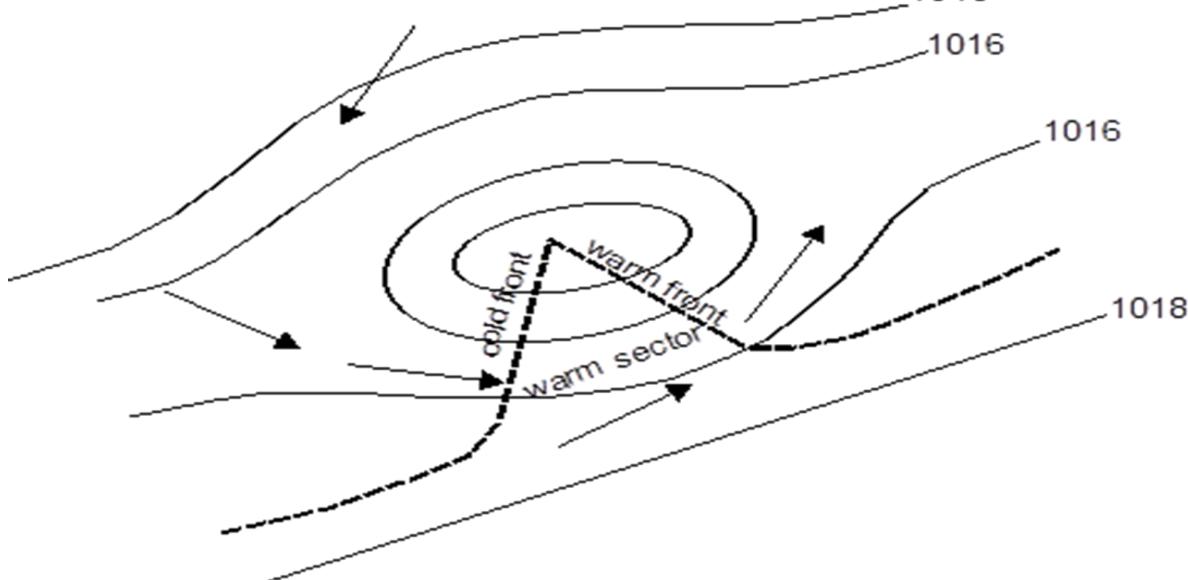
- wave burges in to the colder air and enlarges
- air pressure falls at the tip of the wave
- winds begin to circulate around the low pressure point anti-clockwise in the NH and clockwise in the SH



Stage 3

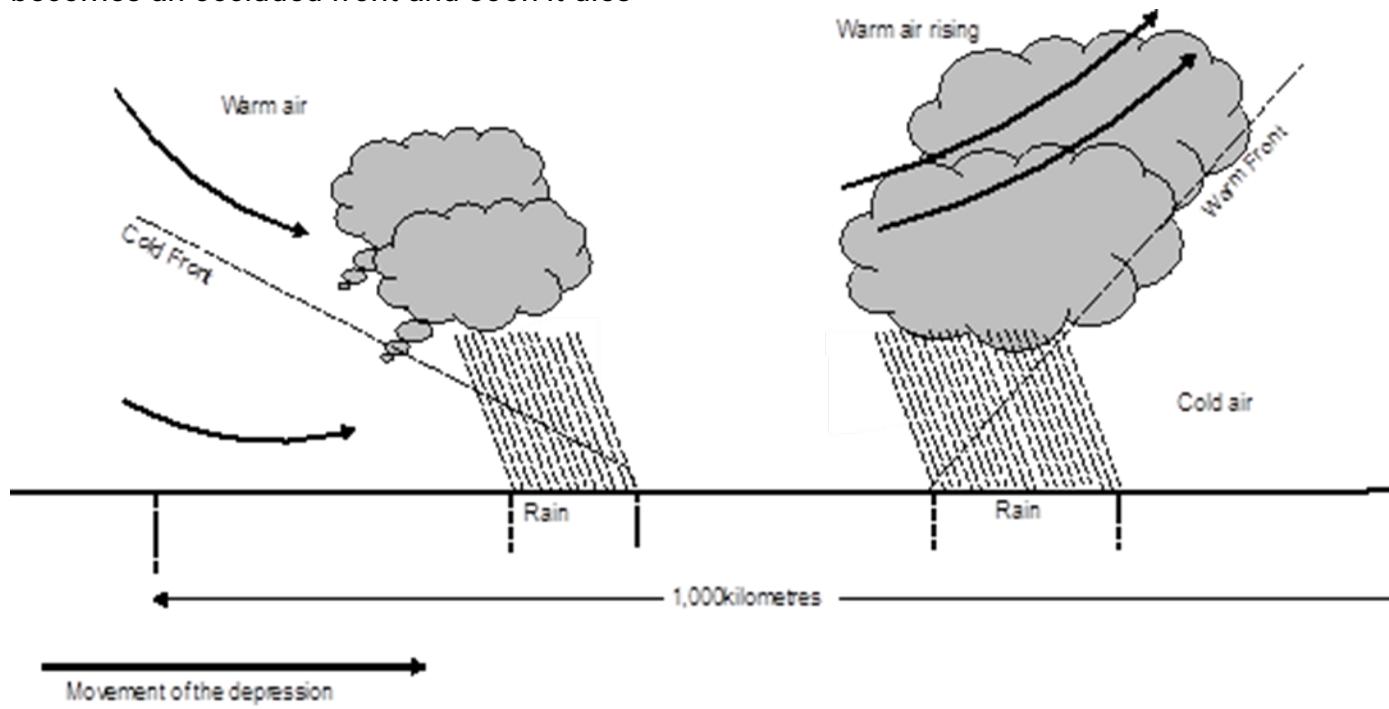
- warm air rises up over the colder air at the front of the bulge(wave) forming a warm front
- colder air forces its way under the warm air at the rear of the bulge forming a cold front
- the warm air between the two fronts is called the warm sector

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Stage 4

- warm front is much more gently sloping than cold front
- later on the cold front catches up with the warm front and lifts it off the ground and then becomes an occluded front and soon it dies



1. Depression is approaching area Z and the sequence of weather at Z will be as follows:

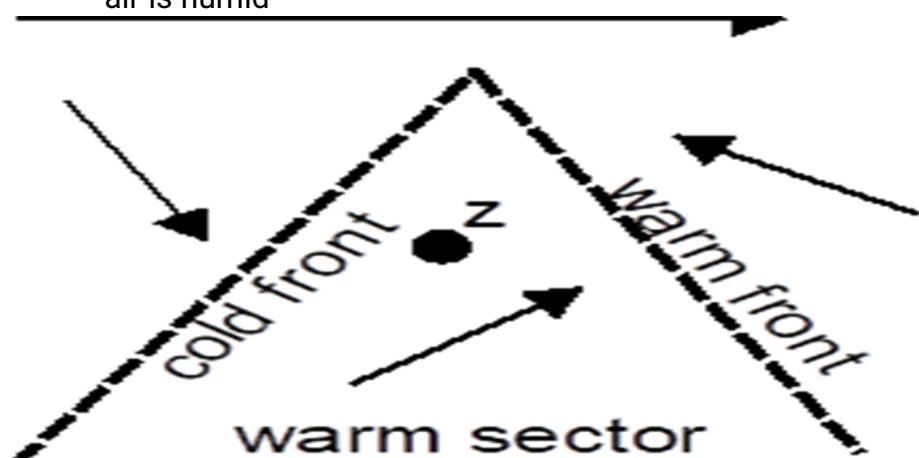
- clear sky (little high cirrus clouds only)
- wind blows from south-east
- definite cloud cover develops and light showers of rain occur after a while
- clouds and rain showers get progressively heavier
- warm front passes

path of depression's centre



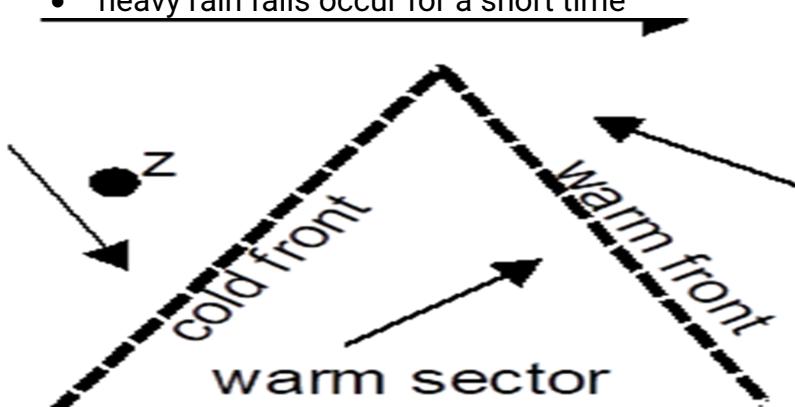
2. Area Z in the warm sector

- Rain stops, wind changes direction from south-east to south west, temperature rises and air is humid



3. Cold front passing area Z

- weather changes rapidly
- wind blows from north-west
- temperature falls
- heavy rain falls occur for a short time



4. With the passage of the depression the sky clears and it remains cool

Characteristics of temperate cyclones

1. They have the weather fronts as the basis for their whole structure and existence
2. They are very large, since they contain two fronts and several air masses, which also help to make their weather effects last for a long time

3. They have a bent oval shape which is often described as a comma
4. They are associated with unsettled weather conditions, which can be long-standing and various, because they contain air masses of contrasting temperature and humidity
5. They usually move over land rather than water, and this limits the moisture they pick up.

B. TROPICAL CYCLONES

Tropical Cyclone: A tropical cyclone is an area of intense low pressure into which winds are rushing.

- They develop along the ITCZ where trade winds meet.
- They mainly develop over tropical seas.
- The air temperature of the sea must be above 270c.
- When the two air masses meet along the Inter-Tropical front one is lifted up. This causes instability. Large cumulonimbus clouds develop giving rise to intense thunderstorms.

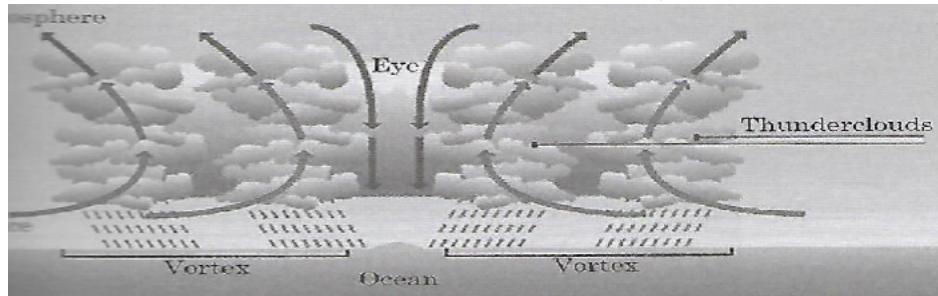
DEVELOPMENT OF A TROPICAL CYCLONE

LIFE CYCLE OF A TROPICAL CYCLONE

1. **Formative stage**
 - Warm dry air mass and warm moist air mass meet over the ocean at the intertropical front and air pressure falls greatly.
 - Warm moist air rises, cools and moisture condenses to produce heavy rainfall.
 - Condensation releases latent heat energy which makes the cyclone to rotate.
2. **Growth stage**
 - a. **Immature**
 - Air pressure in the centre falls below 1000hpa
 - Winds begin to reach hurricane strength (too violent)
 - The affected area is small, 30-50km in diameter
 - b. **Mature**
 - Air pressure stops to drop
 - The area affected increase considerably
3. **Degeneration stage**
 - The cyclone reaches the land
 - Air pressure in the centre rises
 - Area affected is reduced
 - Eventually the system dies out completely

STRUCTURE OF A TROPICAL CYCLONE

- The central part of the tropical cyclone is known as the **eye**. the eye is usually 30 to 50 km across
- It is an area of calm, with light winds and no rain
- The low pressure in the eye lifts water surface in the centre
- Surrounding the eye is a region of high speed winds (150-250 per hour) and thick cumulonimbus clouds with heavy rain-the **vortex**. These weather conditions in the vortex are caused by moist condensing as it rises.
- The region is the most violent part of the storm. Away from this region, the wind speed gradually decreases



CONDITIONS FOR A TROPICAL CYCLONE TO DEVELOP

- i. Abundant supply of warm moist air of temperature of about 27°C (Tropical sea/ocean).
- ii. The air must be blowing inwards and rising rapidly to great height to give clouds of great vertical extent capable of producing torrential rainfall.
- iii. There must be sufficient amount of Coriolis force. This would cause the storm to spin as cool air flows into the low pressure centre. Cyclones cannot occur along the equator, as there is insufficient Coriolis force to deflect the air moving towards the low-pressure centre
- iv. The vertical wind speed (shear) must be low. Under this condition, the heat and moisture are retained rather than being exchanged and diluted with surrounding air

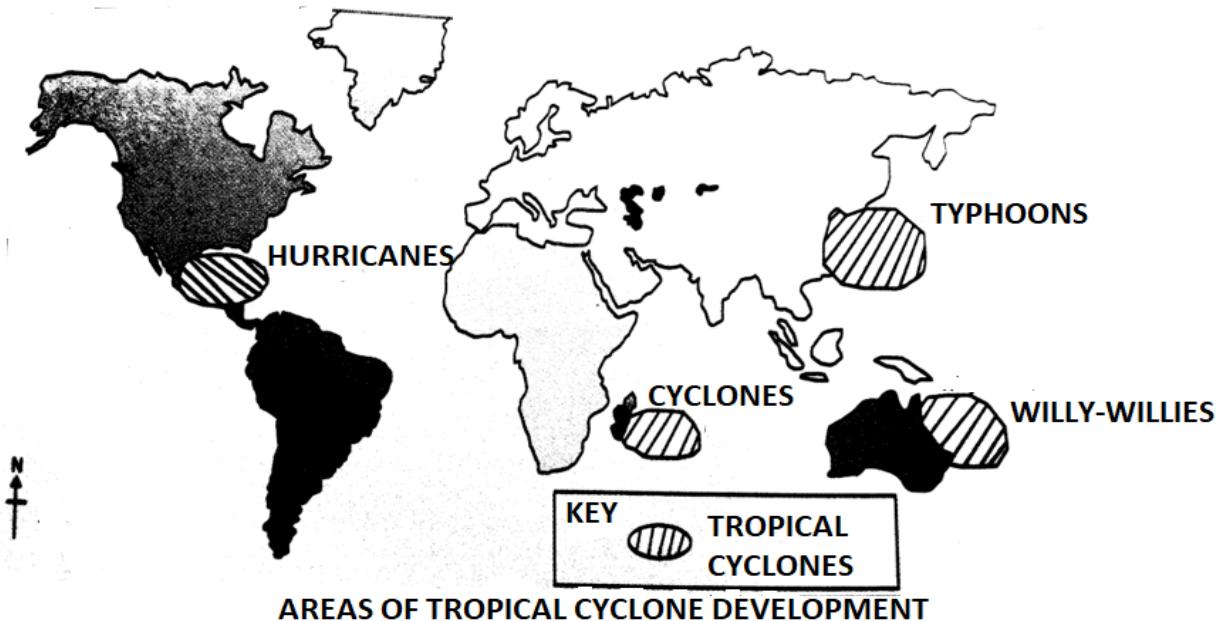
WEATHER ASSOCIATED WITH A TROPICAL CYCLONE

- i. Before arrival of the cyclone the air is still. Temperature and humidity are high.
- ii. As the front arrives, gusty winds develop and thick clouds appear.
- iii. When the vortex appears, winds become violent (up to 240km/hr) dense clouds and torrential rains fall (visibility is reduced to a few metres).
- iv. Calm conditions return when the eye of the cyclone arrives.
- v. The arrival of the rear vortex brings again violent winds, dense clouds and heavy rains. The wind now blows from a direction opposite to that of the front vortex.
- vi. After the rear vortex has passed, calm conditions return. The air becomes still and temperature and humidity are high

DIFFERENT NAMES FOR TROPICAL CYCLONES

- Tropical cyclones have different names in different parts of the world:

 - i. **Hurricanes** - in the Caribbean region
 - ii. **Cyclones** - in the Indian Ocean
 - iii. **Typhoons** - in South East Asia
 - iv. **Willy Willies** - in Australia



AREAS OF TROPICAL CYCLONE DEVELOPMENT

Similarities and differences between temperate and tropical cyclones

1. They are both associated with stormy conditions
2. Both cyclones are formed when two air masses meet
3. They both circulate in an anticlockwise direction in the northern hemisphere and clockwise direction in the southern hemisphere (this is Buys Ballot's Law)

Differences between tropical and temperate cyclones

- 1 A tropical cyclone usually occurs in the tropics within the belt of trade winds while as temperate cyclone occurs in the temperate regions within the belt of Weatherly winds
- 2 A tropical cyclone is smaller in size while as a temperate cyclone is larger in size
- 3 A tropical cyclone is more violent accompanied by very strong winds as compared to a temperate cyclone
- 4 Tropical cyclone is accompanied by heavy rains while temperate cyclone is accompanied by light rains

HAZARDS ASSOCIATED TO CYCLONES

1. **Flooding**
 - Since it develops over ocean surfaces, the rotating storm may be pushed toward the shore; increasing the average water level, thereby causing severe flooding in coastal areas
 - The thunderstorm activity in a tropical cyclone produces intense rainfall, potentially resulting in flooding, mudslides, and landslides
2. **Destruction of structures**
 - Many homes are destroyed by storms.
3. **Physical injuries and death**
 - These are caused by collapsing of buildings, wind-strewn debris, drowning, fires and electrocution due to destruction of main electricity lines
4. **Water borne diseases and vector transmitted diseases.**
 - Human exposure to disease vector can be increased due to changes in the physical environment
5. **Interruption of land transport, air travel and shipping**
 - Tropical cyclones can destroy key bridges, overpasses, and roads, complicating efforts to transport food, clean water, and medicine to the areas that need.

- Tropical cyclones on the open sea cause large waves, heavy rain and high winds, disrupting international shipping and, at times, causing shipwrecks

6. Crop damage.

- Tropical cyclones destroy crops, farm machinery, sheds, fences, and livestock, which in turn lead to food shortages and unemployment

7. Disruption of economics

- Cyclones can lead to the loss of investments and jobs e.g. through destruction of factories, closure of shops and businesses

8. Stress

- People may suffer from stress due to loss of possessions and housing

9. Environmental damage

- Sensitive ecosystems may be destroyed and plant and animal habitats lost. For instance, fresh water fish may be killed in storm surges and also sea fish are often killed because of silting

TORNADOES

- Tornadoes are rotating columns of air which extend from the base of a cloud to the ground
- They rotate counter-clockwise in the northern hemisphere and clockwise south of equator, although some (usually very weak tornadoes) rotate in the opposite direction
- Tornadoes are the most violent storms on earth
- Tornadoes differ from cyclones in that they generally develop over land, and are relatively small, with a short lifespan. They are more destructive than cyclones at the speed of winds is very high, exceeding 480 km per hour
- Tornadoes have been observed on every land surface except Antarctica. However, United States is subject to a far more tornadoes than other regions of the planet. This is because of the following reasons

Why United States is subject to a far more tornadoes than other regions of the planet?

a. The shape of North America continent.

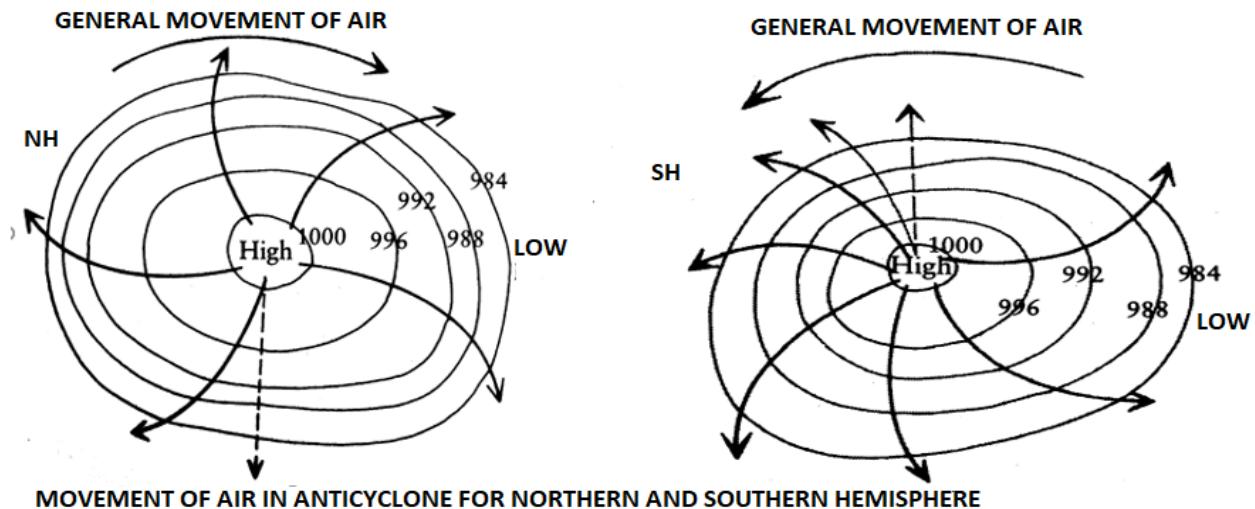
- North America has no mountain ranges that extend from east to west, only north to south.
- Arctic air and tropical air can therefore clash over the plains of central USA without any natural barrier to mitigate the contact

b. Rocky Mountains and the hot dry Chinook winds

- This dry air descending from the Rockies on the eastern side presses down on the hot, wet air flowing in at ground level from the Gulf of Mexico, creating regular low pressure areas with intense instability.

ANTICYCLONES

- An anticyclone is a system of wind rotating around a centre of high pressure, turning clockwise in the northern hemisphere and anticlockwise in the southern hemisphere



- The pressure gradient is gentle and winds are light. They normally herald fine weather. Skies are clear, the air is calm and temperatures are high in summer but low in winter. In winter great cooling of the lower atmosphere may result in thick fogs.
- The main anticyclones of the world include: **South Atlantic High** and **Indian Ocean High**.

Characteristics of anticyclones

- a. They have cloudless and rainless weather conditions since air descends at the centre due to high pressure
- b. They only involve one type of air mass which usually covers large areas and do not have any fronts
- c. Their centres are cooler than surroundings
- d. Anticyclones have very light winds blowing outwards from the centre
- e. They observe **Ferrel's law of deflection** in that; they blow in clockwise direction in the northern hemisphere and anticlockwise direction in the southern hemisphere

Hazards of anticyclones

- a. Prolonged heat waves or drought. During the summer, a persistent warm core anticyclone that becomes stationary over a region may produce drought conditions (due to lack of rainfall and evaporation from the earth's surface) causing death, crop failures, and wild fires
- b. Ice caps and glaciers melt at a faster rate in mountainous regions, causing floods. Rivers and lakes that are not glacially fed can dry up

UNIT 22: CLOUDS

- A **cloud** is a mass of small water drops or ice crystals, formed by the condensation of the water vapour in the atmosphere.
- Almost all air around us is moist, meaning that it contains water in the form of vapour. Water vapour in the air cannot be seen unless it collects and condenses to form a cloud.

Formation of clouds

- Cloud formation starts with the processes of evaporation and transpiration which releases water into the atmosphere. The water vapour then rises and cools when subjected to low temperatures. Water vapour then begins to condense around different condensation nuclei which include small particles of dust, smoke, salt and other particles of matter. Tiny water droplets are formed when the dew point (a temperature at which water vapour begins to condense) is reached. These drops

enlarge and combine to form a cloud

Relating the hydrological cycle to cloud formation

- The hydrological cycle is the source of water that evaporates into the atmosphere to make clouds
- The water that originates from water bodies and plants is converted into various forms as it goes through hydrological cycle
- It starts in liquid form, for instance in large water bodies, then turns to vapour (gaseous state) upon evaporation
- It condenses around condensation nuclei at dew point, forming clouds
- When clouds become too heavy, they fall back to earth as precipitation in form of hail, snow or rain

Types of clouds

- There are many different types of clouds. The type of cloud depends on how high up in the atmosphere the water condenses and its appearance (texture) from the ground

Criteria used to classify clouds

- Clouds are classified according to
 - i. **General form or shape and appearance,**
 - ii. **Altitude (height)**
 - a. **Classification based on general form or shape and appearance**
- Latin words are used to describe the appearance of clouds as seen by an observer on the ground.
- This is a descriptive classification that was suggested by a British called Luke Howard in 1803.

Latin Word	Translation	Example
Cumulus	Heap	Fair weather cumulus
Stratus	Layer	Altostratus
Cirrus	Curl of hair	Cirrus
Nimbus	Rain-bearing	Cumulonimbus

- The word '**nimbus**' in front of any type of word or cloud name means a cloud that produces precipitation
- b. **Classification based on height**
- Clouds can occur at any level of the atmosphere whenever there is sufficient moisture to allow condensation to take place. Based on height, the following types of clouds exists

Type or category of clouds	Examples
High clouds	Cirrus, cirrocumulus and cirrostratus
Middle/medium clouds	Altostratus and altocumulus
Low clouds	Stratus, stratocumulus and nimbostratus
Clouds with vertical development	Cumulus and cumulonimbus

1. LOW LEVEL CLOUDS

- Low level clouds are closer to the ground; occur below 2,100 metres.
- When observed from the ground they appear to move faster than other clouds. They generally move in the direction of the surface wind.

HEIGHT	CLOUDS	CHARACTERISTICS	WEATHER
Below metres	2000	1. Stratocumulus (St-Cu)	a. They are round and bumpy they mean fair or clear weather but

Or Between 0 to 2 km above the ground		<p>clouds</p> <p>b. They are grey-white and patchy, appearing in long rows or in rolls</p> <p>c. They are more wavy form than altocumulus</p>	sometimes produce light rain
	2. Nimbostratus (Ni-St)	<p>a. They are dark and dull clouds</p> <p>b. They are clearly layered but may have detached darker patches</p> <p>c. They have grey-black colour</p>	They bring continuous rain, snow or sleet as forms of precipitation
	3. Stratus (St)	<p>a. They are grey in colour</p> <p>b. They are thick</p> <p>c. They look like a low ceiling or highland</p>	<p>a. They bring dull weather which is associated with drizzle</p> <p>b. They reduce visibility</p>

MIDDLE LEVEL CLOUDS

- The clouds develop in the middle layers of the atmosphere.
- These clouds are brighter and less fragmented in appearance due to their distance from the ground and higher composition of ice crystals. They move slower than the low level clouds
- The two types of medium or middle level clouds are altocumulus (**Alt-Cu**) and altostratus(**Alt-St**)
- **Alto** means **middle level**

HEIGHT	CLOUDS	CHARACTERISTICS	WEATHER
Between 2,000 metres and 6000 metres Or between 2 km to 6 km above the ground	1. Altocumulus (Alt-Cu) clouds	<p>a. White grey clouds</p> <p>b. Woolly, bumpy and are arranged in layers</p> <p>c. They appear like waves or lumps in the blue sky</p> <p>d. The sun or moon may be surrounded by a halo</p>	<p>a. They bring about fine weather</p> <p>b. Small amount of precipitation that are occasional</p>

	2. Altostratus (Alt-St) clouds	<ul style="list-style-type: none"> a. They are denser than altocumulus b. They are layered and puffy c. Greyish in colour with watery look d. They have fibrous or striated structure through which the sun's rays shine faintly 	<ul style="list-style-type: none"> a. Small amounts of precipitation that are occasional
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3. HIGH CLOUDS

- These clouds exist between 6000 metres to 12000 metres above the ground
- They are in the highest and the coldest levels of the troposphere
- They mostly appear brilliant white because the water drops have turned into ice crystals at that level
- Their direction of movement does not necessarily represent the wind direction at the ground level

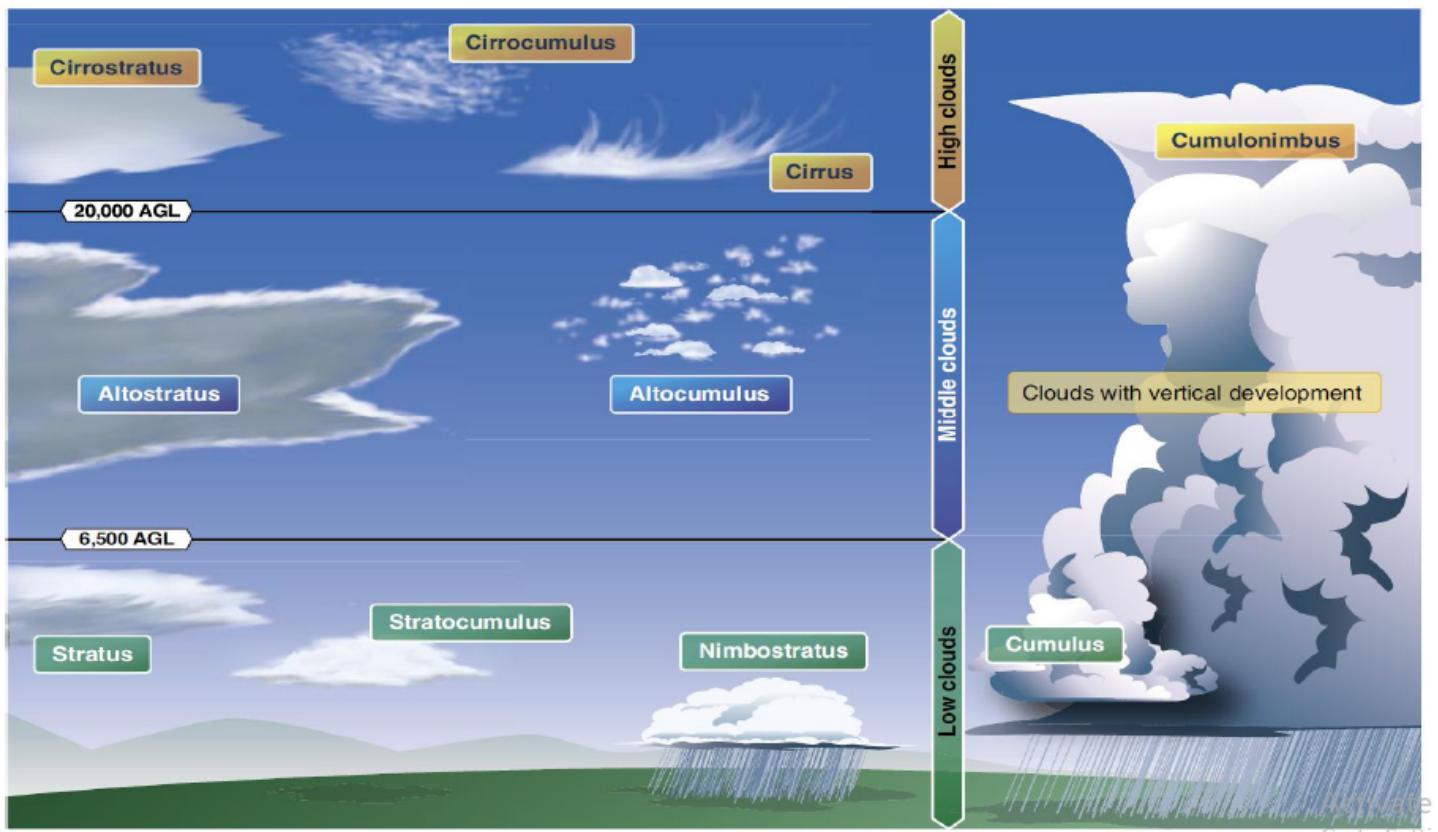
HEIGHT	CLOUDS	CHARACTERISTICS	WEATHER
between 6000 metres to 12000 metres i.e. 6 km above the ground	Cirrus (Ci) Clouds	<ul style="list-style-type: none"> a. They look fibrous and appear like wisps in the blue sky b. They have feathery filaments, sometimes referred to as 'mere tails' c. They are thin, white and icy d. They are detached, wispy, delicate white clouds 	<ul style="list-style-type: none"> a. They indicate a fine and fair weather b. They give a brilliant sunset c. No precipitation
	Cirrocumulus (Cc) clouds	<ul style="list-style-type: none"> a. They appear as white globular masses b. They have ripped appearance c. They look like scales of fish, hence the sky filled with these clouds is called a 'mackerel sky' d. They are thin, white 	<ul style="list-style-type: none"> a. Cold air at high altitudes causes small cloud droplets to freeze into ice crystals b. No precipitation

		and icy.	
	Cirrostratus (Cs) clouds	<ul style="list-style-type: none"> a. They look like a thin white sheet or veil b. The sky looks milky c. The sun and moon may shine through them 	<ul style="list-style-type: none"> a. The sun or moon shines through cirrostratus and often form a 'halo'. Haloes are circular shapes resembling the sun or moon b. No precipitation

4. CLOUDS OF GREAT VERTICAL EXTENT

- These clouds have no definite height. They are found between 6,100 metres to 9000 metres above sea level.

HEIGHT	CLOUDS	CHARACTERISTICS	WEATHER
1500 metres to 9000 metres i.e. 1.5 km-km above the ground	Cumulus (Cu)	<ul style="list-style-type: none"> a. Have round tops b. Resemble a cauliflower c. Tall, narrow and puffy d. White and grey e. Have flat bases and look like the globe f. They are detached, white clouds with a sharp outline g. Common in tropical regions where humidity is high 	<ul style="list-style-type: none"> a. Are associated with uprising convectional currents b. They bring fair weather
	Cumulonimbus (Cu-Ni) clouds	<ul style="list-style-type: none"> a. Black and white globular mass b. They have a cauliflower top that spreads out like anvil c. Common within tropics 	<ul style="list-style-type: none"> a. They bring about heavy convectional rainfall b. The rain is accompanied by thunder and lightening



MEASURING CLOUD COVER

- Cloud cover refers to the fraction of the sky obscured or covered by clouds when observed from a particular location.
- There is no instrument that can measure the amount of cloud cover in the sky
- However, it is possible to tell and record the cloud cover using weather map. The weather map shows the state of weather for a specific date and time for a country or a region
- An **Oktta** is the unit of measurement used to describe the amount of cloud cover at any given location such as a weather station
- Sky conditions are estimated in terms of how many eighths of the sky are covered in cloud ranging from 0 oktas (completely clear sky) through to 8 oktas (completely overcast)
- In addition, there is an extra cloud cover indicator '9' indicating that the sky is totally obscured (i.e. hidden from view); usually due to dense fog or heavy snow
- Lines on a map joining places of equal cloud cover is called **Isoneph**

IMPORTANCE OF CLOUDS

- a. They help regulate the earth's energy balance by reflecting and scattering solar radiation by absorbing some of the energy emitted by the earth's surface.
 - As clouds move in the atmosphere, they carry with them the heat they have absorbed in hot regions and re-radiated it back down toward the surface of other regions of lower temperatures.
 - This helps to re-distribute extra heat, for instance, from the equator toward the poles.

- b. Clouds are required for precipitation to occur and, hence are an essential part of the hydrologic turbulence
- c. Clouds indicate what type of atmospheric processes are occurring (e.g., cumulus clouds indicate surface heating and atmospheric turbulence)

HOW DO CLOUDS CAUSE RAIN?

- When water condenses into cloud, the clouds have to be heavy in order to fall on earth. Water droplets need to acquire more water and become larger.
- If the droplets keep growing, they will reach a mass where they cannot stay floating in the cloud because they are too heavy and will start to fall to earth as rain

UNIT 23: PRECIPITATION

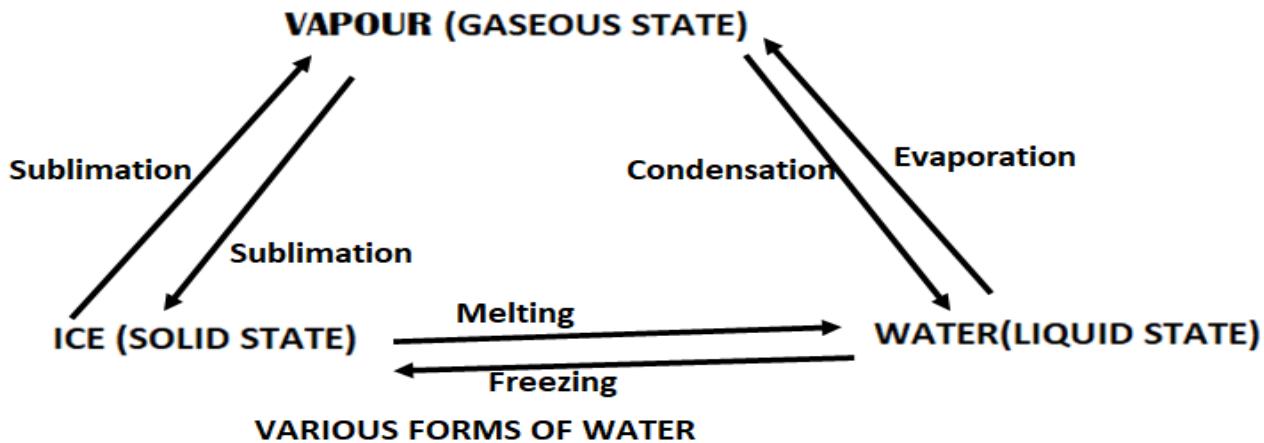
- This is the falling of water either in liquid or solid form which reaches the earth from the atmosphere

MAJOR FORMS OF PRECIPITATION

- The following are the major forms of precipitation.
 - a. Precipitation in liquid forms which include rain, drizzle, and freezing rain
 - b. Precipitation in solid form which include hail, sleet and snow

STATES OF WATER

- Water occurs in three states: solid (ice), liquid as water, and gaseous as water vapour. It can change from one state to another depending on temperature.
- From gaseous state, molecules may pass into the liquid state by condensation if temperatures are below freezing point, or can pass into a solid by sublimation to form ice crystals.
- By evaporation, due to high temperatures, water can change from a liquid to a gaseous state or from liquid to solid by freezing; or from solid to liquid by melting.



CONDITIONS FOR PRECIPITATION

- Air must be saturated.
- Air must contain small particles of dust or nuclei around which the droplets form.
- Air must be cooled below its dew point.
 - Dew point is the temperature at which a volume of air gets saturated. Air cools down by
 - rising in form of convection currents
 - by coming across mountains, e.g., winds, warm air rising over cold air
 - by passing over cold surfaces such as cold ocean currents or land.

Why sometimes rain cannot reach the ground?

- Sometimes rain evaporates before reaching the ground, resulting in **virga**. These are grey streaks below a cloud that do not reach the ground
- If the wind is blowing upwards faster than the rain is falling there by creating updrafts

A. LIQUID PRECIPITATION

I. Rain

- Rain is liquid water falling visibly in separate drops from the atmosphere. It is the most common form of precipitation
- For drops to be classified as rain, they are required to be 0.5mm and 6mm in diameter

II. Drizzle

- It is liquid precipitation that reaches the surface in form of drops that are in between 0.2 mm to 0.5 mm in diameter

III. Freezing rain

- Refers to rain droplets which fall in super cooled liquid form, but freeze on impact with the ground or another object form clear ice

IV. Dew

- This is a form of precipitation where water droplets condense on the ground or on objects near the ground.
- These droplets are deposited on surface objects such as rocks, trees, buildings and grass, within one meter of ground level

B. SOLID PRECIPITAION

I. Hail

- Hail is formed when raindrops in the sky freeze and then fall to the earth as crystals, ice or small pellets.
- Hailstones are made of frozen raindrops which exceeded in diameter

- Hail only form in cumulonimbus clouds commonly known as thunder clouds
- Hail is formed when thunder storm updrafts are strong enough to carry water droplets to cold and high altitude regions of the cloud, where they freeze
- Because of their size, they can cause extensive damage to buildings, car windscreens and crops and have caused fatalities of animals and even humans

II. Snow

- Snow is tiny ice crystals stuck together to become snowflakes. It is the most common form of solid precipitation
- Snow forms when temperatures are too cold (below 0°C) than water vapour changes directly into crystals. Ice crystals are usually six sided. Snow can fall as individual ice crystals or combine to form snowflakes

III. SLEET

- Sleet is a mixture of ice and snow which falls as frozen raindrops
- Sleet is formed when the upper air temperature is below freezing point, allowing snowflakes to form

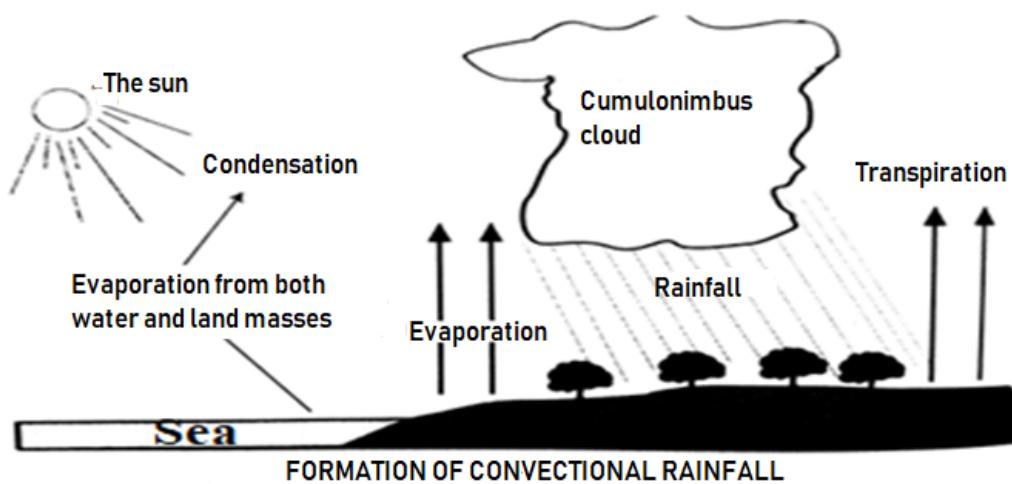
UNIT 24: RAINFALL

TYPES OF RAINFALL

- There are three basic types of rainfall. These convectional, cyclonic and relief rainfall

a. Convectional rainfall

- Convectional rainfall forms when there is intense heat originating from the sun reaching land and water masses during morning hours. The sun heats up the ground, which heats the air above it, and the heated air then rises and cools and water vapour condenses into water droplets, forming clouds. When the clouds become heavy, they fall as rain



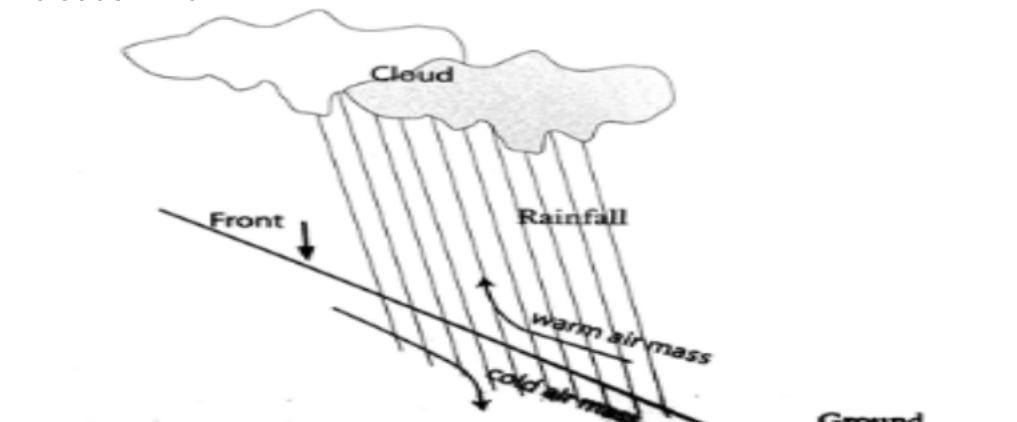
Characteristics of convectional rain

- i. It is usually accompanied by lightning and thunderstorms i.e. tropical depression (typhoons)
- ii. It falls heavily, but it is short-lived
- iii. It covers a small area
- iv. They are characterised by an anvil-shaped cumulonimbus clouds

- v. It commonly occurs in the late afternoon after the maximum heating, and in hot areas such as equatorial/tropical

b. **Frontal/cyclonic/depression rainfall**

- Also known as convergent rainfall, it is formed when two air masses meet along a line of separation called a front. Then the warm air mass rises over the cold air mass because it is lighter while cold air mass tends to remain close to the ground as it is denser. The rising warm air cools and forms clouds which



Formation of cyclonic/frontal/depression rainfall

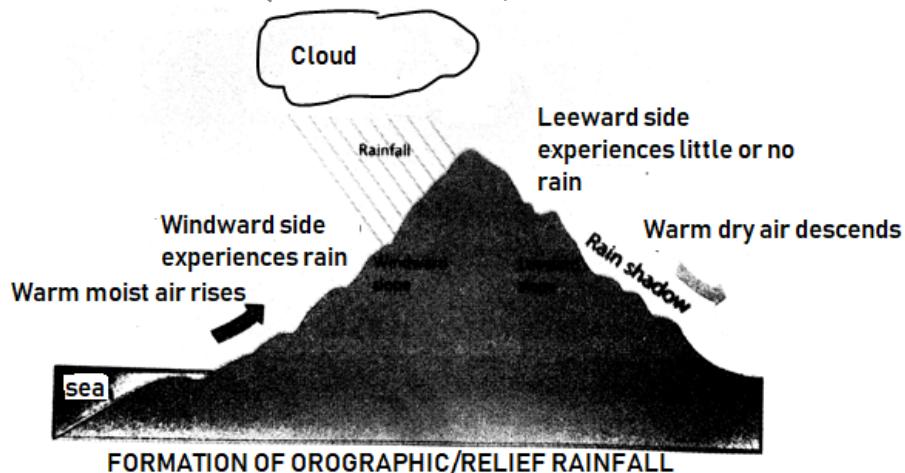
Characteristics of cyclonic/frontal or depression/ convergent rainfall

- i. In tropical cyclones, the rainfall is often very heavy but it lasts for only a few hours
- ii. In temperate depressions, the rainfall is much lighter but it lasts for many hours or even days
- iii. Cyclonic rainfall is common throughout the doldrums where trade winds meet
- iv. It usually occurs in winter, but can occur any time of the year
- v. It produces cumulonimbus clouds

c. **Orographic or relief rainfall**

- This type of rain is formed when winds blow over the sea and pick moisture. As the warm moist wind pass over the higher land like a mountain, it is forced to rise. The rising air cools and form clouds which fall as rain. As the air is descending on the other side of the mountain, air is compressed and warmed, a condition not favourable for rain

NB. The side of a hill facing the wind is called **windward side**. This side is facing the rain-bearing wind. **Leeward side** is the side that receives heavy rainfall because it receives descending dry air. It is also referred to as rain shadow due to the limited rainfall experienced



Characteristics of relief rainfall

- i. It is widespread as it occurs in all latitudes and of longer duration
- ii. It occurs in the mountains on the side that faces the direction of wind (windward side)
- iii. Warm, dry, descending winds bring no rainfall on the leeward side
- iv. It is common along the coastal areas with mountain ranges

Examples of areas which experience orographic rainfall in Malawi and beyond

- Southeast facing slopes of the Nyika plateau where winds originate from Lake Malawi
- Southeast facing slopes of Viphya plateau where winds originate from Lake Malawi
- Southeast facing slopes of Mulanje Mountain where winds originate from Indian Ocean
- Western side of the Rockies fold mountain where onshore winds originate from the Pacific Ocean

Similarities and differences

- All the three types of rainfall are similar in that they involve the following
 - a. Warm moist air rising
 - b. Warm air cooling
 - c. Water vapour condensing to form clouds
 - d. Further cooling leading to precipitation
- The difference is the reason why the air is rising
 - a. In convectional rainfall, air is rising because it is being heated
 - b. In orographic rainfall, air is forced to rise over the mountain
 - c. In frontal rainfall, warm air rises over the cold air

How rainfall is measured?

- RAINFALL is measured by an instrument called rain gauge. It is measured in millimetres (mm) over a set period, usually 24 hours
- For meteorological recordings, a rain day is reckoned as a period of 24 hours with at least 0.25 mm or more rain being recorded. If the amount exceeds 1 mm, it is considered as wet day
- It is measured in mm because it is measured on the basis of the vertical depth of water that would accumulate on the plain surface, if the precipitation remains where it falls.
- Therefore, 25mm of rainfall means the amount of water that would cover the ground the ground to a depth of 25mm, provided none evaporated, drained off or percolate away

- Isohyets are lines drawn on a map joining places of equal rainfall.
- The rain gauge is composed of the following parts: metal container, a funnel, a collecting bucket, and a measuring cylinder.
- The funnel directs precipitation into collecting bucket/glass tube. The rain accumulated in the bucket of the rain gauge is poured into a specially calibrated measuring glass cylinder and the millimetre is recorded
- The cylinder is made of cooper or plastic because the two do not rust when in contact with water
- The measuring cylinder is tapered or narrowed end to ensure that even the smallest amount of rainfall is measured

Precautionary measures for a rain gauge

- In order to have accurate rainfall information, take the following precautionary measures
 - a. **The rain gauge is placed away from buildings, trees, bushes or vegetation**
 - These may shelter the rain gauge and intercept rain drops from entering the funnel
 - This is to prevent water collected on the roofs of the buildings or leaves of trees from dripping into the rain gauge, resulting into inaccurate readings
 - b. **It is placed 30 cm above the ground**
 - This is to prevent splashes of water from entering the rain gauge when the rain drops hit the ground.
 - This is also to prevent evaporation of water due to the reflected heat from the ground
 - c. **The collecting jar is 20 cm below the ground level**
 - In order to prevent evaporation of water after being collected in the jar

INTERPRETATION OF RAINFALL DATA FROM VARIOUS SOURCES

- It is extremely important to be able to interpret rainfall data from various types graphs and tables, this will definitely help to compare rainfall patterns of different locations
- Rainfall data collected at different locations over a specific period of time are used to make graphs and maps
- The average rainfall typically experienced in a particular location is shown on a bar graph or histogram. It is usually presented alongside with temperature, but the temperature is shown on a line graph. The two are presented on the same axes with months of the year along the base
- Things to look out when interpreting rainfall or temperature data
 - i. Overall shape of the graph. Is the temperature line steep or gentle? Does it change throughout the year and/or look almost flat?
 - ii. Look for extremes; quote the highest and the lowest temperature and rainfall and the month in which it occurs. Remember to quote units, e.g. Celsius or millimetres
 - iii. Identifying the seasons when most rain or least rain falls or when the highest and lowest temperature are experienced
 - iv. Workout the **temperature range** by subtracting the lowest figure from the highest figure
 - v. Add the **rainfall totals** for each month together to work out the total annual rainfall

Mean annual temperature

This is the sum of mean monthly temperatures for one year divided by the total number of months in a year

= sum of mean monthly temperatures for 1 year

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FACTORS THAT AFFECT THE AMOUNT OF RAINFALL IN A LOCATION

1. Latitude

- It rains more in areas near the equator than in the temperate zones and polar regions
- Temperature is higher near the equator so there is more evaporation

2. Altitude

- It rains more in high areas than in low areas. Mountains force air masses passing through to rise to rise. After rising, the air cools and condenses into clouds which eventually fall as rain.

3. Nearness of large lakes or oceans

- Closeness to large bodies of water, particularly oceans, provides plenty of water for evaporation. Hence, it rains more on the coast than inland.

4. Prevalent wind direction

- Prevailing winds can move air masses from the ocean into a continent bringing moisture onto the continent. The moisture condenses into clouds which produce more rain

5. Vegetation

- Vegetation add more water vapour into the atmosphere through the process of transpiration, the moisture contributes to the formation of rain clouds. This means that if trees are cut, it affects the rainfall patterns

6. Global warming

- Global warming refers to an average increase in the earth's temperature.
- Condensation occurs when air cools and contracts so that it is no longer able to hold all the water vapour it was able to hold when it was warm. This extra water vapour begins to condense out of the air into liquid water droplets.
- Therefore, the lower the temperature of the air, the greater the condensation of water vapour to raindrops. Air temperature also determines the type of precipitation that might occur (whether it will rain, snow, or sleet)

ADVANTAGES OF RAIN

- a. Dissolve soil nutrients for plant growth since it easily soaks into the ground. This helps farmers to grow crops
- b. Recharge water, rivers, wetlands and lakes through infiltration and runoffs. This is important for survival of people and animals
- c. Clean up our surroundings by washing away dirt

DISADVANTAGES OF RAIN

- a. **Flooding** as a result of rain falling in large amounts. This result in destruction of people's homes, crops, roads and human lives
- b. **Mudslides** after excessive rain can have devastating effects
- c. **Erosion:** too much rainfall can wash away top soil and nutrients causing the land to become unproductive
- d. **Water borne diseases:** rain washes dirt and untreated sewage into streams and other water sources, spreading diseases such as cholera and diarrhoea. Rain also creates breeding grounds for mosquitoes that spread malaria

UNIT 25: CLIMATIC REGIONS AND WORLD VEGETATION (BIOMES)

Meanings of some terms

1. Weather

- Refers to the daily condition of the atmosphere observed over a short period of time and over a small area. Weather includes temperature, wind, air pressure etc. Weather is unpredictable

2. Climate

- Refers to the average weather condition of a certain area observed over a long period of time for a given area. It is easy to predict the climate.

3. Climatic region

- This is part of the world which have similar climatic conditions
- It can also be defined as the main areas into which the earth is divided according to climate

4. Biome

- A division of the world's vegetation that corresponds to a defined climate, characterised by specific type of plants and animals
- The climate of a region will determine what plants will grow there, and what animals will inhabit it

Criteria that is used to classify world climate

There are a number of factors to consider when classifying world climate

- a. Temperature: This refers to degree of hotness or coldness of air in the atmosphere. There is un even distribution of heat over space and this will result into different climatic regions
- b. Rainfall: The type and amount of rainfall experienced in an area differ from Place to place. Other types of rainfall dominate in a specific area.
- c. Vegetation: The type of vegetation experienced varies from one geographical area to another.
- d. Agricultural Development: The type of agricultural activities carried out in an area is influenced by weather elements which make up climate.

Climate does the following

- i. It determines where people can live, if the area is experiencing harsh climatic conditions people run away from them.
- ii. It controls the type of crop to be grown and type of animals to be raised.
- iii. It controls the type of housing and type of clothing.

Things to be looked into on each climatic region

a. Location in terms of

- i. Latitude, which is how far, is the place from the equator.

- ii. Places on the continents that is if it found in the Northern Hemisphere or Southern Hemisphere.

b. Climatic characteristics in terms of

- i. Monthly rainfall (graphs and tables)
- ii. Total annual rainfall
- iii. Annual temperature range
- iv. Other relevant climatic factors

c. Agricultural developments

- i. Type of vegetation
- ii. Crops grown and animals raised
- iii. Problems faced, that hinder agricultural development

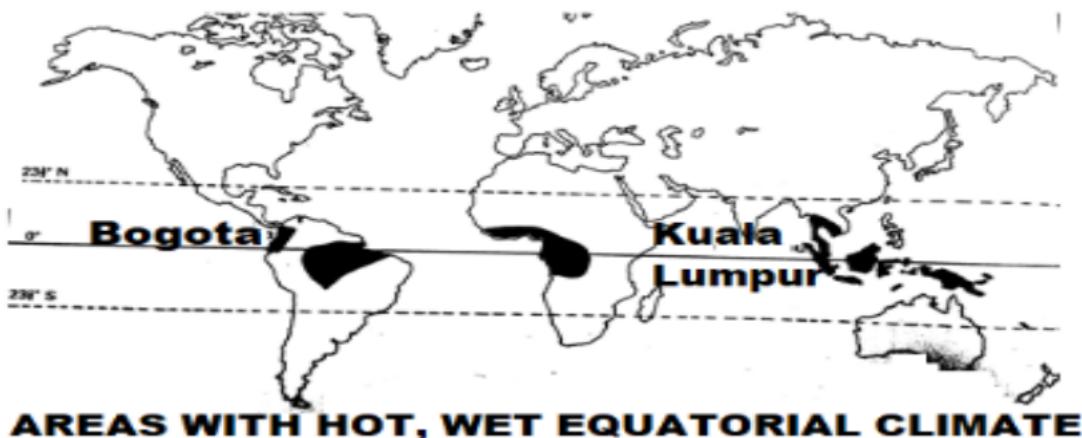
CLIMATIC REGIONS OF THE WORLD

A. Equatorial Climate

Location

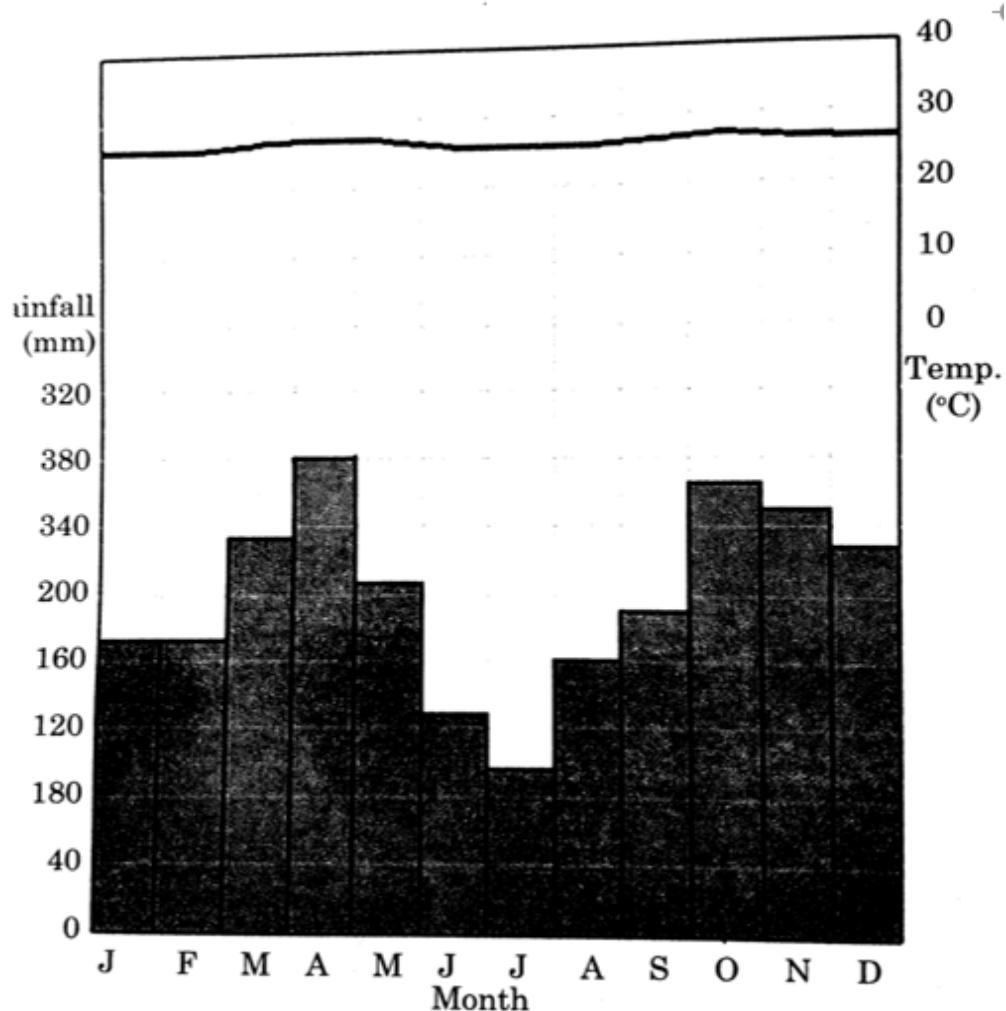
- It is found in lowlands between 5° North and 5° South of the equator, though it sometimes stretches for 10°N and 10°S of the equator. The areas experiencing this climate include the following
- i. **South America:** West coastlands of Ecuador and Colombia, and the Amazon Basin
- ii. **Africa:** Gabon, Central African Republic, the Congo Basin, Southern Ivory Coast, South Western and Central Ghana, and Western and Coastal Nigeria and Cameroon
- iii. **Asia:** Malaysia, Indonesia, Myanmar, Philippines and Singapore

NB. It must be noted that not all places that lies along the equator have Equatorial Climate. The high mountain areas like the Andes in South America, Kenyan Highlands experience cool climate despite lying within the equator



Equatorial climate for Kananga (altitude 670m, 5°55'S)

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Temp °C	25	25	25	25	25	24	23	25	25	25	25	25
Rainfall (mm)	138	144	194	190	83	24	13	58	117	173	225	223



A GRAPH FOR EQUATORIAL CLIMATE

Climatic characteristics of Equatorial Climate

- i. There are no definite seasons because of low pressure throughout the year
- ii. Average daily temperatures are 26°C and annual temperature range is 3°C. this is caused by an almost constant length of the day all year with the mid-day sun being always near-vertical
- iii. Extensive clouds cover and heavy rainfall prevents temperature from rising over 26°C
- iv. It has no seasons because it lies along the doldrums where temperature constantly high throughout the year.
- v. It experiences heavy convectional rainfall that is well distributed throughout the year.
 - The rainfall usually comes in the afternoon accompanied with lightning and thunder.
 - There are two periods of maximum rainfall, in April and October. These occur shortly after equinoxes because there is more and intense heating. however, this simple pattern maybe upset by local conditions
 - Annual rainfall is about 2000 mm, some areas such as Guinea Coast of west Africa, Accra, receive low annual rainfall of about 700mm due to modified changes by monsoon wind
- vi. Humidity is always high due to high evaporation
- vii. Mid-day sun is always near-vertical. It is overhead twice a year, at the equinoxes

viii. Major winds experienced are the South East and North East trade winds which converge meet here

Vegetation

- Vegetation is equatorial which is characterized by the following
 - i. The Equatorial climate support a dense luxuriant type of dense evergreen vegetation (the equatorial rain forest) because of the heavy rainfall and uniformly high temperature
 - ii. There is a wide variety of plants and animals
 - iii. Trees grow closely
 - iv. Growth is continuous (flowering, fruiting, and shedding takes place throughout the year) because of abundant moisture (over 2000 mm annually) and high temperature, averaging 26°C
 - v. The typical vegetation are hard wood which include Mahogany, Ebony and chengal, green heart, iroko, sapele, okoume, teak and rubber.
 - vi. There is little or no undergrowth because taller trees cut off most of sunlight. As the result the ground is with ferns and herbaceous plants which can tolerate shade
 - vii. Trees are huge, tall, slender and are arranged in layers, forming a leafy canopy over the forest floor
 - viii. The tropical rainforest has four layers as follows
 - a) **Emergent layer:** the uppermost layer where tallest trees rise above the rest. The trees grow up to 40 to 48 m to capture direct sunlight
 - b) **Canopy layer:** tall trees in this layer are called canopy trees. They grow so close together that their crowns interlock to form a continuous canopy (a cover or a ceiling for the rainforest). The canopy later shuts out most of the sunlight from the forest
 - c) **Understory layer:** short trees are found in this layer. Some epiphytes and lianas are also found here
 - d) **Ground or forest floor layer:** shrubs, ferns, mosses, fungi and other small plants are found here because they do not need much sunlight to grow
 - ix. There are a lot of creeping stems known as lianas which reach up to 200metres long.
 - x. The bottoms of the thick forests are clear because light does not reach there

Features of adaptations by plants in hot, wet tropics

- a. They have thin and smooth barks, because there is no need for protection against harsh weathers. The smoothness helps water to drain off easily and prevent bacteria from growing on it
- b. The trees have branches on top most portion of the trunk to get as much sunlight as possible
- c. Roots are very shallow; they do not need to reach deep since nutrients in the soil are near the surface. However, tall trees have **buttress roots** which grow one to five metres above the ground to support weight of trees
- d. Thousands of flowering plants grow onto trees so they get sunshine. There also many climbing plants into the canopy so their leaves get more sunlight
- e. The leaves are large and broad to maximise the surface area for photosynthesis
- f. The leaves are also waxy, and have 'drip tips' to let the rain drain off quickly. The wax also prevents bacteria from growing on the leaf

Economic activities in the equatorial climate region

a. Agriculture

- The land has been cleared for plantation agriculture such as rubber and oil palm plantations in West Malaysia. Amazon Basin is also used for commercial livestock

ranching/beef cattle rearing, also cocoa growing in Ghana, sugar cultivation in Cuba, etc.

b. Pharmaceuticals

- Tropical forests are called the '**world's largest pharmacy**' because of the large amounts of medicines discovered in rainforests that are derived from forest plants. For example, 'basic ingredients of hormonal contraception methods, cocaine, stimulants, and tranquilizing drugs', Curare (paralysing drugs), and quinine (a malaria cure) are also found there

c. Tourism

- People travel nationally and internationally to experience rainforest first hand. Climbing through the canopies, camping, biking, and animal/insect watching are also common forms of tourism done in the forest

d. Mining

- Many rainforests are rich in oil deposits and mineral reserves such as bauxite, coal, copper, diamond, gold, iron ore, kaolin, nickel, tin, uranium

e. Lumbering

- Luxuriant and diverse vegetation provides a wide variety of woods for making furniture, pulp, and ship board or as cellulose for the production of plastics

f. Fishing

- Due to heavy rainfall, there are numerous rivers which makes fishing one of the occupations in the region

g. Electricity

- Some of the rivers have been developed for hydroelectric power generation, and this has attracted some industries

h. Hunting and gathering

- Most primitive people live as hunters and collectors and more advanced ones practise shifting cultivation

Factors that limit development in the equatorial climate region

- i. There are many diseases and pests which attack human, animals and crops. Pests and diseases are common because of prevalence of a hot and wet climate. If humans are sick they could not cultivate in their fields hence low development and on the other hand if crops are and animals are attacked by pests and disease they will be of poor quality leading to low development.
- ii. It is difficult to establish communication since the area is heavily forested. Roads and railway lines are difficult and expensive to construct
- iii. Soils are generally poor because thin layer of rich top soil are eroded very quickly by running water and heavy rains, also result into a lot of leaching.
- iv. There is excessive heat and high humidity.
- v. Impassable rivers
- vi. Dangerous snakes and other wild animals thrive in this region that attack people

B. Tropical continental (Sudan type) climate

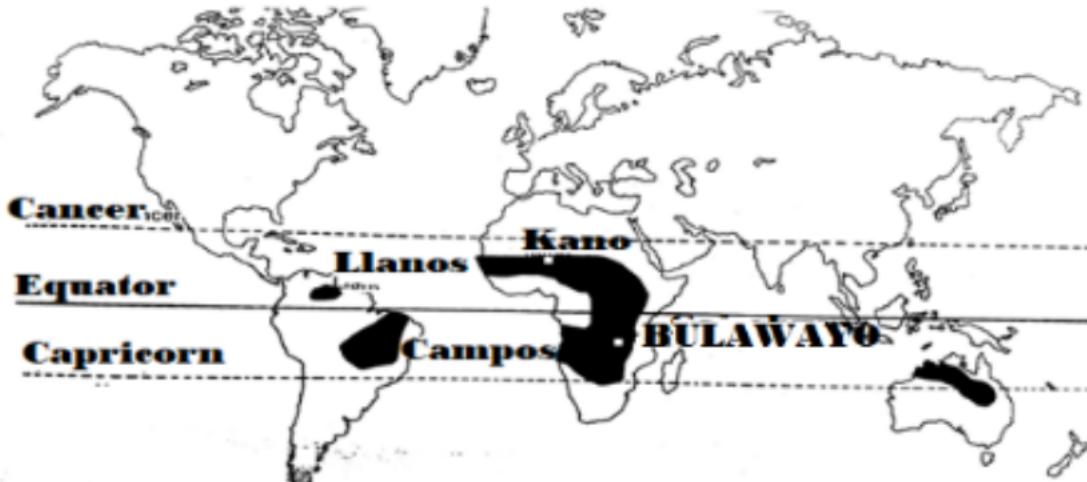
Location

- It is found between latitudes 5°- 15° North and 5°- 15°South of the equator
- It is a transitional climate between the equatorial forests and the hot deserts.
- The savanna climate is confined within the tropics and it is best developed in Sudan

where dry and wet seasons are most distinct, hence it is also called **Sudan Climate**

The main areas where this climate is found are

- i. **Africa:** Tanzania, Kenya, Uganda, Western Sudan, Malawi, Zambia, Zimbabwe, Mozambique and Northern Nigeria
- ii. **Brazil:** Llanos of Orinoco Basin, Campos of Brazilian highlands
- iii. **Australia:** northern areas to the north of the tropic of Capricorn



AREAS WITH TROPICAL CONTINENTAL CLIMATE

The distinguishing feature of the savannah climate

- This climate is characterized by alternating hot, rainy season and cool, dry season.
- In the northern hemisphere, the hot, rainy season usually is from May to October. The rest of the year is cool and dry. In the southern hemisphere, the hot, wet season is from November to April and the rest of the year is cool and dry.

Climatic characteristics of Savanna climate

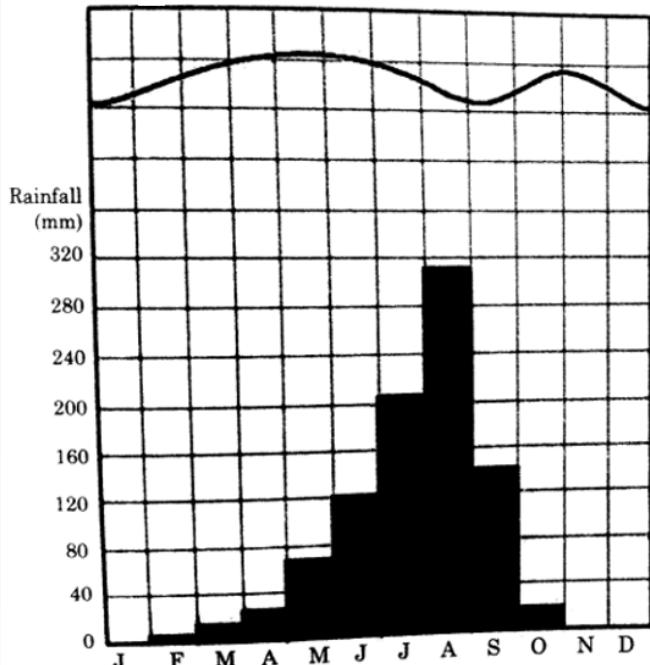
- i. The area is affected by trade winds in winter and doldrums in summer
- ii. The climate is characterised by alternate wet and dry seasons caused by the apparent movement of the sun
- iii. Summers are hot with temperature around of 32°C and cooler winters of 21°C with the annual range of 11°C
- iv. Humidity is high in the summer
- v. Heavy convectional rainfall is common in summer. Winters are usually dry
- vi. Annual rainfall is moderate, often around 760 mm. This amount of rainfall may be more in coastal regions and less near the hot deserts
- vii. The highest temperature occur just before the rainy season begins e.g. April in Northern Hemisphere and October in Southern Hemisphere
 - **Malawi's climate** is generally subtropical, with the characteristics of the Savanna climate. A hot, rainy season runs from November through April. From May to November, it is cool and dry throughout the country

Month	J	F	M	A	M	J	J	A	S	O	N	D
Temperature °C	22	21	21	19	16	14	15	16	20	22	23	22
Rainfall (mm)	205	220	154	36	8	0	0	4	5	9	85	131

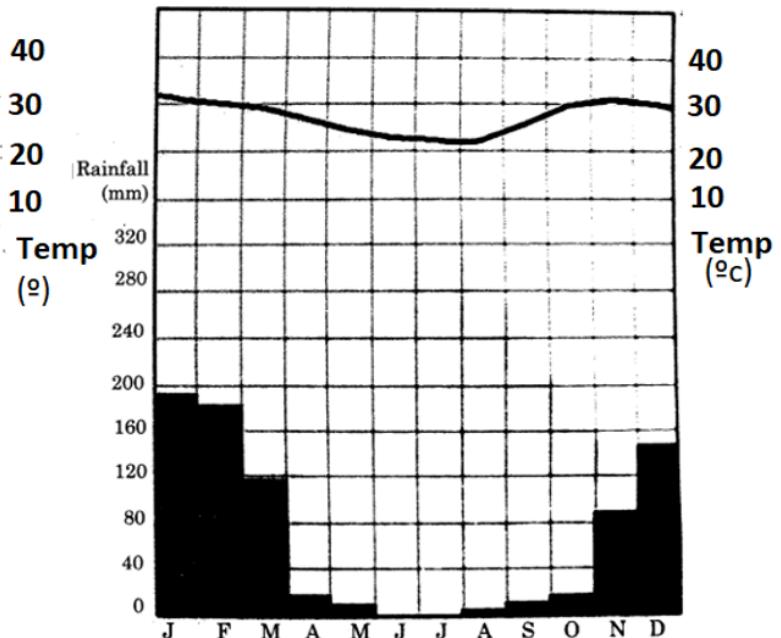
A CLIMATIC TABLE FOR LILONGWE

months	J	F	M	A	M	J	J	A	S	O	N	D
Temp °C	24	24	27	28	30	29	27	27	27	28	27	25
Rainfall mm	2	2	-	-	18	505	610	368	269	48	10	0

CLIMATIC DATA FOR KANO, NIGERIA IN NORTHERN HEMISPHERE



CLIMATIC GRAPH FOR KANO, NIGERIA IN N.H



CLIMATIC GRAPH FOR LILONGWE, MALAWI S.H

- The graphs above show that they are for Tropical continental or Sudan climate as it has alternating dry and wet seasons.
- The graph for Lilongwe indicates that the climatic station from where the data was gathered is from southern hemisphere. **Reason why it is for southern hemisphere?**
 - The graph has its lowest temperatures around June-July when the sun is overhead in the northern hemisphere or it can be said that the temperatures are higher around Dec-Jan when it is summer in the southern hemisphere as the sun is overhead at the Tropic of Capricorn
- The graph for Kano indicates that the climatic station is for Northern Hemisphere. **Why Northern Hemisphere?**
 - The graph has the lowest temperatures in Dec-Jan when the sun is overhead in the northern hemisphere or it can be said that the temperatures are higher around June-July when it is summer in the northern hemisphere as the sun is overhead at the tropic of cancer

Natural Vegetation

The type of vegetation is mostly savannah or tropical grassland, which has the following characteristics

- Consists of tall grass with scattered trees
- Trees are deciduous, meaning that they shed their leaves in dry season to prevent excessive loss of water through transpiration
- They lie dormant during the long drought
- Grass dries out in the hot and dry season

- e. Plants have long roots, which reach deep down to the moist rock layers in search of ground water
- f. Many trees are umbrella shaped to shield the roots from the scorching heat and to expose only a narrow edge to the strong winds that blow all year round
- g. The appearance of vegetation changes with season. It appears green and fresh in rainy season and yellowish brown and parched with the ensuing dry season
- h. They have broad trunks (e.g. baobab to store excessive water)
 - In Africa, the vegetation is called **Savanna** while in South America is known as **Llanos (Guinea highlands)** and **Campos in Brazil**
 - Savannah is the home of wild animals. It is called big game country

Examples of the trees found in this type of climate

- Baobab trees, Palms, Acacias, Gum trees, Elephant grass

Economic activities in the tropical continental climate

i. Agriculture

- Agricultural development is not well developed in Africa savannas because some still follow primitive methods of agriculture e.g. the Masai of Kenya
- In some areas e.g. Nigeria, the Hausa and Kikuyu of East Africa grow crops like millet, maize, bananas, groundnuts and beans. They also keep herds of cattle and goats
- Commercial plantation is also carried on e.g. Kenya, Malawi, Uganda etc. crops include Sugar cane, tobacco, Sisal, Cotton and Tea
- The two Savanna regions of South America are important for ranching

Factors that prevent further expansion of agricultural development

1. Unreliable rain (droughts are common)
2. Diseases and insect pests which attack people and animals e.g. Tsetse flies
3. Loss of soil fertility through leaching in summer during the torrential rain
4. Poor communication from agricultural regions to the markets
5. The dry season makes much of the region prone to wildfires

ii. Tourism

- Grasslands provide shelter and pasture for wild animals, this makes tourism an important activity

iii. Mining

- Savannah areas are also rich in mineral reserves such as bauxite, coal, copper, diamonds, gold, nickel, tin and uranium

iv. Fishing

- The heavy rainfall received during the short rainy season give rise to permanent water bodies. This has made fishing one of the most important occupations in the region

v. Electricity

- The seasonal heavy rains also made some of the rivers support hydroelectric power generation

C. Hot desert climate

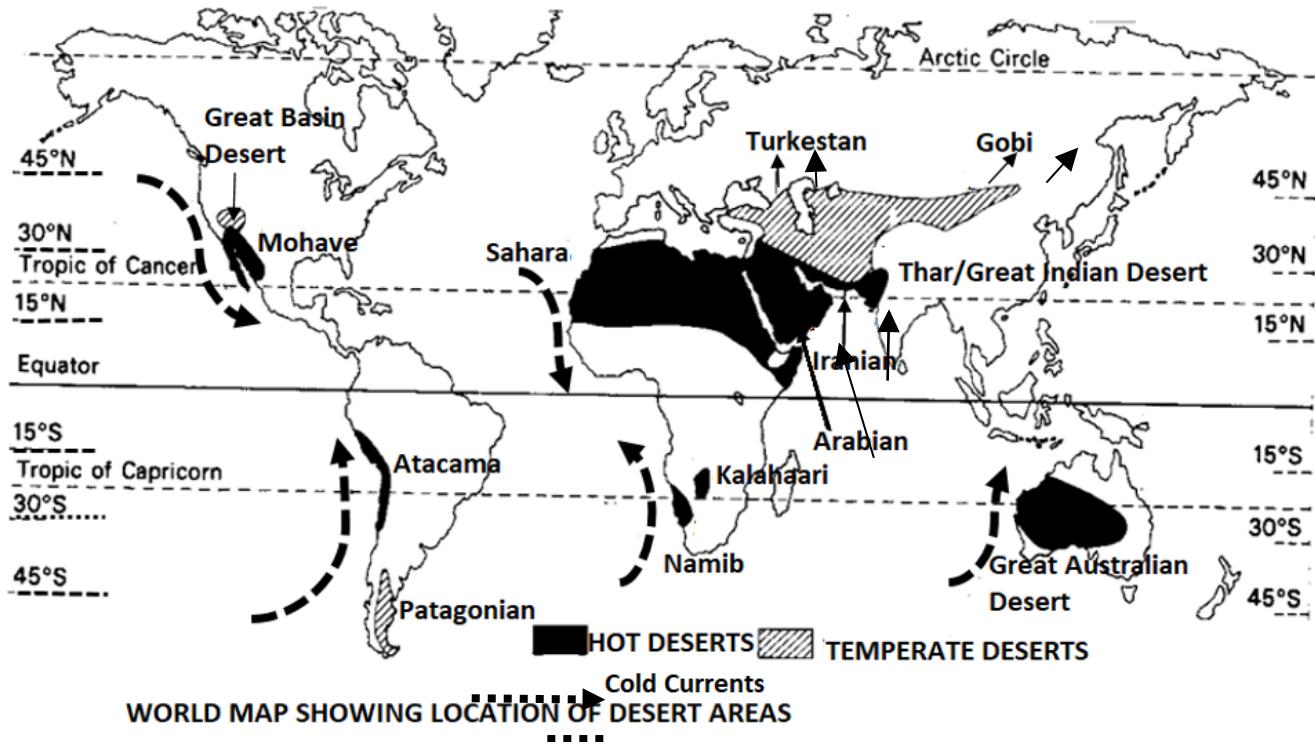
Location:

- The hot desert climate is found around the Tropics of Capricorn and Cancer, usually on the west side of continents in the trade wind belt, hence they are also called **tropical deserts**
- The most important regions of hot deserts are found in the following continents
 - a. **Africa:** Sahara, Kalahari and Namib Desert

- b. **Asia:** Arabian Desert, part of Israel, Syria, Jordan, Iraq, Iran and part of Pakistan (Thar desert)
- c. **Australia:** Central and Western Australia
- d. **South America:** The Atacama Desert in Chile
- e. **North America:** Mohave/Californian desert

General pattern on the way the deserts are distributed across the globe

- a. Most are located on the western sides of continents, with some seen as narrow stretch of land along the western coast. These are known as coastal deserts e.g. Namib, Atacama and Californian
- b. Some deserts are found in the interior of continents. These are called continental deserts. For example, the Sahara Desert which has a coastal connection on the west but extends across in areas of land masses in North Africa and into Arabia and other Middle East countries.
 - The Kalahari and Central Australian Desert are located in the interior



Distinguishing features of the hot desert climate

- Its climate graph will show a very high temperature but very little rainfall, even in the wettest months

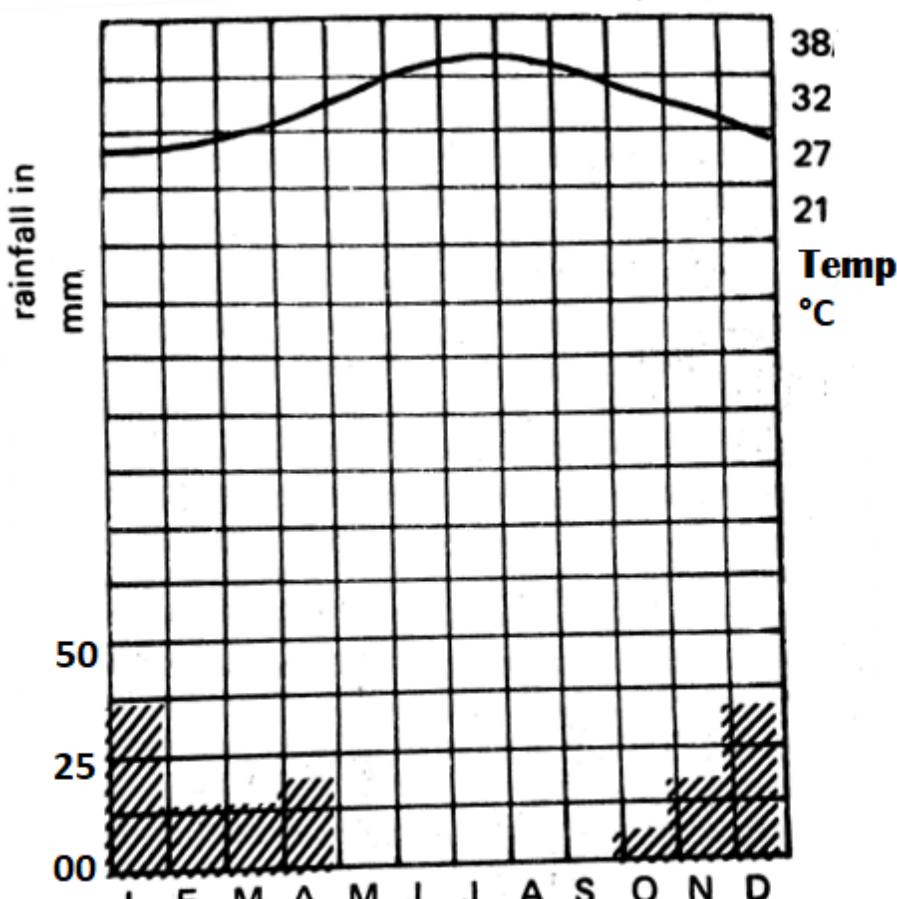
Why the major hot deserts of the world are located on the western coasts of continents between 15° and 30° North and South of the equator?

1. They lie across the sub-tropical high pressure belts where winds are descending; a condition not favourable for precipitation
2. They lie in western coastal areas where rain-bearing trade winds blow off-shore and westerlies that are on-shore blow outside the desert limit
3. They lie adjacent to cold currents. When the onshore winds blow over the cold current, they are cooled and condensed to form fogs and low stratus clouds, when they reach the desert they are dry

- Some deserts lie on the leeward side of mountain barriers. As the prevailing winds cross the mountain barrier, they drop their moisture on the windward side, creating a rain shadow on the leeward side. For example, the **Kalahari is in the rain shadow of the Drakensberg Mountains** in South Africa. Also the **Great Australian Desert is shielded by mountains which lie parallel to the east-coast of the continent**
- Some deserts are temperate deserts. They are cold e.g. Patagonia, Gobi Desert. These desert areas are located in the continental interiors, so they are far from nearest sea or ocean. The Patagonian Desert is more due to its rain-shadow position on the leeward side of the lofty Andes than to continentality

Climatic characteristics

- a. Rain rarely falls. Some desert areas may receive rain only once every two to three years. Average rainfall is usually 120 mm
- b. Temperature is high throughout the year
- c. There is no cold season in hot desert
- d. Diurnal temperature range is high (difference between daily maximum and daily minimum). During the day the sun is high in the sky; cloudless skies let the intense solar radiation reach the bare sand surfaces on ground. The bare ground heats up and air temperatures close to the ground may reach over 40°C. At night the sun has set, so the ground receives no radiation. Cloudless skies allow the heat of the ground to radiate into the atmosphere. Air temperature near the ground can fall to below 0°C



THE CLIMATIC GRAPH FOR HOT
DESERT CLIMATE IN NH, ETHIOPIA

Month	J	F	M
Temperature	26	26	26
Rainfall	38	15	1

A CLIMATIC TABLE FOR HOT DESERT

Natural vegetation

- Vegetation in the hot desert climate is scanty due to lack of rain. Plants have adapted to this very hot and dry environment in a number of ways
- The predominant vegetation for both hot and mid-latitude deserts is xerophytic or drought resistant
- The vegetation is best described

as scrub whose special characteristics is to withstand long dry periods without rain

How desert plants have adapted to hot and dry conditions of the deserts

- a. They develop long roots to tap water from deep down the soil and they are well spaced out to cover as much area as possible for water
 - b. They have very thick leaves and stems to store water
 - c. Have waxy layers on the outside of their stems and leaves which helps to reflect some of the heat and reduce loss of water
 - d. Some plants are halophytes. This means that these plants are adapted to survive in saline conditions
 - e. They have thick succulent stems to store water and prevent loss of water through the stems. Cactus
 - f. Few and no leaves or thorns instead of leaves to prevent the loss of water through transpiration
 - g. Some flowering desert plants are ephemeral; they live for a few days at most. They produce sleepy seeds (those that lie dormant) and germinate when water is available
- The most common plants are cacti, thorny bushes, coarse grasses and thorn bushes

Countries which are likely to have this climate are

- In Northern Hemisphere: Mali, Chad, Niger, Libya, Mauritania, Central African Republic, Ethiopia, etc.
- In the Southern Hemisphere: Chile, Australia and Namibia

Economic activities in the hot desert

a. Hunting and gathering

- The Bushmen of the Kalahari Desert region remain so primitive in their mode of living that they barely survive. These people are nomadic hunters and food gatherers, they do not grow crops or keep animals

b. Agriculture

- The crops are grown by irrigation using the oasis. Wheat, barley, dates, figs and a variety of vegetables are grown for both commercial and local use
- Animals like sheep, goats and camels are also kept

c. Mining

- Hot desert areas are source of enormous wealth in natural resources like petroleum and copper

d. Tourism

- Hot deserts are attractive places for adventurous tourists in various countries, providing different tours and sports such as motorcycling, hiking and camel riding

e. Solar power generation

- Extreme temperatures in deserts make them ideal places for producing solar energy

Problems which prevents further development in the desert areas

a. Lack of rainfall and very limited quantities and distribution of available fresh water.

- This affects farmers who keep animals as they have to move from place to place in search of water and pasture. Hence people do not have time to develop their areas
- Desert people get their water from two sources: **oases** and **exotic**
- **Exotic streams** are streams or rivers that begin in more humid region and flow into the desert. Many exotic streams dry up before ever reaching the sea
- **Oases** occur in places either where a spring is present or the groundwater table lies very close to the surface

Solution

- Towing/pulling icebergs from Antarctic to the hot deserts and piping the water that is coming from melting ice into the desert
 - b. **Strong, dusty winds that blow across the deserts.** This affects driving, flying and walking
 - c. **Poor sandy soils** that cannot support agriculture because they drain quickly
 - d. **Plenty of locusts** which live on plants and migrate in swamps
- Solution**
- Spreading poisonous baits so that they eat and die
- e. Too much heat from the sun
- f. **Communication problem**
- As large areas are covered by sand, roads and railways cannot be constructed

D. Mediterranean climate (warm temperate western margin)

Location

- Experienced between 30° and 45° North and South of the equator in the western sides of continents
- It is best developed around the shores of Mediterranean Sea, hence the term Mediterranean climate
- Also southwest Africa, Central Chile, Central California, Southwest and Southern Australia



Countries with this climate

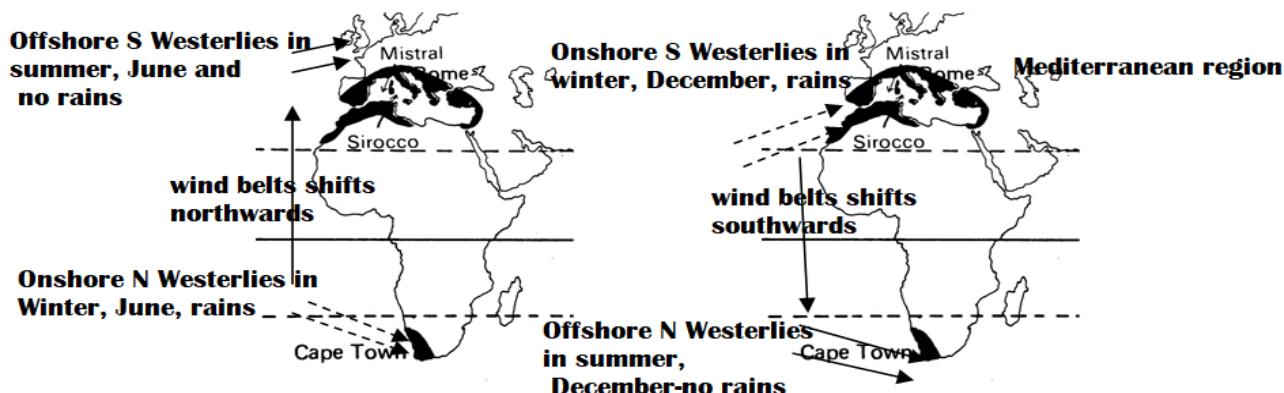
- Chile, South Africa, Australia in the Southern Hemisphere and USA, Spain, Italy, Greece, Algeria in the Northern Hemisphere

Distinguishing features of the Mediterranean climate

- The distinctive feature of this climate that makes it easy to identify is **summer drought** and **winter rains**. It receives rain in winter, hence it is also called **winter rain climate** while the rest receive rain in summer.

The basic cause of the climate

- The basic cause of this climate is the **shifting of wind belts**.
- When the sun is overhead at the tropical of cancer in June, all the belts move about 5° - 10° north of their average position. Then Mediterranean parts of the southern continent then come under influence of westerlies and receive rain in June (winter in the Southern Hemisphere)
- In the same manner, when the sun is overhead at the Capricorn, all the belts swing 5° - 10° south of their average position. Then the Mediterranean parts of Europe and California then come under influence of westerlies and receive rain in December (winter in the northern hemisphere)



Climatic characteristics of Mediterranean climate

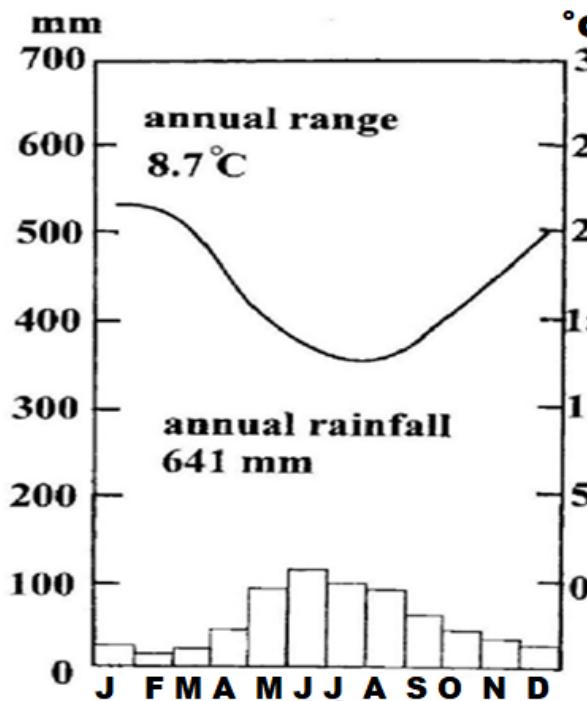
- a. It receives rain in winter, both cyclonic and convectional. Annual rainfall is between 500-900 mm
- b. Winter temperatures normally do not fall below freezing point (0°) while summer temperatures are around 21° C to 27° C.
- c. Onshore westerly winds blow in winter bringing cyclonic rainfall. These winds are wet as they blow from the ocean. Trade winds blow offshore in summer, causing dry conditions since they blow from the land
- d. Areas affected experience local winds. For instance, Sirocco a hot, dusty and dry wind blows in summer across the Mediterranean Sea from the Sahara. Also Bora blows in winter

Month	J	F	M	A	M	J	J	A	S	O	N	D
Temp	21	21	20	17	15	13	13	13	14	16	18	20
Rain	18	15	23	48	97	114	94	86	58	41	28	20

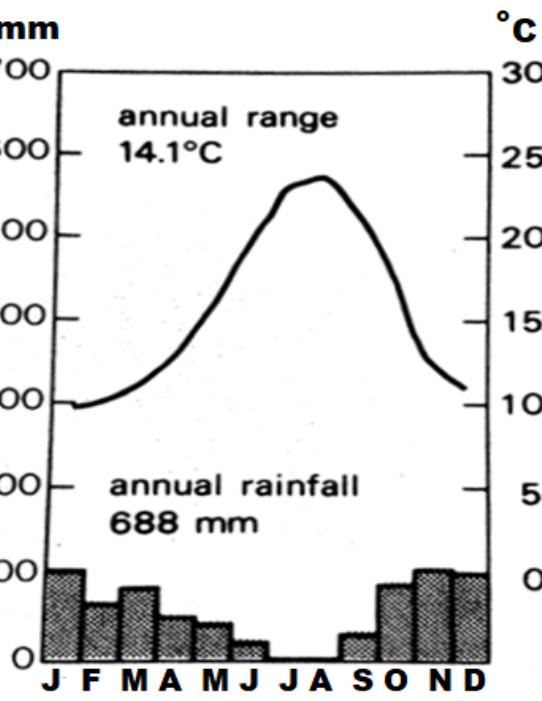
CLIMATIC DATA FOR CAPE TOWN, SOUTH AFRICA

Month	J	F	M	A	M	J	J	A	S	O	N	D
Temp	7	8	11	18	22	24	22	24	21	17	12	8
Rain	81	69	74	66	56	41	18	25	64	127	112	99

CLIMATIC DATA FOR ALGIERS, ALGERIA



**MEDITERANEAN CLIMATE
CAPE TOWN, SOUTH AFRICA**



**MEDITERANEAN CLIMATE
ALGIERS, ALGERIA**

- The graph for Cape Town shows that it is for Mediterranean because it receives rain in winter i.e. May, June, July where temperatures are low. Also the climatic station is located in the southern hemisphere because it has lower temperatures in June-July when is winter in the south
- While the Algiers station also has most rain in winter i.e. November, December and January. This station is located in the northern hemisphere because it has higher temperatures during June-July when the sun is overhead in NH and is summer there

Natural vegetation

- Vegetation in Mediterranean areas is varied. It ranges from scrub to grassland to woodlands.
- Some people call this kind of vegetation '**chaparral**', a Spanish word that means '**an area of small evergreen oak trees**'
- Some common trees found in Mediterranean regions includes the following; Red wood (sequoia), Eucalyptus, Pine, Firs
- The following types of vegetation exist in Mediterranean regions
 - Mediterranean evergreen forests**
 - Comprises of open woodlands with evergreen oaks, giant sequoia and eucalyptus
 - Evergreen coniferous forests**
 - These include different kinds of cedars, cypresses, firs and pines
 - This vegetation is common in cooler areas where droughts are rare
 - Mediterranean bushes and shrubs**
 - This is the most dominant type of vegetation in Mediterranean

regions

- The most common species include the evergreen sage, thyme and rosemary

Many plants have adapted themselves to the demands of Mediterranean temperatures

- a. The olive tree is a distinctive feature of the landscape, with tough, waxy leaves and thick bark, which enable it to cope with the excessive heat and dryness of the summer months. Some plants remain evergreen e.g. the oak
- b. The vegetation is short, dense, and scrubby. The reason it looks like this is because short, dense and scrubby vegetation can survive very well in dry habitats. This is called a **drought-resistant** strategy for survival
- c. Many of these plants have the ability to lose their leaves when times get tough.
- d. They have both a long deep taproot, and a dense network of lateral roots close to the surface to absorb as much moisture as possible
- e. They produce thick, woody tubers called **burls**, which are found at the base of the plant. These **burls** are so thick they can even resist being burned all the way through in a fire. The fire-resistant burl at the base of the trunk can re-sprout, enabling the shrubs to regrow to their original size in just a few seasons
- f. Some plants are nocturnal. They have a short growing cycle to avoid the summer drought
- g. Others have hair on their leaves to trap moisture from fog or rain and to insulate them from the high heat in summer. For example, rosemary and thyme

NB. The vegetation in Mediterranean regions have been affected in the following ways

- a. Forest fires due to hot, dry conditions. In addition, some plants contain flammable fuels or sometimes fires deliberately have also destroyed the vegetation
- b. Extensive livestock (goats and sheep) grazing and deforestation have destroyed the vegetation

Economic activities in the Mediterranean climate region

a. Agriculture

- Agriculture is more developed in the Mediterranean region

i. Fruit farming

- There is widespread growing of various species of fruits in the region including oranges, lemons, and grapes. Other fruits include peaches, pears, figs and cherries

ii. **Crop cultivation.** The climate suits growth of many crops e.g. wheat, barley, olive trees for making oil, vegetables etc.

iii. **Livestock farming.** Mountain pastures with their colder climate, provide favourable conditions for goat, sheep and sometimes cattle rearing

• Some industries common in these regions are

1. Wine making from grapes
2. Fruit canning
3. Flour milling from wheat and barley
4. Food processing

b. Tourism

- The long hot, dry summers attract many tourists from the cold regions

c. Mining

- The Mediterranean climate region has abundant mineral resources such as coal, gold, diamond, platinum, etc.

However, the following problems are common

- a. Fires start due to hot, dry conditions.

- b. Limited amount of water
- c. The spread of irrigation has created environmental problems such as soil salinity due to intense heat in summers which cause a lot of evaporation

UNIT 26: ENVIRONMENTAL ISSUES

Terminologies

- a. **Environment:** This is the sum total of all surrounding conditions for a person, animal or plant
- b. **Environmental issues**
 - These refer to the harmful aspects of human activity on the biophysical environment or the planet's systems (air, water and soil).
 - Environmental issues include problems with the planet's system (air, water and soil etc.) that have developed as a result of human interference or mistreatment of the planet
 - Some of the environmental issues include pollution, climate change, global warming, desertification, resource depletion, over population, hazardous wastes, toxicants and deforestation.
- c. **Environmental problems:**
 - These refer to the difficulties that are caused by human activities that result in changes in the environment. These changes have disastrous effects on certain aspects of the environment
 - these are processes such as resource consumption that have negative effects on the sustainability of the environmental quality for the well-being of the organisms living in it
 - Environmental problems include greenhouse effect, ozone depletion, air pollution, air quality, waste water, urban run-off, water crisis, habitat destruction, non-recyclable wastes. Population explosion, eutrophication etc.

A. POLLUTION

Definition

- Refers to the introduction of waste materials into natural environment that renders part of the environment unfit for intended or desired use
- Most of the pollution results from human activities. As people use natural resources, they produce pollutants. Pollutants are the normal by-products of people
- Environmental pollution can be classified as air pollution, water pollution, land pollution and noise pollution. There are other types of pollution known as visual pollution which can actually be embedded in the three major pollution

The main types of pollution

1. Air pollution

- Refers to the addition of harmful chemicals, toxins, particulate matter into the atmosphere

Causes of air pollution

- Harmful gases emitted through volcanic eruption
- Burning of fossil fuels e.g. burning of fuels in factories and automobile exhaust fumes
- Deforestation. Removing vegetative cover purifies air and its removal can cause pollution
- Increased urbanisation which leads to more construction, transport and industrial activities which cause fine particles of dust to rise into the atmosphere
- Setting of bush fires which pollute the air
- Bursting of sewages which releases gas into the atmosphere which pollute the air

Harmful effects of air pollution

- Diseases such as bronchitis, lung cancer, and heart diseases may affect people
- May lead to the formation of acid rain. Acid rain damages trees and causes soils and other water bodies to acidify, thereby making the water unsuitable for some fish and other wildlife

NB. Acids rain is a precipitation containing harmful amounts of nitric and sulphuric acids. These acids are formed primarily by nitrogen and sulphur oxides released into the atmosphere when fossil fuels are burned.

- Poor visibility or haze
 - Haze obscures the clarity, colour, texture and form of what we see, and this causes serious problems in the transport industry, especially aviation and shipping.
- NB. Haze** occurs when sunlight encounters tiny pollution particles in the air
- Depletion of the protective ozone layer.
 - This can cause increased amount of Ultra-violet radiation to reach the earth, which can lead to more cases of skin cancer and impaired immune systems
 - Ultra-Violet radiation can also damage sensitive crops, such as soya beans, and hence, reduce crop yield
- Global climate change
 - The production of large amount of greenhouse gases, including carbon dioxide and methane has caused the earth's atmosphere to trap more of the sun's heat. This had caused the earth's average temperature to rise; a phenomenon known as **global warming**
 - Global warming** could have significant impacts on human health, agriculture, water resources, forests, wildlife, and coastal areas

2. Water pollution

- Water pollution refers to any contamination of water bodies with chemicals or other foreign substances that are harmful to human, plant, or animal health

Causes of pollution

- Dumping of industrial wastes that contain heavy metals, harmful chemicals, organic toxins and oils into the nearby source of water
- Oil spills from ruptured oil rigs, refineries or oil tankers can produce widespread and potentially hazardous substances into water bodies
- Improper disposal of human and animal wastes
- Residues of agricultural practices, including fertilisers and pesticides which enter the groundwater systems through rain water causing pollution
- Natural disasters like hurricanes can destroy nuclear power plants and

automobiles into water bodies causing widespread damage to marine life

- f. Some fishing methods such as use of chemicals pollutes water

Harmful effects of water pollution

- a. Waterborne diseases such as cholera and diarrhoea are produced by the pathogens present in polluted water, affecting humans and animals alike
- b. Scarcity of safe and portable water for humans, animals and plants
- c. Water pollution kills life and lead to extinction
- d. Pollutants such as toxic chemicals can change the acidity, conductivity and temperature of water. This would in turn affect the pattern of ocean currents as well as the climate of the surrounding regions
- e. Eutrophication in water masses such as lakes and rivers.

Eutrophication is the build-up of large amounts of minerals such as nitrates and phosphates in fresh waters

3. Land pollution

- Land pollution refers to the degradation of the earth's land surface through deposition of hazardous solid or liquid waste materials on land or underground

Causes of land pollution

- a. Dumping of toxic materials such as chemicals and paints on land
- b. Increase in urbanisation which causes large amounts of rubbish to be left untreated and then dumped along streets.
- c. Improper treatment of sewage solid lead to the accumulation of solids, such as biomass sludge. These solid wastes overflow through the sewage, making the entire area look dirty.
- d. Littering of rubbish anyhow in road sides, streets such as food remains and food wrappers
- e. Overuse of agricultural chemicals such as pesticides, herbicides, insecticides and chemical fertilizers
- f. The disposal of non-biodegradable wastes: including nuclear wastes, containers, bottles and cans made of plastic, used cars and electronic goods, also leads to the pollution of land
- g. Burning of solid fuels which leads to the formation of ashes, which is yet another cause of land pollution
- h. Mining leads to the formation of piles of coal and slag

Harmful effects of land pollution

- a. It leaves places dirty and makes them unhealthy. Skin problems and other diseases are often diagnosed due to land pollution
- b. The toxic chemicals disposed of on land may leach into the ground water, posing serious long-term hazards to the environment
- c. Land pollution releases airborne chemicals and smell, which endanger health and lower property values in an area
- d. Unpleasant and smelly environment
- e. Leads to less productivity of the land and land becomes unfavourable for growth of crops

4. Another form of pollution is noise pollution

- **Noise pollution** refers to the excessive propagation of noise which is harmful or negative effects on the activities of human or animal life

Causes of noise pollution

- a. **Social events** e.g. music concerts, wedding ceremonies, birthday, and other

- parties, cheering crowds in events like football matches, and activities in market centres where people engage in loud conversations
- b. **Construction activities** e.g. drilling and blasting of rocks and the mixing of various materials required for construction
 - c. **Industrialisation:** Factories and industries use massive machines
 - d. **Transportation:** Many vehicles on the road cause noise pollution through the sounds produced by their engines. Also hooting and honking of their horns. Airplanes and Trains make a lot of noise as they move
 - e. **War zones:** e.g. the use of guns and atomic bombs

Effects of noise pollution

- a. Excessive noise produced may lead to loss in hearing
- b. Health issues like cardiovascular and hypertension problems in human being
- c. Breakdown in communication
- d. It may cause stress, which can lead to psychological disorders.
- e. It may affect sleeping patterns and lead to sleep disorders

Ways of controlling noise pollution

- a. Using silencers in automobiles will allow them to generate less noise on the roads
- b. Planting more trees in strategic areas. Trees will act as sound barriers for the noise produced
- c. Ensuring that all machines are well lubricated to reduce the noise they produce
- d. Using sound insulating equipment in buildings and for all workers operating in noisy environment

Why environmental degradation is a gender issue?

- a. When the environment is degraded women and girls do more work, such as walking long distances to gather water and firewood
- b. Environmental degradation prevents women and girls from leisure activities and education because they have to spend much of their time fulfilling traditional responsibilities such as food growers, water and fuel gatherers, and caregivers
- c. There is also an increased incidence of physical and sexual assault when women have to walk long distances to remote areas for water and sanitation, particularly in situations of conflict and war

Possible control measures to air, land and water pollution

- a. Using renewable and clean sources of energy such as solar and wind
- b. Using recycled products
- c. Reusing things such as paper and plastic bags
- d. Public awareness campaigns on causes and dangers of various forms of pollution
- e. Legislation and enforcing laws that protect the environment against all forms of pollution
- f. Planting more trees to act as 'carbon sink'. Vegetation absorbs carbon dioxide for the process of photosynthesis
- g. Encouraging the use of public transport to reduce the number of vehicles on roads
- h. Effective collection and treatment of waste in urban areas

UNIT 27: DESERTIFICATION

- Desertification is a process in which habitable land is gradually transformed into a desert
- Desertification involves the expansion of an existing desert or the formation of a new desert
- Desertification sometimes is referred as "**creeping desert**", this is because it spreads slowly once it starts

Causes of desertification

- The causes of desertification are classified into two main categories, that is:
 - a. Human causes
 - b. Non-human causes

A. Human causes

a. Deforestation

- Destruction of forest cover exposes land to erosion, which decreases soil depth and soil fertility. Loss of soil fertility restricts future growth. This eventually results in failures of expected rainfall, hence producing desert conditions

b. Overgrazing by livestock and wild animals

- This habit destroys vegetation and causes compaction of soil under trampling hoofs. This makes the earth's surface bare, hard, infertile, and thus unproductive

c. Shifting cultivation

- This involves converting more forest dry land into crop lands by slashing and burning of pre-existing vegetation, hence increasing the area of land which is of poor quality

d. Incorrect irrigation in arid regions

- Irrigation of pumping water from underground to water crops has reduced the level of water table, this causes plants to dry since their roots can no longer reach water supplies.
- Poor irrigation methods have led to the accumulation of salts in the surface soil causing massive death of plants

e. Pollution

- Some pollutants like sulphur dioxide combine with water to form acids in the atmosphere. This leads to acid rains, which kill many forests. Disappearance of forest cover causes the atmosphere to contain less water vapour, hence leading to less rain

f. Industrialisation or urbanisation

- Urbanisation is also encroaching upon agricultural lands causing immense damage to our natural resources

g. Mining

- Mineral exploitation takes up vast areas of productive land, destroying vegetative cover. This triggers soil erosion and siltation of water bodies, resulting in land degradation and water scarcity

B. Natural (physical) factors

a. Existence of cold currents on the path of rain-bearing winds

- The winds passing over a cold current are cooled and condense to form low stratus clouds and fogs. So when they reach the land masses they are dry and create a desert condition. For instance, the Namib and Atacama deserts are good examples

of deserts influenced by cold currents

b. Rain shadow effect of high mountains

- Warm moist winds deposit most of the moisture on the windward side of the mountain. As the winds descends to the leeward side, they are compressed, warmed and become dry, hence no rain. For example, California lies on the leeward side of Rockies

c. Great distance from the ocean

- Dry conditions are experienced in places that are far from the ocean. This is because rain bearing winds lose their moisture as they blow over the large land masses. For example, the Harmattan winds blowing over Sahara Desert accounts for aridity in the Sahel region, also southeast trade winds reach Chalbi desert in Kenya while dry

d. Formation of sub-tropical high pressure belts

- Air sinks in sub-tropical high pressure belts at about 30° North and South of equator. This is unfavourable condition for rain. These conditions make it difficult for vegetation to survive resulting to desertification. Most of the world deserts are found in these zones, for example, Sahara, Arabian, Thar and Gobi deserts

e. Rain shadow effects of easterly trade winds

- They lie in western coastal areas where rain-bearing trade winds blow off-shore and drop their moisture in the eastern edges of the land masses and westerlies that are on-shore blow outside the desert limit

Levels of desertification

- The process of desertification is not a desert itself. The process varies from place to place depending on the factors in place.
- As a result, the process falls into four categories as follows
 1. **Slight:** There is significant reduction in plant cover due to human activities.
 2. **Moderate:** The top soil is eroded and the productive grassland is replaced by some scrubs which are not productive.
 3. **Severe:** There is total destruction of land where there are deep gullies and desertification process is irreversible.
 4. **Very severe:** This is where deserts already exist and human activities cannot affect land cover. E.g. Kalahari

Effects of desertification

1. It disturbs the hydrological cycle since the rate of transpiration is tampered
2. It prevents regeneration of various valuable plant species
3. It causes the land to be prone to landslides
4. It encourages soil erosion and contributes to the silting of river beds
5. It causes climate change
6. It leads to poor yield leading to food shortage
7. It leads to poor crop yield leading to food shortage
8. It leads to drying up of water bodies and water catchment areas
9. It triggers the migration of people to other more agriculturally productive areas
10. It leads to the loss of vegetation and animal species resulting into extinction
11. Increased frequency of sand and dust storms which contributes to air pollution and causes eye infections, respiratory problems, and allergies
12. Flooding due to high run-off

Why is desertification becoming a threat to Malawi?

a. Reduced agricultural land

- Malawi depends on agriculture for its economy. Majority of the country's population

works in agricultural industries. Therefore, any loss of agricultural land to desertification is extremely costly to the economy of the economy

b. Poverty and underdevelopment

- Desertification means reduced food production. This makes Malawi to import more food supplies than it is exporting; this lowers the country's reserves of foreign currency. And also Malawi obtains huge loans from other countries to pay for imports. Therefore, instead of concentrating on development programmes, Malawi is hugely burdened with repaying of loans which causes poverty and underdevelopment

c. Depletion of water resources

- Loss of vegetation to desertification results in little rainfall. Therefore, water sources become depleted, and wells run dry. For instance, Lake Malawi is the country's major tourist site, so shrinking of the lake would seriously affect tourism

d. Loss of biodiversity

- Desertification contributes to the destruction of habitats of animal and vegetable species and micro-organisms. This would deprive tourists of game viewing and reduce tourism activities

e. Increased flooding

- As protective plant cover disappears due to desertification, the risk of flooding is highly increased. This makes rivers swell and floods become more frequent and more severe. The Lower Shire Valley is always hit by floods almost every year

f. Increased illiteracy rates among women

- Due to desertification, women walk long distances to fetch water and collect firewood. The time spent on fetching water and collecting firewood could be spent in school, job training, on paid work or even on leisure and health promoting activities

g. Increased urbanisation rate

- Many Malawians move from rural areas to abandon their land because it can no longer sustain them due to desertification. This pile pressure in their new destinations

h. Climate change

- Increase in average temperatures and unpredictable rains are seriously affecting the country's agriculture sector and this is affecting many lives

Reason why desertification is fast in the developing countries like Malawi.

- a. Most people do not have alternatives for energy because of poverty; as such they mostly use fire wood as the main source of their energy.
- b. Illiteracy level is high as such they fail to understand the long term impact of desertification.
- c. Over population i.e. the rate of their population increase does not match with the rate at which vegetation is replaced.

Measures to control desertification

1. **Afforestation**- this is the process of planting of trees on land not formerly covered with trees to make a forest for commercial or other purposes.
2. **Re-afforestation** – This is the planting of trees where they have been cut
3. **Proper land husbandry**- These include all processes that promote conservation of land e.g. practicing crop rotation, rotational grazing and making ridges across the slope.
4. **Civic education campaigns**- people must be taught about the dangers of deforestation and desertification
5. **Controlling rapid population growth**-this reduces pressure on the vegetation
6. **Provision of alternative sources of energy**- these alternative sources of energy include;

- solar, hydroelectricity, energy from wind, biogas, thermal energy, geothermal energy and nuclear energy. These will reduce pressure on vegetation, which in turn will control desertification
7. **Creating other opportunities:** for people to earn a living would help to relieve dependence on land and, in turn, the pressures that are causing desertification
 8. **Irrigation improvements**
 9. Use irrigation techniques that can reduce water loss from evaporation and prevent salt accumulation. This involves changes in the design in irrigation systems to prevent water from pooling or evaporating easily from soil. For example, the use of drip irrigation helps to save water

UNIT 28: Climate change

- **Climate change** is the significant long-term changes in global or regional climatic patterns
- Climatic change includes major changes in temperature, precipitation, or wind patterns, among others that occur over several decades or longer
- **Global warming** is the rise in average temperature of the earth's atmosphere.
- Precipitation patterns have also shifted dramatically in response to the rise in global temperatures
- Climate change is attributed largely to increased levels of atmospheric carbon dioxide produced by the over use of fossil fuels
- The climate changes that have occurred are caused by both natural and human factors.

A. Natural causes of climate change

- a. **Volcanic eruptions**
 - The immense quantities of dust and sulphur dioxide released into the atmosphere during major volcanic eruptions can remain suspended in the atmosphere for several years. It blocks solar radiation which eventually lowers global temperatures. Therefore, the periods that have greater volcanic activities also experience cool climatic seasons as a result
- b. **Plate tectonics and continental drifts**
 - As continents drift from one latitudinal position to another, areas that were previously in warmer latitudes can drift to cooler latitudes while those that were previously in cooler areas may have drifted into warmer areas causing climate change.
 - Continental drifting and plate tectonics have also resulted in land being pushed upwards to form Fold Mountains. The mountain chains have encouraged greater accumulation of ice and possibly disruption of global and wind systems
- c. **Slow changes in the earth's orbit around the sun**
 - The shape of the earth's elliptical orbit appears to change. Sometimes it becomes more elliptical, and the earth passes closer to the sun and temperature become warmer than normal, when the orbit become more circular, the earth is farther from the sun and the temperature dip below the average
- d. **Changes in sun's heat**

- Sun's energy output changes over time with respect to sunspots available on the sun. more spots mean more energy being fired out from the sun towards the earth, causing slight changes in the earth's climate

NB. Sunspots are dark areas on the surface of the earth. Sometimes the sun has more of these spots; and at times they disappear

e. **Changes in the amount of sun's heat**

- As the earth spins on axis, it does not achieve perfect rotation. The angle of tilt changes slightly with time, moving from 22.1 degrees to 24.5 degrees and back again in about 41,000 years.
- When the angle of tilt increases, the summers become warmer and winters become colder, but when the angle decreases summers and winters become mild.

f. **Changes in the ocean's circulation**

- Any changes in ocean current can cause changes in climate. El Niño is an example of such changes. Every 2-7 years, the waters off the western coasts of South America become warmer than usual. The cold water of Peruvian current is covered by a sheet of warm water from the equator caused by change in direction of the prevailing easterly winds that blow over the central Pacific Ocean. The change pushes warm water and heavy rains towards North and South America and brings drought to Australia and Asia.
- When the reverse occurs, the strong winds blow warm air westwards and produce rains and flooding in Australia and Asia while North and South America experience drought. This reversal of ocean current is called **La Niña** (a feminine form of the word El Niño)

NB. El Niño refers to an event that occurs every two to seven years in the Pacific Ocean during which winds shift and push warm surface water towards the coast of South America and it causes dramatic changes in climate change

B. Human causes of climate change

a. **Deforestation**

- Firstly, when trees are cut, the rate of transpiration is reduced leading to little or no rain. The water cycle is adversely affected, resulting into drought which famine.
- Secondly, the removal of vegetation means there will be more carbon dioxide in the atmosphere. Vegetation helps to reduce carbon dioxide concentration in the atmosphere through the process of photosynthesis

b. **Emission of various gases into the atmosphere (greenhouse effect)**

- The release of greenhouse gases into the atmosphere causes global warming which leads to climate change. Example of greenhouse gases are
 - i. **Carbon dioxide:** originates from burning of fossil fuels
 - ii. **Chlorofluorocarbons (CFC's):** these are gases released from aerosols and by refrigerators
 - iii. **Methane:** originates from farming, waste disposal, mining and rice fields
 - iv. **Nitrous oxide:** it is emitted from power stations, vehicles, and from the use of fertilisers

c. **Urbanisation**

- Construction of tall concrete buildings, tarmac roads and other modern infrastructure modify the drainage and heat conductivity of the earth's surface. The tall buildings towers and flyovers may reduce the free flow of air, causing climate change.

d. **Rapid population growth**

- Rapid increase in population leads to greater consumption of food, water and energy;

Effects of climate change

i. Declining food production due to severe droughts

- Climate change creates increasingly dry conditions that could cause permanent drought, causing crop failure

ii. Loss of biodiversity

- Climate change changes habitats, causing changes in the abundance and composition of plant and animal species. Animals may either move to cooler habitats or die due to increasing temperatures

iii. Increased frequency and severity of storms

- Warm ocean surfaces are conducive to formation of storms, as the temperatures increasingly rise, so does the frequency of severe storms

iv. Spread of diseases

- With climate change, disease causing organism multiply rapidly, as a result, diseases like malaria will spread to different areas, affecting the health of many people

v. Shifting water resources

- In some regions, climate change threatens to reduce fresh water availability due to decreased rainfall that ultimately feeds major reservoirs.
- In other regions, there is increased flooding from the intense rainfalls due to warmer, more moisture-laden atmosphere.

vi. Global warming

- Caused by the release of greenhouse gases e.g. methane, carbon dioxide etc.
- Global warming is the gradual increase in the overall temperature of the atmosphere of the earth

Indicators of global warming

- a. Global sea level has risen
- b. Glaciers are melting
- c. Ocean currents are changing
- d. The Arctic and Antarctic Ice caps are thinning and shrinking

Impact of global warming

- Heavy rains, flooding, blizzards and storms
- Droughts in Africa and India
- Desertification

vii. Changing Ocean Currents:

- Normally, warm currents flow from the equator polewards while cold ocean currents flow from the poles towards the equator. An increase in temperatures due to global warming especially in regions around the poles can change the direction of flow of ocean currents. The movement of warm and cold currents is vice versa

viii. Shrinking of the Antarctic Ice Cap.

- Global warming increases temperature of Antarctic belt, thereby melting part of this ice cap. This results into shrinking of the Antarctic ice cap. This has also led to flooding

ix. Increased flooding due to rising of sea levels:

- Melting of mountain ice, increased rainfall and expansion of sea water from increased warming cause sea levels to rise. Rising sea levels could put some small, low-lying island states and coastal communities at a greater risk of flooding

Special effects of climate change in Malawi

- Malawi has experienced adverse climatic hazards over the last decades. The most serious ones are dry spells, seasonal droughts, intense rainfall, riverine floods and flash floods. Refer to the formation in the table below

Type of hazard	1940-49	1950-59	1960-69	1970-79	1980-89	1990-99	200-2009
Cyclones	1	4	-	-	-	1	1
Droughts	1	-	-	-	1	2	1
Floods	-	-	-	5	29	44	61
Hailstorms	-	-	-	-	1	1	-
Landslides	1	-	-	-	1	2	-
Avalanches	1	-	-	-	1	-	-
Strong winds	-	-	-	1	2	8	6
Total	4	4	-	6	35	58	69

Source: Njerwa, E.D (2011). Handbook on Climate change, Origins, Current Science and Negotiations, City Printing and Publishing Company Ltd. Adapted from Complete Geography by H.K. Gareta

Explanation of effects of climate change in Malawi

1. Malnutrition

- Climate change is always linked to agricultural production. This is because changes in the amounts of rainfall and temperature affect crop production and animal husbandry. Drought often lead to poor crop yield which lead to malnutrition

2. Occurrence of diarrhoea and cholera

- Due to excessive rainfall brought about by climate change, flooding occurs, which eventually increases the prevalence of such diseases

3. Occurrence of Malaria

- Large amounts of rainfall experienced will create waterlogged conditions or flooding pools which will create favourable conditions for mosquitoes to breed. In addition, hot weather may encourage people to sleep outdoors or discourage them from using mosquito nets

4. Frequent disruption of production of hydro-electric power

- Droughts and floods leads to the fluctuation of water in the Shire River that consequently affects the production of power
- Flooding has led to siltation in the Shire River, resulting into inability of turbines to rotate at Nkula and B as well as Tedzani power stations

5. Loss of biodiversity

- Droughts are responsible for drying up of water masses which leads to the loss of animal species especially fish
- Droughts have been responsible of drying up of lakes in Malawi such as Lake Chirwa in 1995 where a lot of fish died

6. Loss of forests through fires

- Droughts lead to land degradation and loss of soil fertility. The intense heat leads to natural fires in forests. For example, during the drought of 1995, some 5550 hectares (30%) of Chongoni Forest was destroyed by forest fires caused by human activities. This also resulted into the loss of biodiversity and seedlings and caused a lot of pollution

Climate change mitigation and adaptation practices in Malawi

- The differences between climate change mitigation and climate change adaptation
 1. **Climate change mitigation** refers to measures that are taken to reduce the harmful human activities that are causing climate change
 2. **Climate change adaptation** refers to the efforts to reduce the impact of climate change on vulnerable communities and their livelihoods through various measures, while not necessarily dealing with the underlying cause of those impacts
 - It involves reacting to changes that have already happened or anticipate changes that might happen and prepare for them

A. Mitigation measures to climate change

- a. Afforestation to remove the greater amount of carbon dioxide from the atmosphere and reduce flooding and droughts
- b. Providing alternatives to fossil fuels e.g. solar and wind power
- c. Proper disposal of waste products
- d. Recycling and reusing of some products
- e. National and international (funding) of actions in the environmental protection domain
- f. Establishing strict laws and heavy penalties for non-environment friendly actions by companies and industries through international agreements
- g. Encouraging local food production through local agriculture, community gardening, etc. to decrease the distance food must be transported. This would help reduce emissions
- h. Inclusion of climate change issues in school curriculum
- i. Promotion of more fuel efficient vehicles, hybrid vehicles, cleaner diesel vehicles, biofuels, increase the use of non-motorised transport e.g. cycling and walking
- j. Educating, creating awareness and communicating with rural and urban dwellers on the importance of conserving the environment. This may be achieved through the media, school quiz completion, poetry, music and drama

B. Adaptation measures to climate

- a. Enhanced financial and technical support to the agricultural communities so that indigenous and more drought tolerant food crops like cassava, millet, sorghum, sweet potato can be re-introduced into the farming systems.
- b. Promoting irrigated agriculture by developing irrigation schemes along river basins. Also reconfiguring irrigated production systems to use water more efficiently and to accommodate the of marginal quality water
- c. Creating functional linkages with development partners for technology enterprise initiatives
- d. Diversifying rural economies through integrating activities like livestock keeping, fish production and crop growing
- e. Switching to new crops, seeds or agricultural practices can moderate the impacts on agriculture of changes in temperature and water availability
- f. Improving weather and flood forecasting and communications can assist evacuation, relief and rehabilitation

UNIT 29: WORLD FISHING

- i. **FISHING:** fishing involves the catching of fish and other aquatic or marine animals.
- ii. **Fishing piracy:** it refers to the illegal fishing of endangered species. Fish are abundant where food supplies are most plentiful. They feed on very small marine organisms,

collectively called **plankton**

- iii. **Technology:** deep sea fishing requires to be highly mechanised with modern refrigerated sea water vessels.

Factors that influence development of the Fishing Industry

A. Human factors

- I. **Presence of a large population:** provides labour to carry out fishing and a market for the fish
- II. **Skilled personnel:** is required in the development of fishing equipment like ships, boats and fishing nets
- III. **Technology:** commercial fishing requires long distance movement to and from natural habitats for fish and therefore advanced and sophisticated fishing equipment is needed.

Examples of advanced and sophisticated fishing equipments are

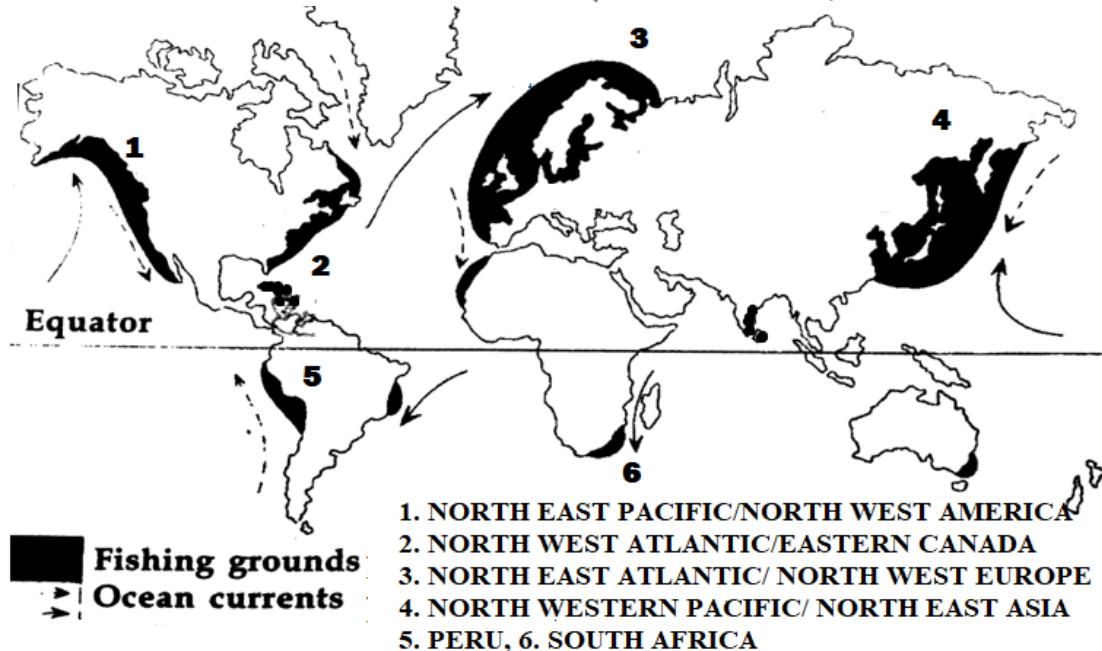
- i. Ships or boats equipped with radar, eco-sounders to locate the fish in case of deep fishing
- ii. Also requires refrigeration as well as processing plant and canning facilities on board in case of off-shore fishing

B. Physical factors

- I. Meeting of warm and cold ocean currents which encourage precipitation of minerals such as nitrates hence the growth of planktons
- II. Indented coastal lines for natural harbours
- III. Presence of continental shelves or shallow waters that allow penetration of sunlight to stimulate growth of abundant planktons
- IV. Availability of planktons (green, microscopic plants) on which fish feed
- V. Existence of cool climate. Fish are cold-blooded animals and they survive in temperatures lower than 20°C. This climate also helps in the growth of planktons
- VI. Scarcity of cultivated land in the coastal lands which may force the people to resort to fishing in order to survive

C. Economic factors

- I. Market availability: Areas which are highly populated offer a wide market for the fish caught
- II. Transport facilities: Since fish is highly perishable, it requires readily available and fast means of transport
- III. Capital: Fishing is a capital-intensive activity requiring large sums of money, since fishing equipment has to be bought



MAP SHOWING LOCATION OF MAJOR FISHING GROUNDS OF THE WORLD

- Major fishing grounds are confined in the Northern Hemisphere because:
 1. It is land hemisphere with large population.
 2. Great length of indented coastlines for harbours.
- Why there are no major fishing grounds along or near the equator
 1. Because the water is much warmer in the area and fish do not breed fast enough in such waters. Fish do well in cool waters outside the tropic
- Main fishing grounds are as follows
- 1. NORTH EAST ATLANTIC or NORTH WEST EUROPE
 - The meeting of North Atlantic drift warm current and Irminger or Eastern Greenland cold current makes fishing industry a possibility all year round
 - This is the coastal waters of North-Western Europe. The area has many rivers draining into the sea, depositing large quantities of nutrients, hence, making the area rich in planktons and fish
 - The North East Atlantic is the greatest fish exporting region of the world
 - Fishing grounds in this area include Barents Sea, Iceland, North Sea and Bay of Biscay. The fishing countries include France, Denmark, Spain, Portugal, Great Britain and Norway. Norway is the leading fishing nation in this region

Why Norway the leading fishing nation in this fishing ground?

- a. Harsh climate makes farming difficult and hence people focus on the sea for their livelihood
- b. Absence of extensive minerals and forest resources has forced Norway to turn to the sea

Reasons for large scale fishing

- a. Ideal cool climate
- b. Presence of ports and fish breeding places
- c. Large markets for fish because the fishing ground is close to densely populated areas of the world
- d. Improved technology enabling mechanisation to take place
- e. Good and wide continental shelves
- f. The mixing of the North Atlantic Drift warm current with cold waters of the arctic ocean

over shallow waters above continental shelves

Examples of fish caught include

- Mackerel, cod, herring, haddock, plaice, halibut, sole, hake and skate.

2. NORTH-WESTERN ATLANTIC/EASTERN CANADA

- This is the coastal waters of Eastern Canada where the North Atlantic Drift and cold Labrador Currents meet, causing rapid growth of plankton and plenty of fish
- Fishing is centred on the sand banks off the coast of Newfoundland, off the coast of Canada in South America. This area has a problem of overfishing

REASONS FOR LARGE SCALE FISHING

- i. It has indented coast with good natural harbours
- ii. Presence of harsh climate and infertile soils has forced people to look for alternative source of income
- iii. The meeting of North Atlantic Drift warm current and Labrador cold ocean current facilitates precipitation of minerals which creates good conditions for plankton growth
- iv. Presence of shallow waters which catalyses the process of photosynthesis in planktons
- v. Availability of capital
- vi. Availability of advanced technology
- vii. Nearness to markets which are found close to densely populated areas of the North Eastern part of the United States of America
- viii. Cool temperate climate
- ix. Availability of temperate forests which provide timber for the manufacture of sailing boats and fishing crafts, as well as parks for floating nets

EXAMPLES OF FISH CAUGHT

- Cod, Haddock, Sardines, Halibut, Hake, Flounder, Mackerel
- Fishing in this area is very important because it provides employment to many people more especially Newfoundland. Fish from this area are exported to South Africa, Southern Europe, North Africa, USA and Canada.

3. NORTH-EAST PACIFIC or NORTH WEST AMERICA

- This fishing grounds extend from California to Alaska

Reasons for large scale fishing

- a. Advanced technology enabling modern methods of commercialisation
- b. Indented coastline with safe sheltered harbours
- c. Unfavourable climate and presence of steep slopes prevents people from carrying out other agricultural activities. This has forced people to divert to the ocean for their livelihood
- d. Presence of mountain rivers such as Fraser and Skeena where fish like Salmon can easily multiply
- e. Upwelling of ocean waters along the coastline encourages plankton growth

EXAMPLES OF FISH CAUGHT

- Halibut, Cod, Herring, Salmon
- Salmon fishing is the most important type of fishing activity that takes place from Bering Strait to Oregon.

DESCRIPTION OF SALMON FISH

- Young Salmon fish hatch from eggs laid in mountain stream and lakes.
- At one-year-old the Salmon fish swim downstream to the sea.
- At about four years old they return to the rivers to lay their eggs (this is when they are

caught)

- Salmon fish are caught by trawls and seine nets in coastal waters
- Dams across rivers prevent Salmon from swimming up rivers unless special ladders are built to bypass the dams.

4. NORTH WESTERN PACIFIC OR NORTH EAST ASIA

- This fishing ground includes **Japan** (major fishing ground) which extends from Bering Sea to the East of China

Reasons for large scale fishing

- a. High demand for fish and its products both locally and internationally due to high population
- b. Good transport
- c. Advanced technology
- d. Presence of indented coastlines, for example, Japan provides sheltered fishing ports, calm waters, and safe land places which are ideal for fishing industry. Hakodat and Kushiro are large fishing ports
- e. The absence of lowlands and pastures which mean that only few animals can be kept to supply meat and other sources of protein. Therefore, there is increased demand for food
- f. The continental shelves are rich in planktons because of the meeting of Kurosiwo Warm current and Kamchatka cold current
- g. Industrialisation has enabled fishing to be scientific thus more efficient

EXAMPLES OF FISH CAUGHT

- The type of fish that thrive in cold waters include
- Cod, Halibut, Herring, Salmon
- The type of fish that thrive in warm waters include
- Sardine, Tuna, Mackerel

WHY JAPAN DIVERTED HER FOCUS TO THE SEA FOR FISHING

- i. It is not well developed with natural resources i.e. about 80% of her land is not used for agriculture.
- ii. Presence of planktons on the continental shelves around the islands of Japan because of Kurosiwo warm current and Oyashio cold current.
- iii. The fishing ports are present on the coastline of Japan, calm waters and safe land places e.g. Hakodat and Kushiro
- iv. Absence of lowlands and pastures which mean that only a few animals can be kept to supply meat and other protein foods.
- v. Industrialisation has made fishing to become scientific

5. PERU

- The fishing ground extends from Southern Chile to Northern Peru. The main fishing nations are Chile and Peru

REASONS FOR BEING ONE OF THE MAJOR FISHING GROUNDS

- i. It has plenty of planktons due to upwelling of cold water and the narrow continental shelf
 - ii. Harsh climate such as the Atacama Desert and Andes mountains which do not encourage other economic activities
 - iii. An indented coastline with good natural harbours
- Anchovy is the most common fish caught in large quantities and Chimbote is the main fishing port

Examples of fish caught

- Bonito, Herring, Sea bass, Tuna
- Most of the fish caught are used for making fertilisers and fish meals

6. South Africa

- In this region, fishing is important over the Agulhas Bank. Important fish caught include cape hake, South African Pilchad, Cape anchovy.
- The major fishing ports include: Port Elizabeth, Port Nolloth, Durban, Saldana Bay

REASONS FOR FISHING

- i. Presence of shallow waters that enable sunlight to penetrate to catalyze photosynthesis process in planktons
- ii. Availability of planktons for fish growth.

Other fishing grounds include the coasts of Brazil, Morocco, India and some inland water bodies

TYPES OF FISHING

- a. **Inshore fishing:** this is carried out along the coastal waters, stretching to only 70 km kilometres from the shore. small fishing vessels are used, and these usually stay at sea for only one or two days
- b. **Offshore fishing:** this is done beyond the 70 km limit into the sea, and involves much larger fishing vessels that are well refrigerated. Since they are equipped with refrigerated holds, the vessels may remain at sea for several weeks at a time without the fish going bad

MAIN TYPES OF FISH CAUGHT

- The following are the types of fish caught
- a. **Pelagic Fish**
 - These are fish that live, breed and feed near the surface of the water. Examples of fish include Herring, Mackerel, tuna, and pilchard, Sardines, Anchovies and Menhaden.
- b. **Demersal Fish**
 - These are fish that live, breed and feed on the sea bed on the continental shelf. Examples of demersal fish are: Sole, Cod, Haddock, Halibut, and galloup, Plaice, Hake and Skate.
- c. **Anadromous Fish**
 - These are the fish that spend part of their life in fresh water rivers and lakes while young and saltwater of the sea when they are old. They go back to the fresh water for spawning.

FISHING METHODS

- The method of fishing is determined by whether the fish are pelagic or demersal, whether fishing is for commercial or subsistence. The following are the different fishing methods
1. **Drift Netting**
 - This is put vertically in the sea and it is fitted with floats on the upper edge and weights below.
 - Fish are trapped by their gills in the meshes when they try to swim across it. This is because their bodies are too big to pass through, and the mesh gets into their gills when they try to move backwards
 - This method is **efficient in catching pelagic fish** e.g. herring. It is drifted by an engine boat called drifter.
 2. **SEINE NETS:**
 - There are two types of these:
 - a. **Purse Seine Net**

- This is similar to drift nets but instead of hanging in the water, the nets are pulled by their ends to surround a school (group) of fish. The net is sometimes stretched between two boats. This is **used for catching pelagic fish**.

b. Haul Seine Netting

- They have an oval mouth with a conical shape. The net is stretched between fishing boats. Sometimes they can be pulled by fishermen with one end being attached to and pulled by a small boat or from the shore. It is **used for catching demersal fish**

3. Trawl nets

- This type of net has a conical shape which is open at the base. The mouth is kept wide open by a system of floats on top part and weights at the bottom. The fish is caught by dragging the net along the sea bed by trawlers.

- They are **used to catch demersal fish**

4. Line Method

- Line fishing uses a line from which several baited hooks hang
- There are several types of line fishing and they include

a. Drop lining

- This is a fishing line set vertically down into the water with a series of baited hooks

b. Trolling

- This is a fishing line with one or more baited lines which are drawn through the water. this may be done by pulling the line behind a slow moving boat

c. Long lining

- This is a commercial technique that uses a long fishing line with a series of baited hooks (hundreds or even thousands) hanging from the main line. The long lines are operated from special boats called **long liners**

Importance of Fishing Industry

- It is source of raw materials for production of fertilisers, fish meals, soap, cosmetics, glue and oil
- Provides much needed proteins and minerals such as iron, calcium, iodine, copper, phosphorus and magnesium
- It attracts tourists who normally study or do research on various species of fish
- It is a source of employment. The fishing industry provides a wide range of employment opportunities in fishing, net making, boat building, fish processing, canning, transport and marketing around the world
- Source of income to fisher men
- Source of foreign exchange through export of fish items

Why is fishing also known as robber industry?

- This is because the catching of fish is not balanced by replacing the stock. This happens due to rapid population growth

Other resources from the sea apart from fish

- Apart from fish, there are several resources that can be obtained from the sea; they include the following: whales, seals, shellfish, minerals (petroleum, common salt, magnesium, potassium bromide, etc.), sea weed, fresh water, etc.

Social and economic importance of other resources obtained from the sea

- Natural gas:** used as fuel for domestic and industrial purposes
- Prawns and shells:** these provide food for people
- Sea weed:** used as raw materials for ice cream, malted milk, salad dressing, mayonnaise,

jellies etc.

4. **Crude oil:** it can be separated and purified to produce such products as kerosene, gasoline, bitumen or asphalt, petroleum gases, lubricants etc.
5. **Sand and gravel:** materials used in construction industries
6. **Fresh water:** salt water can be distilled to produce fresh water supplies. Fresh water can be used for domestic and industrial purposes as well as irrigation
7. **Minerals:** such as sodium chloride for flavouring food, magnesium used in medicine, bromine used in photography, sulphur used as sterilising agent in medicine and also used in matches manufacturing.
8. **Salts:** e.g. ammonium sulphate used in the manufacture of fertiliser, sodium carbonate used in glass making, magnesium sulphate used in medicines as a laxative etc.

Challenges faced by the fishing industry

1. Over fishing

- It is the catching of more fish and other marine animals at a faster rate than they can be replaced by natural means (production). This is as a result of population growth
- Over fishing is a global problem with serious implications, such as the following
 - i. The balance of food chain is disturbed (through changing the relative abundance of predators and prey) as certain species are removed. As a result, many other ocean species like sea birds, and sea mammals are vulnerable to the lack of food
 - ii. The economic welfare millions of people dependent on marine products is put at risk
 - iii. Income generated through tourism is lost if fisheries are depleted and marine biodiversity is lost
 - iv. Evolutionary effects and changes in fish behaviours, for example migration patterns, due to loss of learning from older fish, which have basically been removed from the population.

2. Water pollution

- Industrial wastes discharged into water bodies contain poisonous chemicals that are potentially dangerous to all aquatic life. Oil spills may cause oil slicks on the surface of water, depriving the fish of oxygen. This can kill fish and underwater plant life

3. Climate change

- Rising global temperatures have seriously disrupted the pattern of ocean currents and upwelling of nutrient-rich waters
- In some regions, climate change has dried up fresh water sources due to decreased rainfall

4. Deforestation

- Loss of forest cover has led to an increase in erosion and subsequent siltation of water bodies and degradation of fishing grounds

5. Indiscriminate fishing

- This is the catching of immature fish when fishermen use nets whose mesh size is very small. The population of mature fish will consequently be reduced when fishermen catch the fingerlings or young fish. This will negatively affect the supply of fish which will not be adequate to meet the demand.

6. Lack of knowledge

- Some people lack knowledge of how to manage and conserve fish. this ignorance contributes to death of most marine species that in turn adversely affects fishing

7. Destruction of fishing grounds

- Most fishing grounds are used for various activities which include sporting and recreation. When the activities are taking place, habitat for aquatic or marine animals is destroyed

Possible solutions to the challenges faced by the fishing industry

- Monitoring and controlling fishing effort and destructive fishing practices. This can be achieved through
 - Laying down strict rules about mesh size of the nets so that small immature fish is not caught and imposing tough measures on those that catch small fish by fining them
 - Limiting the fishing season or restricting fishing for specific species only during certain times of the year to allow the fish to spawn and multiply
 - Using quota system to limit the quantity of fish caught per season
- Enacting and enforcing laws against water pollution
- Removal of all poisonous and harmful chemicals from industrial wastes before it is discharged into rivers and seas
- Restocking of overfished waters by transferring small fish from areas well populated with fish or by introducing new species. For example, in Malawi Chambo fish has been overfished and needs restocking
- Promoting fish farming
- Promoting sustainable utilisation of fisheries resources, such as setting aside certain areas as protected areas as protected spots or areas in which fishing is prohibited
- Promoting research in world fisheries to help understand various fish species, their feeding habitat, life expectancy and migratory behaviour.
- Promoting regional and international cooperation and collaboration in fisheries development, management, security and access to shared resources
- Promoting social responsibility and good governance in the fisheries sector

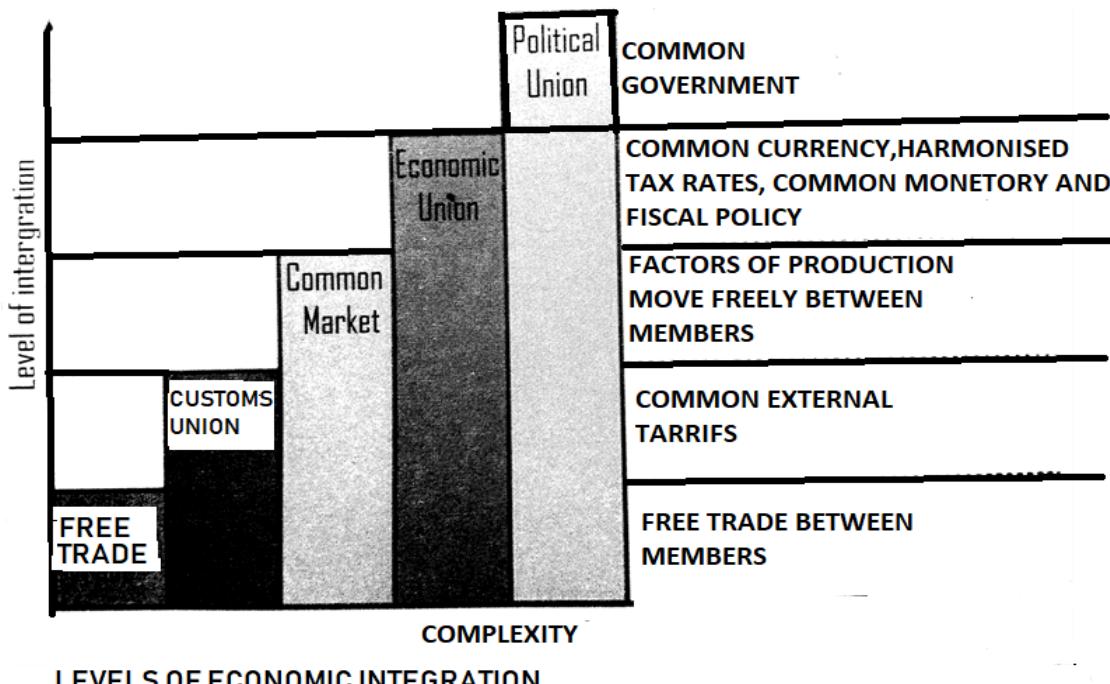
Proposed measures to ensure that solutions are successfully implemented

- Developing policy guidelines that will help people to know how such solutions should be implemented
- Regulations should be laid down that describe the size of mesh to be used by fisherpersons in fishing grounds. In Malawi, the Fisheries Act emphasises the mesh size to be used
- Putting in place small committees in fishing areas to check the people who practise indiscriminate fishing. In Malawi, Village Beach Committees have been set up by Malawi Government to allow fish to spawn and build stocks
- Civic education in terms of fish farming in terms of how it should be done will enable it to be successful. This awareness campaign can also be done in the area of management and conservation
- Fisheries' authorities should periodically check wastes to be disposed by industries. This can help in verifying that there are no poisonous and harmful chemicals from industrial waste before it is discharged into rivers and seas

UNIT 30: REGIONAL AND INTERNATIONAL TRADE BLOCS

Definition of terms

1. A **bloc** is a group of nations or persons united for common action
2. A **trade bloc** refers to an agreement between states or countries, to group together for the purpose of increasing trade among themselves and to gain some economic benefits from the cooperation at some level
3. **Regional trade** refers to reciprocal exchange of capital, goods and services between two or more trade partners within a certain region or territory
4. **International trade** refers to exchange of capital, goods and services across international borders or territories
 - Trade blocs are in different levels depending on the stages of economic integration. From simple to complex, the trade blocs include the following: free trade area, customs union, common market, economic union and political union



LEVELS OF ECONOMIC INTEGRATION

a. Free trade area

- This is the first level of formal economic integration.
- On this level, a group of countries agree to eliminate tariffs, quotas and preferences on most goods and services that flow between them
- They create a **free trade area**, e.g. Southern African Development Community (SADC) and Caribbean Free Trade Area (CARIFTA). Each member may impose its own tariffs on goods from the non-member countries

b. Customs union

- A custom union builds on free trade area by setting up common tariffs on goods of the non-member countries, while conducting free trade among them
- Examples include East African Community (EAC), Southern African Customs Union, Customs Union of Belarus, Kazakhstan, and Russia

c. Common market

- In addition to containing the provisions of a customs union, a common market requires that factors of production, such as labour and capital, are free to move within member

countries, expanding scale economies and comparative advantages

- Thus, a worker in a member country is able to move and work in another member country. Examples include Common Market for Eastern and Southern Africa (COMESA) and Central American Common Market (CACM)

d. Economic union

- An economic union adds to a common market the need to harmonise a number of key policy areas, including the use of a common currency.
- The participant countries have both common policies on product regulation, freedom of movement of goods, services and factors of production (capital and labour) and a common external trade policy
- Examples include European Union (EU) and the Union State of Russia and Belarus

e. Political union

- A political union is when a group of nations or states share a joint government that is internationally acknowledged. It is the most consolidated form of economic integration, United States is an example of even closer political union

Examples of regional and international trade blocs

Trade Bloc	Current members
Southern Africa Development Community (SADC)	Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe
Common Market for East and Southern Africa (COMESA)	Burundi, Comoros, Djibouti, Republic of the Congo, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, South Sudan, Sudan, Swaziland, Uganda, Zambia and Zimbabwe
Economic Community for West African States (ECOWAS)	Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo
North American Free Trade Association (NAFTA)	Canada, Mexico and USA
European Union (EU)	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and UK has just pulled out in 2016
Association of South East Asian Nations (ASEAN)	Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar (Burma), Philippines, Singapore, Thailand, Vietnam
Organisation of Petroleum Exporting Countries (OPEC)	Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela
Southern Common Market	Argentina, Brazil, Paraguay, Uruguay and Venezuela

- Almost all the blocs mentioned above are regional blocs. The very good example of a world trade bloc is World Trade Organisation (WTO)

The aims of regional and international trade blocs

- To promote trade within the bloc and defend its members against global competition
- To remove trade restrictions among member states
- To improve social, political, economic and cultural relations among member states
- To encourage free transfer of resources such as labour, capital, goods and services among member countries
- To establish collective bargaining
- To enhance economic growth through promotion of cross-border investment, promotion of research and adaption of science and technology in development
- To raise the living standards of its people

A. SADC (Southern Africa Development Community)

- It was first created as SADCC (Southern African Development Coordination Conference) in 1980 and changed to SADC on 17th August 1992 in Windhoek, Namibia. The SADC treaty was also amended on 14 August 2001. Headquarters is in Gaborone in Botswana.
- In 2008, SADC established a free trade zone with East African Community (EAC), the Common Market for Eastern and Southern Africa (COMESA). It was during this time that Malawi, Zambia, Tanzania and Mozambique became members of SADC Free Trade Area

Aims of SADC

- To achieve development and economic growth
- To reduce poverty
- To promote peace and security
- To coordinate foreign policy
- To improve the standard and quality of life of the people of southern Africa
- To establish a common market and common regulations
- To promote self-sustaining projects which will still enhance self-reliance

B. COMESA (Common Market for East and Southern Africa)

- It was established in December 1994 to replace the Preferential Trade Area (PTA).
- Its headquarters are in Lusaka, Zambia.

Aims of COMESA

- To achieve free trade area by removing internal tariffs and barriers
- To promote trade through trade liberalisation, improvement of transport and communication
- Promote peace and security in the region
- Promote joint development in all economic fields
- To raise the living standards of people living in member states
- To create a conducive environment for both domestic and foreign investment

C. WORLD TRADE ORGANISATION (WTO)

- World Trade Organisation (WTO) was established on 1st January 1995 and the current set of governing rules stem from the Uruguay Round negotiations
- Its headquarters are in Geneva, Switzerland. This is the only global international organisation dealing with rules of trade between nations

Member countries

- The World Trade Organisation currently has 164 member states

Aims of WTO

- a. To reduce tariffs so as to facilitate global trade on goods
- b. To ensure that global trade is carried out smoothly, free and predictably
- c. To create and embody the ground rules for global trade among member nations, so as to offer a system that facilitates international trade

Roles/functions of WTO

- a. It oversees the implementation, administration and operation of the covered agreements
- b. It provides a forum for negotiations and settling trade disputes
- c. It provides technical assistance and training for developing countries
- d. It facilitates forums for trade negotiations
- e. It promotes cooperation with other international organisation
- f. It helps to improve the welfare of the people living in member states
- g. It helps to create a conducive environment so that the producers of goods and services, exporters and importers can conduct their business

Should Malawi belong to SADC as well as COMESA? Yes. Why?

- Joining SADC and COMESA may give Malawi several advantages. These may include the following
 - a. Increased volumes of trade as there will be ease of movement within the trading blocs as a result of abolition of trade restrictions
 - b. It will give Malawi a greater economic strength especially when trading blocs bargain in world markets
 - c. It will expand markets for its goods through elimination of trading restriction
 - d. Industrial and agricultural specialisation within SADC and COMESA would benefit Malawi with cheaper and more efficient production of goods

THE BENEFITS AND CHALLENGES OF TRADE AGREEMENTS

A. Benefits

a. Competition

- Trade blocs bring manufacturers in numerous countries closer together, resulting in greater competition.
- Accordingly, increased competition promotes greater efficiency within firms

b. Economic development

- Trade agreements enable larger countries to take advantage of increased market size, and have their economies grow. This growth overflows into smaller countries that are economically unstable or mired in poverty but are open to trade

c. International cooperation

- Since international trade relies on traders keeping their agreements, countries and companies are more accountable to each other and therefore more peaceful and stable

d. Resource allocation

- Trade agreements improve the allocation of global resources. If countries or people can trade for the items they need, they can focus on making the ones they do best to export to other countries. This encourages increased productivity

e. Business incentives

- Trade agreements open markets and offer business incentives and protections. They include commitments to protect intellectual property rights and labour rights and open regions to competition

f. Trade effects

- Trade blocs eliminate trade barriers like tariffs which in turn increases opportunities for trade

B. Challenges

a. Political instability

- Serious wars and conflicts have resulted in insufficient diversification of national economies in many African countries.
- This posed a great challenge for trade blocs in the process of regionally integrating some African countries
- Civil wars taking place in some countries cause insecurity which affect trade negatively

b. Disparity in economic size of member states

- Other countries within the bloc have larger economies than others, as a result, member countries with poor quality products find it difficult to compete effectively with those that have a wider and better economic base
- It also makes it difficult to harmonise common external tariff

c. Regionalism versus multi-nationalism

- Trading blocs bear an inherent bias in favour of their countries. Rather than pursuing a global trading regime within the World Trade Organisation, which includes the majority of the world's countries, regional bloc countries contribute to regionalism rather than global integration

d. Loss of sovereignty

- A trading bloc, particularly when it is coupled with a political union, is likely to lead to at least partial loss of sovereignty for its participants.
- For example, the European union, started as a trading bloc in 1957 by the Treaty of Rome, has transformed itself into a far reaching political organisation that deals not only with trade matters, but also with human rights, consumer protection, greenhouse gas emissions and other issues that are only marginally related to trade

e. Excessive harassment to women

- Women traders have complained of excessive harassment especially at ports of entry to the member countries

f. Decline of local industries

- Free trade negatively affects local industries as imported goods which are not good are sold at cheaper price than locally produced goods

g. Visa restrictions

- International Cross Border Traders (ICBTs) often complain about visa restrictions, which stifle their business. E.g. Botswana and South Africa restricts visits to a maximum of 90 days only

THE ROLE OF CUSTOMS IN INTERNATIONAL TRADE

Terminologies

1. **Tariff** refer to a duty levied by a government on imported and exported goods
2. **Customs duty** refers to the duties levied by government on imported goods.
3. **Exercise duty** is charged on goods produced within the country
 - Customs duty is based generally on the value of goods, weight and other criteria of the item such as the size of the engine and year of made (in case of automobiles)

The main advantages of customs on international trade include:

- a. Helps in revenue generation and thus promoting the development of the country
- b. Protecting domestic industries from more efficient or predatory competitors from abroad
- c. Countries may also set tariffs as a retaliation technique if they think that a trading partner has not played by the rules or has gone against the foreign policy objectives of the government
- d. Helps in protecting consumers. This is when the government feels that a certain product could endanger its population, and tariff may be levied. For example, Malawi may place a tariff on imported Frozy drink if it thinks that the Frozy from Mozambique contains too much acids which is bad for people's health
- e. Customs help in balancing economic international relations. It facilitates international trade and competitiveness of nations

Disadvantages of customs

- a. **Poor quality products:** if an industry develops without competition, it could end up producing lower quality goods, and the subsidies required to keep the state-backed industry active could lower economic growth
- b. **Reduced trade:** trade restrictions limit world trade. As a result, global resources are less efficiently allocated and the level of world production and income is reduced, causing widespread unemployment
- c. **Trade war:** increasing prices of imported products encourages retaliation, which may result in trade war
- d. **Cheating:** The buyers' habits of cheating the real value or quantity of goods
- e. **Cumbersome customs and administrative procedures:** this has been found to be a challenge for developing countries when exporting to developed and other developing countries
- f. **lengthy delays and cost escalation in customs clearance:** This comes because of the following reasons
 - i. Excessive documentation, physical inspection, and sometimes multiple inspections in the presence of more than one agency
 - ii. Excessive control and inefficiencies in custom procedures at key entry points in importing countries,

Elements of international trade

Balance of payment

- This is a record of all monetary transactions between a country and the rest of the world for a specific period, usually a year
- Funds for a nation obtained from exports, tourism, loans and investments by foreigners are recorded as **positive** or **surplus** items, while uses of such funds by nation for imports or investment in foreign countries are recorded as **negative** or **deficit** items.
- When positive and negative items balance there can be no overall surplus or deficit; hence balance of payment
- In economic terms, a positive or surplus balance of payments means a nation has more funds from trade and investments coming in that it pays out to other countries, resulting in the appreciation in the value of its national currency against currencies of other nations

Balance of trade

- It is the difference between the values of a country' exports and imports over a certain period of time, normally a year.

- When the value of a country's exports exceeds its imports, it has a favourable balance of trade (trade surplus). However, when the value of imports exceeds the exports, the country registers a **trade deficit**

Causes of trade deficits

- Population growth.** As population increases, imports become essential and the quantity of imports may increase to meet the needs of the people. This may result in a trade deficit
- Development programmes.** In developing countries, development programmes require import of capital goods, technology, some raw materials, which are not available at home. If imports of these items continues for a long time, countries may land in a balance of trade deficit
- Demonstration effect.** When people like to flaunt imported goods, and imitate the consumption pattern of the developed countries, their import will increase. This may cause disequilibrium in the balance of trade
- Natural disasters:** natural calamities such as droughts and floods may adversely affect agriculture and industrial production in a country. The exports may therefore decline while the imports may go up causing a discrepancy in the country/s balance of payments
- Dependence on primary products.** Developing countries export low value primary products like minerals and crops to developed countries while the developed countries refine the primary goods into high value usable products, which they export at very high prices to poor countries. This causes trade deficit
- Political instability.** Conflicts in a country cause low production
- Imports of non-essential goods**

Implication of a trade deficit

- The long term trade deficit in a country may result in unstable economy where the following problems are serious
 - Foreign debts:** when a country buys more goods and services than it sells, it must finance the difference by borrowing money from other countries
 - Shortage of foreign currency:** trade deficits are paid for out of foreign exchange reserves, and may continue until such reserves are depleted
 - Dependence on foreign aid:** poor countries resort to foreign aid to finance their national budget. This forces such countries to adopt undesirable policies dictated by the donor countries as terms and conditions for their financial aid
 - Unemployment:** increased imports deprive the domestic industries of markets; as a result, they lower their production which in turn leads to widespread unemployment

The difference between balance of payment and balance of trade

- Balance of trade is only a part of the balance payments. Deficit balance of trade does not necessarily mean that the balance of payment is also deficit. Conversely, surplus balance of trade also does not mean that balance of payment is surplus, because trade balance may be covered by other surplus investments

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