THE CLIMATE OF EAST AFRICA

East Africa lies within the tropical latitudes but due to a combination of factors the region experiences a variety of climatic types. The different parts experience different types of climate which include:

1. **Equatorial climate**

This type of climate is experienced in the region between 5°N and 5°S of the equator. For instance in places such as the Congo basin. In East Africa the equatorial climate is experienced around the L.Victoria basin and typical equatorial climate is experiences within the L.Victoria and specifically the Islands within L.Victoria. Typical equatorial climate is characterised by;

a) Heavy rainfall of about 2000mm evenly distributed throughout the year.
b) Temperatures are high with an average of 27°C
c) High humidity of about 80% or more. This is because of evaporation and heavy rainfall is received.
d) Double maxima of rain i.e. there are two rainfall peaks received. The rainfall regime is characterized by a bimodal pattern. There is hardly any dry spell (dry season).
e) The type of rainfall received is mainly convectional rainfall commonly accompanied by lightning and thunderstorms.
f) There is thick or dense cloud cover because of the humid conditions that result into rising air whose moisture condenses at higher levels to form clouds.
g) It is characterised by low atmospheric pressure and this is mainly because of the high temperatures experienced.

In East Africa due to factors such as altitude, the equatorial climate has tended to be modified. The equatorial climate experienced in much of East Africa is not typical that of the rest in other tropical regions. That is why most of the areas fringing Lake Victoria are said to experience a modified equatorial type of climate rather than a typical equatorial type of climate. This is because the characteristics do not reflect typical equatorial type of climate e.g. heavy rainfall of about 1500mm is experienced. Temperatures average 23°C.
In addition, humidity is less than 80% and there is some distinct or short dry spell experienced especially in January and June.

2. Moist Tropical Climate/Modified Equatorial climate

This is experienced in much of Central and Western Uganda and parts of Northern Uganda. This type of climate may not differ much from the equatorial type of climate however rainfall received is less and seasons tend to be distinct. It is characterized by the following;

a) High rainfall fairly distributed throughout the year. Annual rainfall ranges from 1000-1500mm.
b) Moderate temperatures of between 25°C and 27°C.
c) There are seasons of rainfall and aridity experienced i.e. there are dry and wet seasons. However in some parts, the rainfall seasons tend to merge to form one long rainfall season and one long dry season. This is common with regions further from the equator. Therefore some areas experience double maxima of rain while others experience a single maximum of rain.
d) Rainfall varies with the position of the area e.g. in the Northern hemisphere, most tropical regions receive rainfall in the second half of the year while in the Southern it is received in the first half of the year. This is because of the influence of the ITCZ.
e) Relative humidity is moderate i.e. from 50 – 60%.
f) The temperature range is moderate i.e about 5 -10°C.

DRY TROPICAL CLIMATE

This type of climate is experienced in several parts of East Africa mainly adjacent to the semi arid region e.g. the Western parts of Karamoja, the Southern Nyika plateau, parts of Western Tanzania etc.
This type of climate is characterised by the following;

(i) Rainfall received ranges between 760mm – 1000mm.
(ii) Rainfall is seasonal though the dry seasons tend to be long.
(iii) There are high temperatures experienced, average temperatures tend to be above 30°C
(iv) The temperatures ranges are high approximately 10 -15°C.
(v) There is limited cloud cover.
(vi) There is low atmospheric humidity i.e. less than 40%.

SEMI ARID AND ARID CLIMATE /SEMI DESERT & DESERT CLIMATE

This type of climate is experienced in Northern Kenya e.g. the Chalbi desert, North Eastern Uganda i.e. Karamoja, semi desert in Southern Kenya i.e. Nyiri desert, North Eastern parts of Tanzania e.g. Masai steppe semi desert. In central Tanzania, in the Eastern parts of Ankole i.e. the Ankole – Masaka corridor.
In addition Semi desert climate is also experienced in the Western Rift valley region around Lake George and Lake Edward. Semi arid conditions are also experienced in the rift valley as well. This type of climate is characterised by the following:

(i) Low rainfall of less than 760mm. Other areas experience even much less e.g. in the Chalbi desert annual rainfall is 250mm.

(ii) There is very low humidity of about 20% or less.
(iii) There's limited cloud cover i.e. they are generally clear skies partly due to the limited atmospheric moisture required for cloud formation.
(iv) Temperatures tend to be high, average temperatures range from 35°C – 38°C.
(v) There is a high diurnal range of temperature approximately 20°C.
(vi) Unreliable rainfall i.e. periods of extended drought may be experienced and rainfall periods may not be predicted.

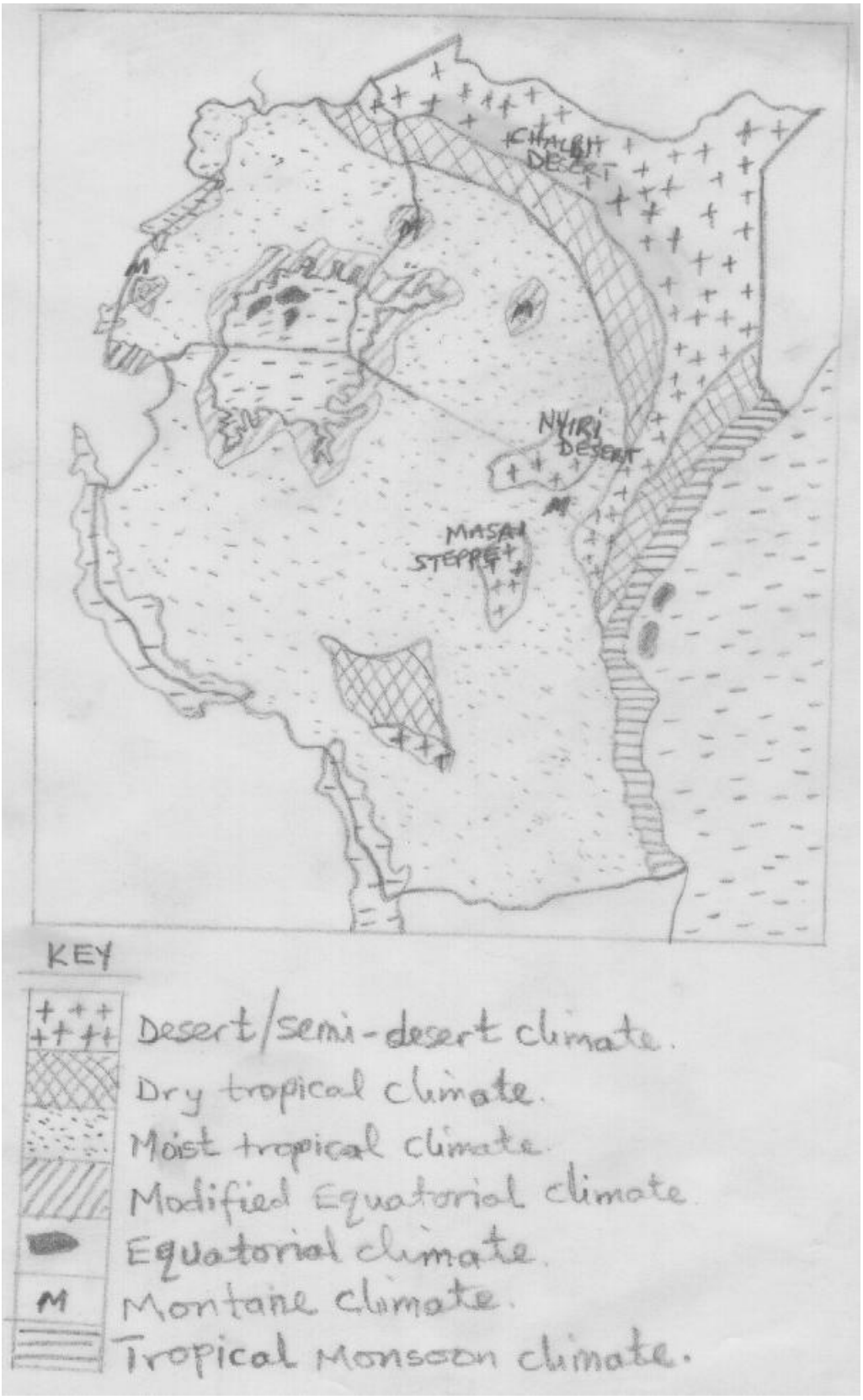
MONTANE CLIMATE/ ALPINE CLIMATE

This climate may also be referred to as Alpine climate and is experienced on the mountain peaks of E.Africa e.g. high levels of Mt. Rwenzori, Mt.Kenya,Mt.Elgon,Mt.Meru,Mt.Kilimanjaro,Mt.Muhavura,Mt.Mgahinga,Mt. Sabinyo etc.
The distinguishing factor is that there are low temperatures experienced.
Snowfall may also be experienced in altitudes of more than 4800m. The type of rainfall received is relief and is heavier on the windward sides of the mountains while the leeward side experience lower rainfall because of the shadow effect.
Atmospheric pressure in the montane climate conditions tends to be low as a result of rarified air.
In addition, the gravitational effect at higher altitudes is lower resulting into the low pressure.

TROPICAL MONSOON CLIMATE

This is experienced in the coastal region of E.Africa. The climate is basically influenced by the seasonal winds known as the monsoon winds. These seasonal winds affect the coastal areas of E.Africa i.e. the N.E & S.E monsoons tend to bring in heavy rainfall.
The rainfall is high and ranges between 1000mm and 1800mm.
Since the coastal regions are at a lower altitude, high temperatures are experienced.
Areas that experience tropical monsoon climate include areas along the coastal belt e.g. around Malindi, Mombasa, Tanga, Dar es Salaam, Kilwa etc.

MAP OF EAST AFRICA SHOWING THE CLIMATIC REGIONS



ARIDITY IN EAST AFRICA

Aridity is a climatic phenomenon characterised by high temperatures and insufficient rainfall or very low rainfall. In the USA areas of less than 250mm of rainfall are regarded as arid areas. However in some parts of the world, the aridity may be measured differently e.g. in East Africa areas of less than 500mm may be regarded as arid. Areas of aridity are generally referred to as deserts or semi deserts and are characterised by dryness.
In East Africa areas that experience aridity include Northern Kenya, parts of Eastern Kenya, North Eastern Uganda, the Ankole - Masaka corridor parts of North Eastern Tanzania, Central Tanzania, parts of southern Kenya and parts of the western and the Eastern rift valley e.g. along Lake Albert, Lake Edward and Lake George.
Desert areas are those that may receive less than 250mm of rainfall and these may include areas in Northern Kenya e.g. around Ladwor in North Eastern Kenya and the Chalbi desert.
In addition to this there is also the Nyiri desert in Southern Kenya and the Masai steppe in North Eastern Tanzania.
On the other hand semi desert areas experience relatively higher rainfall though less than 500mm.

CHARACTERISTICS OF ARID AREAS

1. Low and seasonal rainfall is experienced. Drought is a common phenomenon in such areas.
2. High temperatures are experienced i.e. temperatures of 30°C and above.
3. High diurnal range of temperature normally more than 15°C i.e. during the day it is very hot and during the night is cold.
4. There is generally low humidity. Relative humidity tends to be less than 20%.
5. There is a limited cloud cover. Much of the year is characterised by clear skies.
6. There are high transpiration rates and evaporation rates.
7. There is unreliable or unpredictable rainfall.
8. There is occurrence of strong winds and occasionally dust storms are experienced.
9. There is limited plant cover, this is because of the low rainfall such that the vegetation tends to be adapted to low rainfall conditions e.g. there are generally drought resistant species such as steppe savannah grasslands, thicket, thorn bush, cactus, scrub, as well as patches of bare land.

CAUSES OF ARIDITY

Arid conditions in East Africa have been brought about by a number of factors.
The basic causes of aridity have been physical while human factors have increased or contributed to further aridity in East Africa.

Physical causes of aridity

1. **Prevalence of dry/desiccated winds**.
Some areas in East Africa have been influenced by dry winds for instance the N.E trade winds which emanate from the Arabian Desert. Those winds pick some moisture as they blow Southwards towards Africa however these winds tend to loose their moisture in the Ethiopian highlands. Since they are dry they do not bring in rain.They even absorb the little moisture that exists in the regions in which they blow and even warm up such areas. This explains the dry conditions experienced in Northern Kenya.

2. **Limited water masses:** Several areas in East Africa that experience aridity such as Northern Kenya and Central Tanzania lack large water bodies that could otherwise contribute to atmospheric moisture through evaporation. This therefore results into limited atmospheric moisture in such areas and therefore dry conditions result.

3. **Highland relief causing the rain shadow effect** on the leeward side of the highland. Relief has contributed to aridity in East Africa because of the rain shadow effect produced on the leeward side of mountains.
The prevailing winds that continue onto the leeward side from the Windward side are desiccated or dry and do not bring in rainfall but instead may even absorb the little moisture that may exist in the leeward areas. Arid areas in East Africa that are due to the rain shadow effect include Northern Kenya, the Masai steppe on the leeward side of the Pare and Usambara mountains ranges in N.East Tanzania. The western rift valley zone area on the leeward side of the Rwenzori mountains.
In addition, the absence of highlands or mountains to trap high level winds bearing moisture may also contribute to aridity, this is because winds gather momentum and blow away to other areas.

4. **Continentality:** This refers to the remoteness from the sea. Areas far from the Indian Ocean and whose climate is continental or affected by land conditions have tended to suffer from aridity. Coastal areas are influenced by maritime conditions such as land and sea breezes that lead to high rainfall. However, continental areas such as central and N.Eastern Tanzania tend to be dry because of the long distance from the sea.

5. **Coastal configuration:** this refers to the shape or alignment of the E. African coast. The coast is aligned in a N.E or S.W direction. Due to this alignment winds from the N.E such as the N.E trades tend to blow parallel to the coast especially along the Kenyan coast in a south westerly direction and hardly blow inland. Therefore these moisture-laden winds which may not blow inland deprive much of northern, central and southern parts of Kenya of rainfall. This therefore partly explains the prevalence of arid conditions in these parts of Kenya.

6. **Corriolis force effect:** this is a drag force as a result of the earth's rotation and has effect in that any object moving in the northern hemisphere from the southern hemisphere is deflected to the right. This force accounts for the prevalence of arid conditions in the Ankole - Masaka corridor and other parts to the N.West of Lake Victoria. This is because when the S.E trade winds blowing through Tanzania cross the Equator, they are deflected eastwards i.e. to the right leaving the North Western parts of Lake Victoria without moist winds. This explains the semi-desert/arid conditions experienced in the Ankole-Masaka corridor and the neighbouring areas.

7. **Perturbation:** This is a situation where low pressure conditions due to high temperatures are created on the Indian Ocean and as a result air from the land or air that would have blown on shore is instead redirected into this low pressure belt. Air will therefore blow from the land to the Indian ocean thereby becoming offshore winds and as a result rain is formed in the Indian ocean while parts of the East African mainland and including Northern Kenya are left dry.
Perturbation that may occur during certain seasons contributes to aridity and especially extended drought in East Africa.

Human causes of aridity

These include mans' environmentally unfriendly activities such as the following:

1. Deforestation: The removal of vegetation by man is a cause of aridity. This has been due to mans' activities in the clearance of forests and other forms of natural vegetation. The main activities involved include cultivation, lumbering, industrialisation etc which have led to the destruction of natural forests that contribute to atmospheric moisture. Destruction of this source of atmospheric moisture results into aridity. Deforestation also contributes to soil erosion, which in turn leads to poor plant growth consequently leading to poor rates of transpiration thereby compounding the problem of aridity.

2. **Overstocking:** The rearing of a big number of animals i.e. more than what the pastureland can accommodate can lead to aridity. In case the carrying capacity of the land is exceeded, the pastures are depleted very fast and the large number of animals trample the ground to create bare patches of land and loosening the soils thereby promoting erosion. This results into poor vegetation growth and low levels of transpiration and consequently leading to aridity.

3. **Overgrazing:** This may be as a result of continuous grazing by herbivorous animals without leaving the land to rest. Overgrazing depletes the vegetation cover and may lead to low rainfall because of limited transpiration.

4. **Bush burning:** This may also be responsible for aridity because it leads to the degeneration of the grass and other plants and reduces transpiration. Traditional farmers normally burn grass with the aim of ensuring growth of fresh pastures for the animals but this may have adverse effects on the climate.

5. **Reclamation of wetlands:** Wetlands like swamps, swamp forests, grass swamps, marshlands, dambos etc are major sources of atmospheric moisture through evapotranspiration and their reclamation greatly reduces the process. In addition, the water table is lowered. In the final analysis, humidity and rainfall are reduced and this leads to aridity. Reclamation in East Africa has been due to the search for land, for cultivation, settlement as well as industrialisation.

6. **Borehole drilling:** The sinking of boreholes to provide underground water resources for humans and animals may lead to the lowering of the water table. As the water table falls, plant roots may fail to access the soil moisture and as a result the plants wither. This therefore reduces the capacity of the natural vegetation to recharge the atmosphere with water vapour through evapotranspiration and this may increase on the problems of aridity.

7. **Industrialisation**: Industrial development has also been a cause of aridity or desertification in East Africa. Industrial plants or factories emit exhaust fumes or clouds of smoke containing pollutants such as carbon dioxide, carbon monoxide, sulphurdioxide etc which tend to be green house gases. Such gases are good absorbers of solar radiation thereby contributing to increase in temperatures.
   In addition, gases such as carbon dioxide and sulphurdioxide may dissolve in water leading to acid rains. Acid rains lead to forest damage in that the plants loose their leaves, their growth stagnants and may finally die. This in turn will also reduce on the ability of the natural vegetation to

recharge the atmosphere with moisture through transpiration and hence aridity.

8. **Mining:** The extraction of minerals and more so through open cast method leads to the destruction of surface vegetation meaning that the ability of the vegetation to contribute to the atmospheric moisture is greatly reduced and thereby compounding the problem of aridity.

9. **Poor methods of cultivation:** Primitive or non-scientific methods of cultivation that expose soils to erosion have also contributed to aridity. With erosion the ability of the soil to support plant growth is reduced meaning that there would be poor vegetation and consequently low levels of evapotranspiration. Such methods include shifting cultivation, cultivating up and down slope and other forms of subsistence cultivation. In addition, the use of machinery such as tractor ploughs that carry out deep cultivation tend to loosen soil particles making them prone to erosion.

10. **Political conflicts/Wars:** These may lead to destruction of vegetation through burning, cutting down of trees, demolition of vegetation by armoured vehicles as well as emission of dangerous chemicals and gases through explosives and bombs. Such explosives tend to harm the natural vegetation. Consequently, transpiration is reduced and rainfall also reduces.

All these human environmentally unfriendly activities may result in reduced atmospheric moisture and an increase in temperature. It is important to note that human causes of aridity increase desert conditions. They are also, the causes of desertification. Otherwise the naturally existing desert areas of East Africa are basically as a result of physical factors.

DESERTIFICATION

This refers to the development of desert like conditions in an area and more so in a region adjacent to a desert. It may be expressed as the advancement or extension of the desert. Desertification has been commonly experienced in the Sahel region of Africa. In East Africa desert like conditions have been experienced or developed in parts of Northern Kenya, Central and Northern Tanzania, N.Eastern Uganda and the Ankole-Masaka corridor and parts of Western Uganda adjacent to Lake Albert, Lake George, Albert Nile and within the East African rift valley.

Indicators of desertification

1. Decreasing rainfall amounts.
2. Rainfall becomes more unreliable i.e. more recurring cycles of drought start being experienced.
3. Increasing temperatures i.e. temperatures tend to rise.
4. Reducing relative humidity i.e. the amount of water vapour in the atmosphere reduces.
5. Increasing diurnal range of temperature.
6. Reducing thickness of cloud cover i.e. the skies tend to become clearer and clearer with each passing year.
7. There is loss of water retention capacity of the vegetation and soils i.e. there are increasing evapotranspiration rates.
8. Reduced bio-diversity i.e. there is degradation of the biological productivity of the land i.e. reduced plant and animal species.
9. Increasing wind and run off erosion hence consequently resulting into reduced soil fertility.

Causes of desertification

Desertification is basically caused by environmentally unfriendly human activities. However to a small extent it may be brought about by naturally existing conditions in the atmosphere that may lead to cycles of drought. Such atmospheric systems that result into cyclic changes or occurances in the atmosphere have compounded the problem of desertification.

Human activities that have contributed to desertification in East Africa in general include the following:

1. Deforestation.
2. Overgrazing.
3. Overstocking.
4. Bush burning.
5. Reclamation of wetlands.
6. Borehole drilling.
7. Industrial activity.

8. Mining/Quarrying.
9. Poor methods of cultivation.
10. Political conflicts/wars.

Problems of desertification

Desertification is associated with a number of negative effects and therefore it is undesirable. This is because of the following:

1. It may lead to crop failure or low crop yields hence leading to famine and human suffering. In sub – Saharan Africa it has been a major cause of famine. This is because of the prolonged dry seasons and recurring droughts which lead to crop failure and consequently food shortages resulting into human suffering and death due to hunger, starvation and disease.
2. The resultant decreasing rains may prompt irrigation. Consequently this may lead to salination of the soils, which is also a form of soil degradation.
3. The high or increasing temperatures are unconducive for human settlement as well as human activities such as cultivation.
4. The degradation or deterioration of the natural vegetation may cause a decrease in forestry products and a reduction in the ability of the natural vegetation to protect the environment.
5. It encourages soil erosion and creates conducive conditions not only for run off water erosion but also wind erosion.
6. It may lead to the encroachment of sand dunes due to wind erosion and such sand dunes are normally unsuitable for human activities such as cultivation.
7. It may result into the disappearance of some drainage features such as small streams and wetlands due to excessive evaporation and yet these drainage features play important roles i.e. both protective and productive roles.
8. Leads to the destruction of the natural habitat for wildlife and hence reduced biodiversity. This is because desertification leads to a change in the physical environment such as reduced vegetation cover, increased temperatures and reduced wetlands. It also destroys the natural habitat for a variety of wildlife.

Measures to combat desertification

In East Africa and other parts of Africa, the number of steps has been taken to combat desertification or reverse the trend of desertification. These include;

1. **Legislation against environmental degradation**. Laws have been passed against the destruction of the environment such as wetland reclamation. Most of such vulnerable areas have been gazetted as nature reserves or conservation sites.

2. **Afforestation:** this has involved the campaign to plant trees in order to arrest the effects of desertification. Tree planting campaigns have been conducted by the government, NGO's, environmental/wildlife clubs as well as individuals.
3. **Reafforestation**: i.e. re-planting of trees where trees have been cut or where deforestation has taken place e.g. Mabira forest, Kibaale forest etc.
4. **Introduction and practice of improved methods of cultivation** i.e. methods that do not harm the environment. This has been mainly through protecting agricultural land by adopting practices that conserve soils e.g. mulching, crop rotation, gully prevention measures, application of manure and fertilizers etc.
5. **Rotational grazing:** This has been facilitated by paddocking. Efforts have also been made to ensure that the carrying capacity of land is maintained in order to avoid overstocking. Rotational grazing also helps to check overgrazing.
6. **Re-settlement of people** adjacent to forest reserves as well as eviction of forests encroachers. Re-settlement of the people is to prevent encroachment upon the forests especially when population is increasing and when land shortage problems are cropping up e.g. encroachers in Kibaale forest reserve were evicted and resettled.
7. **Sensitization of the public** about the role of forests or natural vegetation. This has been through the education of the masses on the dangers of deforestation and also how to utilize the enviroment sustainably. This has created awareness about environmental issues such as desertification-associated problems. This sensitization has been through a variety of mass media e.g. the press, electronic media, seminars/workshops, schools, Local council meetings, public rallies etc.
8. **Introduction and encouragement of the use of fuel saving stoves** or those that use saw dust such that less biomass is used as fuel. This reduces on the tendency of the destruction of forests for fuel.
9. **Rural electrification** and provision of other sources of energy such as solar energy, biogas etc as an alternative to wood fuel.
10. **Creation or establishment of environmental organizations** to champion or spearhead the fight against desertification through environmental protection and restoration of degraded lands. Some of these organizations are governmental or non-governmental. They may also be international, inter-state, national or local. Some are also voluntary organizations. Examples of these bodies include; NEMA in Uganda (a parastatal body charged with protecting the environment.) Uganda Wildlife Authority (UWA). In addition, there are wildlife clubs, tree planting clubs and anti-pollution clubs. International organizations include; the Kagera Basin Organisation, Inter Governmental Authority on Drought and Development (IGADD), interstate ones like the East African Wildlife Society and others like Karamoja Development Agency

(KDA) to combat desertification and aridity and ensure development of the area.

11. **Encouragement and use of indigenous methods** of protecting the environment and more so natural vegetation and drainage features i.e. through traditional customs and taboos.
12. **Population control measures** through population re-distribution and family planning as well as encouraging late marriages, discouraging polygamy etc to avoid over population, which would lead to land shortage and deforestation.

EFFECTS OF CLIMATE ON HUMAN ACTIVITIES

Climate has influenced land use and human activities in several parts of East Africa. The different climatic conditions such as equatorial climate, modified equatorial climate, tropical, montane, semi desert and desert climates have had profound effect on human activities, or land use in areas where they are experienced. This is because the rainfall and temperatures may vary and create conditions for different land use or human activities. The effects can be seen in the following ways;

1. In the equatorial or moist tropical type of climate, a variety of human land use activities have cropped up e.g. forestry, cultivation of annual and perennial crops, dairy farming such as in the Kenya highlands, areas around Lake Victoria etc.
2. In areas of tropical climate, there is cultivation of mainly annual crops as well as the rearing of livestock, wildlife conservation and tourism have been important.
3. Temperate climatic conditions as experienced in the highland areas such as the Kenya and Kigezi highlands, Rwenzori Mt. Ranges have cool conditions that have favoured dairy farming and growth of vegetables or temperate crops such as wheat, Irish potatoes etc.These highland areas have also favoured the growth of pyrethrum e.g. in Kabale and Bundibugyo.
4. Montane climatic conditions as experienced in the mountainous areas such as the Rwenzori, Elgon, Kenya, Kilimanjaro, Meru etc have encouraged forestry especially montane forests which may be temperate e.g. the Coniferous forests or they may be Bamboo forests. Other economic activities in montane climatic regions include; Lumbering, Wildlife conservation and tourism such as mountaineering or sight seeing.
5. In the semi-desert climatic regions there has been the growth of drought - resistant crops e.g. Sorghum, Millet, Maize and Sisal have been encouraged. Nomadic pastoralism has also been practised in Semi-arid areas such as Karamoja, the Masailand, Turkana land and the Boran region of Northern Kenya.

   Furthermore, tourism and wildlife conservation have developed in these areas. Many of the semi-desert regions have been gazetted as wildlife conservation sites such as National parks and Game reserves thereby promoting tourism e.g. Tsavo National Park, Queen Elizabeth National Park, Serengeti National Park, Kidepo Valley National Park, and Lake Mburo National Park etc.