Lecture 4
Environmental Engineering
Climate Change

1.0 Introduction

The difference between weather and climate are that weather refers to atmospheric conditions such as temperature and rainfall over a short period of time (a few hours or a few days). Weather is what you experience day to day. While climate is the average pattern of weather for a particular place over a long period of time. Climatic factors include quantity of: light, temperature, humidity, wind, gases, visibility, type and amount of precipitation, atmospheric pressure, water etc.

Climate change refers to the long-term changes in the climate that occur over decades, centuries or longer. It is caused by rapidly increasing greenhouse gases in the earth's atmosphere due primarily to burning fossil fuels (e.g., coal, oil, and natural gas). In other words, the changes in environmental conditions of an area over long period of time is called climate change. These changes effect the agriculture, migration of animals, hydrological cycle.

"Climate change" means a change in the climate system which is caused by significant changes in the concentration of greenhouse gases as a consequence of human activities and which is in addition to natural climate change that has been observed during a considerable period. (Climate Change Act, 2016).

2.0 Sources Of Climate Change

Some of the sources of climate change are:

a. The emissions that cause climate change come from every part of the world and affect everyone. Seven biggest emitters are China, the United States of America, India, the European Union, Indonesia, the Russian Federation, and Brazil. The emissions from these countries accounted for about half of all global greenhouse gas emissions in 2020.
b. Natural causes of climate change can be attributed to natural phenomena. Forests shape our natural environment and local climatic conditions. They maintain humidity, regulate temperatures, break wind velocities and influence precipitation.
c. Human-driven causes of climate change.
d. Transportation using fusel fuel.
e. Electricity generation using petroleum products and coal.
f. Industries and manufacturing emitting gases responsible for global warming.
g. Agricultural activities using chemical fertilisers.
h. Oil and gas development.

3.0 Consequences of Climate Change

The consequences of climate change are:

a. The consequences of climate change include intense droughts, water scarcity, severe fires, rising sea levels, changes in storm patterns, altered ocean currents, changes in rainfall, melting of snow and ice, flooding, catastrophic storms and declining biodiversity.
b. Conditions like sea level rise and salt water intrusion have advanced to the point where whole communities have had to relocate, and protracted droughts are putting people at

risk of famine. In the future, the number of people displaced by weather related events is expected to rise.

c. The impacts of climate change are projected to continue and, in some cases, intensify, affecting human health, infrastructure, forests, agriculture, freshwater supplies, coastlines, and marine systems.
d. Climate change may aggravate erosion, decline in organic matter, salinisation, soil biodiversity loss, landslides, desertification and flooding.
e. Climate impacts are already harming health, through air pollution, disease, extreme weather events, forced displacement, pressures on mental health, and increased hunger and poor nutrition in places where people cannot grow or find sufficient food.

4.0 Control of Climate Change

Climate change can be controlled by:

a. Switching energy systems from fossil fuels to renewable energies such as solar, geothermal, hydropower or wind will reduce the emissions driving climate change.
b. Switch to sustainable transport – reducing car use, switching to electric vehicles, and minimising travels.
c. Improve farming and encourage vegan diets. Reducing meat and dairy consumption.
d. Restore nature to absorb more carbon. Planting trees to absorb carbon emissions.
e. Development of polices to minimize climate change. In this regard, Kenya government developed Sessional Papers, Action Plans and Acts of Parliament to minimize climate change.

4.1 Sessional Paper No. 5 0f 2016

Kenya Government has commitment to protect the climate system for the benefit of the present and future generations by supporting the United Nations Framework Convention on Climate Change (UNFCCC) process, ratifying the Kyoto Protocol in 2005, and contributing to continental and regional climate change initiatives.

The country's Constitution has set out a legal commitment to attain ecologically sustainable development; hence providing a firm basis to address the challenge of climate change while striving to attain the development goals set out in Kenya Vision 2030.

The Kenya Government developed a Sessional Paper No. 5 of 2016 on the Framework Policy on Climate Change.

The Government will:

1. Mainstream climate change into national and county planning processes, including national development policies and plans, Country Integrated Development Plans, Performance Contracts, and the short to medium term budget making process.
2. Develop a framework and tools for mainstreaming climate change responses into national and county government planning and budget procedures.
3. Ensure that national and county planning processes and documents account for climate risk analyses and vulnerability assessments, and identify opportunities to build climate resilience and achieve low carbon development.
4. Establish the institutional framework and build capacity to coordinate and enhance mainstreaming at the sector level.

5. Put in place mechanisms linking climate change data and information with national and county planning processes.

4.2 National Climate Change Action Plan

The National Climate Change Action Plan (NCCAP), 2018-2022, is a five-year plan that helped Kenya adapt to climate change and reduce greenhouse gas emissions. The Climate Change Act, 2016 requires the Government to develop action plans to guide the mainstreaming of climate change into sector functions. The Action Plan for2023-2027 is yet to be developed.

In Kenya the National Climate Change Action Plan shall prescribe measures and mechanisms –

1. to guide the county toward the achievement of low carbon climate resilient sustainable development;
2. to set out actions for mainstreaming climate change responses into sector functions; for adaptation to climate change; for mitigation against climate change;
3. to specifically identify all actions required as enablers to climate change response;
4. to mainstream climate change disaster risk reduction actions in development programmes; to set out a structure for public awareness and engagement in climate change response and disaster reduction;
5. to identify strategic areas of national infrastructure requiring climate proofing;
6. to review and determine mechanisms for climate change knowledge management and access to information;
7. to enhance energy conservation, efficiency and use of renewable energy in industrial, commercial, transport, domestic and other uses;
8. to strengthen approaches to climate change research and development training and technology transfer; (1) to review and recommend duties of public and private bodies on climate change;

4.3 Climate Change Act

The Act places duties on the national government and county governments to mainstream climate change responses into development planning, decision making and implementation and to respond in various other ways to climate change. The Act sets out principles of climate change planning and implementation of measures.

The Act also provides for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve low carbon climate development, and for connected purposes.

4.3.1 Objects and Purposes

The objects and purposes of Climate Change Act are:

1. The Act shall be applied for the development, management, implementation and regulation of mechanisms to enhance climate change resilience and low carbon development for the sustainable development of Kenya.
2. Without prejudice to subsection (1), this Act shall be applied in all sectors of the economy by the national and county governments to:
    a) Mainstream climate change responses into development planning, decision making and implementation;
    b) Build resilience and enhance adaptive capacity to the impacts of climate change;

c) Formulate programmes and plans to enhance the resilience and adaptive capacity of human and ecological systems to the impacts of climate change mainstream and reinforce climate change disaster risk reduction into strategies and actions of public and private entities;
d) Mainstream intergenerational and gender equity in all aspects of climate change responses;
e) Provide incentives and obligations for private sector contribution in achieving low carbon climate resilient development;
f) Promote low carbon technologies, improve efficiency and reduce emissions intensity by facilitating approaches and uptake of technologies that support low carbon, and climate resilient development;
g) Facilitate capacity development for public participation in climate change responses through awareness creation, consultation, representation and access to information;
h) Mobilize and transparently manage public and other financial resources for climate change response;
i) Provide mechanisms for, and facilitate climate change research and development, training and capacity building;
j) Mainstream the principle of sustainable development into the planning for and decision making on climate change response; and
k) Integrate climate change into the exercise of power and functions of all levels of governance, and to enhance cooperative climate change governance between the national government and county governments.

4.3.2 Revised Climate Change Act

AN ACT of Parliament to provide for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve low carbon climate development, and for connected purposes.

The Climate Change (Amendment) Act, no.9 of 2023. An Act of Parliament amended the Climate Change Act, 2016, and for connected purposes. The Climate Change Act, 2016, in the Act is referred to as the "Principal Act"

The revised Act entrenches the need for carbon projects to specify the anticipated environmental, economic or social benefits of project which includes the extent to which the project will contribute to the removal of greenhouse gases from the atmosphere in order to contribute to meeting Kenya's greenhouse gases.

In an effort to boost accountability and transparency, the Act provides for establishment of a carbon registry that would be accessible to the public with registers on information relating to carbon credit projects and the amount of carbon credits issued or transferred from Kenya. The Act establishes National Authority as the custodian of the Registry.

The Act provides for amending the 2016 Climate Change Act by introducing new definitions.

4.3.2.1 Definitions

Definitions as in the revised Act 2023.

a. Aggregate earnings

Aggregate earnings mean the total of all income in a carbon project without adjustment for inflation, taxation or types of double counting;

b. Carbon budget

Carbon budget means the approved quantity of greenhouse gas emission that is acceptable over a specified time and shall be informed by the National Greenhouse Gas Inventory and guide on emission reduction allocation for Nationally Determined Contributions or any other use consistent with the Conference of the Parties serving at the meeting of the Parties to the Paris Agreement guidance, rules, modalities and procedures;

c. Carbon credit

Carbon Credits means a credit created when the equivalent of one metric tonne of carbon dioxide is prevented from entering the atmosphere and is equal to one tonne of carbon dioxide or the equivalent amount of a different greenhouse gas reduced, sequestered, or avoided Agreement guidance, rules, modalities and procedures;

d. Carbon market

Carbon market means a mechanism that enables and allows public and private entities to transfer and transact emission reduction units, mitigation outcomes or of sets generated through carbon initiatives, products, programmes and projects subject to compliance of national and international laws.

e. Carbon Projects

Carbon Projects means interventions including programs, projects, and products designed to remove, reduce, sequester or avoid carbon emissions.

f. Carbon offset

Carbon offset means a reduction or removal of emissions of carbon dioxide or other greenhouse gases made in order to compensate with equivalent number of emissions for emissions made elsewhere.

g. Carbon standards

Carbon Standards mean a complete set of established rules, procedures, and methodologies that guide on the generation and issuance of certified carbon credits.

4.3.2.2 Regulation of Carbon Market

The policy direction on carbon markets provided shall apply to all carbon markets and prescribe:

a. Carbon reduction credits that aim to reduce emissions from current sources through projects;
b. Removal or sequestration credits that take carbon dioxide out of the atmosphere and either use or store it via afforestation, reforestation nature-based technology-based removal; and
c. Technologies and projects on the white list;
d. Emission credits not taken into account, including:
    i. previously used emission credits;
    ii. Emission reductions that have been achieved in violation of human rights and without free prior informed consent;
    iii. Emission reductions that have had significant negative social or environmental impact;
    iv. Emission reductions that were achieved before January, 2013; and

v. Emission reductions that were registered before the 1st January, 2013.

4.3.2.3 Environmental Impact and Social Assessment

There is need to conduct environmental Impact and social assessment for proposed projects.

i. Every carbon trading project authorized under this Act shall be required to undergo an environmental and social impact assessment in accordance with the Environmental Coordination Act, 1999.

ii. Notwithstanding subsection (i), reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries projects shall be required to undergo a Reduced Emissions from Deforestation and Forest Degradation safeguard standards assessment.

5.0 Climate Change – Kenya

Climate change adversely impacts key sectors that are important to the economy and society: Environment, Water and Forestry; Agriculture, Livestock and Fisheries; Trade; Extractive industries; Energy; Physical Infrastructure; Tourism; and Health. This Policy therefore elaborates intervention measures that can help to achieve the goal of low carbon climate resilient development.

Climate change is likely to negatively impact Kenya's future development and achievement of the goals of Kenya Vision 2030.

Kenya takes climate change seriously, as demonstrated by the enactment of the Climate Change Act (Number 11 of 2016). This Act requires the Government to develop five-year National Climate Change Action Plans (NCCAP) to guide the mainstreaming of adaptation and mitigation actions into sector functions of the National and County Governments.

5.1 Impact of Climate Change in Kenya

Higher temperatures, unpredictable rainfall patterns, increased incidence of droughts and floods, and rising sea levels Higher temperatures, unpredictable rainfall patterns, increased incidence of droughts and floods, and rising sea levels Higher temperatures, unpredictable rainfall patterns, increased incidence of droughts and floods, and rising sea levels.

Some of the major impart of climate change in Kenya are:

- An increase in temperature of up to 2.5 °C by 2050 is predicted to increase the frequency of extreme events such as floods and droughts.
- Increasing heat and recurrent droughts contribute to severe crop and livestock losses, leading to famine, displacement, and other threats to human health and wellbeing
- The frequency of cold days, cold nights and frost has decreased; while the frequency of hot days, hot nights and heat waves has increased.
- Temperature increase has been observed across all seasons, but particularly from March to May. Rainfall patterns have also changed.
- The long rainy season has become shorter and drier, and the short rainy season has become longer and wetter, while overall annual rainfall remains low.
- The long rains have been declining continuously in recent decades, and droughts have become longer and more intense and tend to continue across rainy seasons.
- The increasing intensity and magnitude of weather-related disasters in Kenya aggravates conflicts, mostly over natural resources, and contributes to security threats.

- Rain and flooding wiped out resources worth billions of shillings. Roads and infrastructure were destroyed, seasonal crops were destroyed and several livestock drowned.
- Droughts are typically large-scale disasters in Kenya destroying livelihoods, triggering local conflicts over scarce resources, and eroding the ability of communities to cope.
- Rising sea temperatures off the coast of Kenya have triggered mass coral bleaching and mortality on coral reef systems over the past two decades.
- This impacts the abundance and composition of fish species and negatively impacts coastal fisheries.

In summary the climate impacts in Kenya include:

- Floods
- Longer and intense Droughts.
- Rising sea level.
- Rising atmospheric temperature.
- Glaciers of Mount Kenya declining.
- Deceased yield of stable crops.
- Shorter long rainy season.
- Negative impact on fishing.
- Reduced livestock production.
- Deterioration of infrastructure due to floods.

5.2 Kenya's Contribution to Climate Change

The following are some of the Kenya's Contribution to Climate Change:

- Climate change is a global problem that demands a global solution, and Kenya is an active player in international efforts. The international response to climate change is founded upon the United Nations Framework Convention on Climate Change.
- Kenya has little historical or current responsibility for global climate change; the country's GHG emissions represent less than 1% of total global emissions.
- Adaptation is the priority for Kenya, but climate action also needs to reduce greenhouse gas emissions that are projected to increase because of population and economic growth.
- Actions in the six mitigation sectors set out in the UNFCCC – agriculture, energy, forestry, industry, transport, and waste – are expected to lead to lower emissions than in the projected baseline and help to meet Kenya's mitigation NDC to abate GHG emissions by 30% by 2030 relative to the business-as-usual scenario.
- The forestry sector has large potential to reduce greenhouse gas emissions in Kenya because forests act as "sinks" through carbon sequestration.
- Globally, Kenya has signed several global agreements regarding climate change like the Paris Agreement[1] which now forms part of the law of Kenya.

[1] The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016