

Agricultural Engineering Department

Option: Irrigation and Drainage Technology Year 3/2022-2023

WORKPLACE ENVIRONMENTAL MANAGEMENT (CCMEM701)

Credits: 5

Learning Hours: 50

By

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Competence

Manage workplace environmental impact

PURPOSE

- This module describes the knowledge, skills and attitudes required to manage workplace environment
- It is intended for learners pursuing TVET Advanced diploma of irrigation and drainage technology.
- Throughout this module, leaners will be able to describe environmental management, to assess environmental impact and to control human projects impact on environment.
- Qualified student deemed competent to this competency, may work with others in support of current professional practice in marshland, hillside, small and large-scale irrigation, garden, greenhouses under minimum guidance.

CONTENTS

- VINIT 1. DESCRIBE ENVIRONMENTAL MANAGEMENT (12 Hours)
- UNIT 2. ASSESS ENVIRONMENTAL IMPACT (20 Hours)
- UNIT 3. CONTROL HUMAN PROJECTS IMPACT ON ENVIRONMENT (18 Hours)

UNIT 1 - DESCRIBE ENVIRONMENTAL MANAGEMENT

- 1.1. Explain the basics of environmental management
- 1.2. Describe the environment of earth
- 1.3. Describe Rwanda's environmental features

Environmental principles

- i. Inclusiveness: Effective involvement of women and youth in environmental management and climate change intervention decision-making is essential and should be encouraged.
- ii. Economic Value: Integration of <u>Natural Capital Accounting</u> (NCA) and Payment of Ecosystem Services (PES) in national economic planning and finance.

- iii. Ecosystem Approach to conserving environmental resources will be adopted and enhanced to ensure that all ecosystems are managed in an integrated manner while also providing a range of benefits to the citizenry.
- iv. Assessment of environmental risks and impacts for development projects and strategic environmental and social assessment for national policies, plans, programmes and strategies

- v. Precautionary Principle seeks to minimize activities that have the potential to negatively affect the integrity of the natural environment.
- vi. The principle of sustainability of environment and equal opportunities across generations: Human beings are central to sustainable development. They are also entitled to the right of a healthy and productive life in harmony with nature.

- vii. Mitigation and Adaptation: The country is committed to addressing global warming and taking steps to cope with the effects of global warming.
- viii. Polluter Pays Principle: Those responsible for environmental damage must be held liable for the repair caused to both the physical and human environments. They must also be held responsible for the costs of preventive measures to reduce or prevent further pollution and environmental damage.

- ix. The Pollution Prevention Principle anticipates problems and prevents negative impacts on the environment and people's environmental rights.
- x. Extended Producer Responsibility (EPR) is a policy approach under which producers are given a significant responsibility - financial and/or physical - for the treatment or disposal of wastes. Assigning such responsibility provides incentives to prevent and reduce waste at the source, promote waste reuse and recycling.

Principles of the Environment and Climate Change Policy

xi. The principle of information dissemination and community awareness raising in the conservation and protection of the environment: Every person has the right to be informed of the state of the weather, climate, and environment and to take part in the decisions to protect the environment.

Principles of the Environment and Climate Change Policy

xii. Principle of Cooperation: Public institutions, international institutions, associations and private individuals are required to protect the environment at all possible levels. Multilateral Environmental Agreements (MEAs) and regional instruments will be domesticated and implemented cooperatively for better environmental and climate change management.

Principles of the Environment and Climate Change Policy

xiii. Endeavour to promote Circular Economy and industrial symbiosis: Industries are brought together in innovative collaborations, finding new ways to efficiently use resources and thus increase revenues while reducing waste and associated costs.

Environmental management

Environmental management (EM) is perceived as a framework or a set of practices and processes that enable any organization, whether private or public, to reduce its environmental impacts while aiming at increasing its operating productivity.

Environmental management

Environmental policy

Environmental policy: any measure by a government or corporation or other public or private organization regarding the effects of human activities on the <u>environment</u>, particularly those measures that are designed to prevent or reduce harmful effects of human activities on <u>ecosystems</u>.

Environmental management

Environmental policy

- Environmental policies are needed because environmental values are usually not considered in organizational <u>decision</u> <u>making</u>.
- There are two main reasons for that omission.
- First, environmental effects are <u>economic</u> <u>externalities</u>. <u>Polluters</u> do not usually bear the consequences of their actions; the negative effects most often occur elsewhere or in the future.
- Second, <u>natural resources</u> are almost always underpriced because they are often assumed to have <u>infinite</u> availability.

Environmental management

Environmental policy

Externalities

- When goods are produced, they may create consequences that no one pays for. Such unaccounted-for consequences are called externalities. Because externalities are not accounted for in the costs and prices of the free market, market agents will receive the wrong signals and <u>allocate</u> resources toward bad externalities and away from good externalities.
- Good externalities are consequences that benefit society. However, because those benefits are not accounted for in the price of the good, the price is higher than it should be, and too little of the good is consumed and produced. Bad externalities harm society. However, because the costs of those externalities are not accounted for in the price of the good, the price is lower than it should be, and too much of the good is consumed and produced. In both cases, the market has failed to reach efficiency, because it has allocated resources and production without considering the externalities.

Environmental management

Characteristics of environmental management

Environmental management characteristics include:

- Environmental management supports sustainable development.
- Environmental management demands the multi-disciplinary approach. It deals with a world affected by humans.
- Environmental management has to integrate different development viewpoints.
- Environmental management seeks to integrate natural and social science.
- Environmental management can extend from short-term to longterm and from local to global level.

Environmental management

Purpose of environmental management

An <u>Environmental Management System</u> (EMS) helps an organization address its regulatory requirements in a systematic and cost-effective manner. This proactive approach can help reduce the risk of non-compliance and improve health and safety practices for employees and the public. An EMS can also help address non-regulated issues, such as energy conservation, and can promote stronger operational control and employee stewardship.

Environmental management

Advantages to undertake environmental management

Potential Benefits:

- ✓ Improved environmental performance
- ✓ Enhanced compliance
- ✓ Pollution prevention
- ✓ Resource conservation
- ✓ New customers/markets
- ✓ Increased efficiency/reduced costs
- ✓ Enhanced employee morale
- Enhanced image with public, regulators, lenders, investors
- Employee awareness of environmental issues and responsibilities

Environmental management

Advantages to undertake environmental management

<u>5 Common Benefits of Environmental Management:</u>

- Managing your environmental risks and putting the necessary measures in place to reduce those risks and improve performance is a goal for many businesses.
- Depending on your current situation, and how much of a priority environmental management has been in the past, there will be different drivers, but there are some <u>common benefits</u>.

Environmental management

Advantages to undertake environmental management

- Legal compliance: Environmental management helps businesses identify and adhere to relevant environmental acts and regulations. By ensuring compliance, businesses can demonstrate their commitment to meeting legal requirements and avoid potential fines or penalties.
- Competitive edge: Having a focus on environmental management can give businesses an advantage in tendering processes. When environmental management questions arise, companies with robust environmental practices can easily answer them and showcase their responsible approach. Many customers consider environmental management when choosing suppliers, so demonstrating good environmental practices can give a competitive edge over rivals.

Environmental management

Advantages to undertake environmental management

- Cost savings: Improving environmental performance often leads to cost savings. By focusing on areas such as utility use, waste management, and transportation, businesses can reduce expenses. Additionally, enhanced environmental performance can decrease the likelihood of fines or legal actions, further contributing to cost savings.
- Environmental protection: Taking measures to prevent pollution and improve the environment not only fulfills legal obligations but also showcases a company's commitment to environmental stewardship. By actively protecting and improving the environment, businesses can enhance their reputation, gain positive public relations, and boost their overall image.

Environmental management

Advantages to undertake environmental management

Staff morale: Being an environmentally responsible company can have a positive impact on employee morale. When employees see their organization prioritizing environmental management, it instills confidence and pride in their work. A company's commitment to environmental sustainability can improve staff retention, attract new talent, and support recruitment efforts.

Environmental management

- Types of environment (Natural, Industrial, & Social)
- Constituents of environment (Physical elements, Biological elements, & Cultural elements)
- Types of environmental management:
- ✓ The construction environmental management plan
- ✓ The operations environmental management plan
- ✓ The decommissioning environmental management plan

Environmental management

Types of environment (Natural, Industrial, & Social)

1. Natural Environment: The natural environment refers to the physical surroundings and resources that exist in the natural world.

- It includes elements such as landforms, water bodies, air quality, flora, fauna, and ecosystems.
- The natural environment encompasses natural processes and phenomena, such as climate, weather, geological formations, and biodiversity.
- It is essential for sustaining life and providing ecosystem services that support human well-being.

Environmental management

Types of environment (Natural, Industrial, & Social)

2. Industrial Environment: The industrial environment pertains to the human-made or built environment, particularly the settings associated with industrial activities and infrastructure.

- It includes manufacturing plants, factories, industrial zones, warehouses, transportation networks, and energy production facilities.
- The industrial environment can have both positive and negative impacts on society and the natural environment, as it influences economic development, employment, pollution levels, resource consumption, and technological advancements.

Environmental management

Types of environment (Natural, Industrial, & Social)

3. Social Environment: The social environment refers to the interpersonal, cultural, and societal factors that influence human behavior, relationships, and interactions.

- It encompasses social structures, institutions, norms, values, beliefs, customs, and social systems.
- The social environment includes aspects such as family, community, education, government, economy, politics, religion, and technology.
- It plays a crucial role in shaping individual and collective behaviors, social dynamics, and the overall quality of life in a society

Environmental management

Types of environment (Natural, Industrial, & Social)

These three types of environments interact and influence one another.

- The natural environment provides the foundation for human activities and sustains the ecosystems on which we depend.
- The industrial environment affects the natural environment through resource extraction, pollution, and land-use changes.
- The social environment, in turn, influences how individuals and societies perceive, interact with, and impact the natural and industrial environments.
- Understanding and managing these different types of environments are essential for achieving sustainable development and maintaining a balance between human needs and environmental preservation.

Environmental management

Constituents of environment (Physical elements, Biological elements, & Cultural elements)

- 1. Physical Elements: Physical elements are the tangible and visible components of the environment.
- They include non-living elements such as landforms, water bodies (oceans, rivers, lakes), atmosphere (air, climate, weather patterns), soil, minerals, and natural resources.
- These physical elements provide the basis for life and shape the overall structure and characteristics of the environment.

Environmental management

Constituents of environment (Physical elements, Biological elements, & Cultural elements)

2. Biological Elements: Biological elements refer to the living organisms and their interactions within the environment.

- They include plants, animals, microorganisms, and the intricate web of relationships and ecosystems they form.
- Biological elements contribute to biodiversity, ecological balance, and the functioning of ecosystems.
- They play essential roles in nutrient cycling, pollination, decomposition, and maintaining the overall health and resilience of the environment.

Environmental management

Constituents of environment (Physical elements, Biological elements, & Cultural elements)

- 3. Cultural Elements: Cultural elements encompass the humanmade aspects of the environment that are shaped by human activities, beliefs, and values.
- They include language, art, music, customs, traditions, social institutions, knowledge systems, technology, and built structures like cities, towns, and infrastructure.
- Cultural elements reflect human creativity, social organization, and the ways in which societies interact with and modify their surroundings.
- Cultural elements can influence how people perceive, use, and manage the physical and biological components of the environment.

Environmental management

Constituents of environment (Physical elements, Biological elements, & Cultural elements)

- These three constituents of the environment—physical, biological, and cultural—are interconnected and mutually influence each other.
- The physical elements provide the foundation for biological life and cultural activities. Biological elements contribute to the diversity and functionality of ecosystems, which in turn shape human societies and cultures. Cultural elements influence how people perceive and interact with the natural world, shaping their behaviors, values, and attitudes towards environmental stewardship.

Environmental management

Constituents of environment (Physical elements, Biological elements, & Cultural elements)

Understanding and managing these constituents of the environment are crucial for sustainable development and maintaining the delicate balance between human needs, ecological integrity, and cultural diversity. It requires recognizing the interdependencies among these elements and adopting integrated approaches that promote the conservation of natural resources, biodiversity, and cultural heritage while meeting the needs and aspirations of present and future generations.

Environmental management

- Types of environmental management:
- ✓ The construction environmental management plan (<u>CEMP</u>)
- The operations environmental management plan
- The decommissioning environmental management plan
Environmental management

An Environmental Management Plan is a guiding document outlining the environmental protections and measures that must be in place during construction. The EMP serves as a primary document comprising much of a project's environmental management.

Environmental Management Plan (EMP): An EMP is prepared during the initial stages of construction planning. This document outlines all environmental sensitivities in a location of interest and prescribes the mitigation measures necessary to avoid impacts. The EMP outlines all measures necessary for the project, commonly including Environmental Monitoring, Erosion and Sediment Control, Water Quality Monitoring, Wildlife Management and Vegetation Management. The EMP may also outline periods of sensitivities during which work should not occur due to a high risk of impact.

Environmental management

- Construction Environmental Management Plan (CEMP): A CEMP is similar to an EMP. It is prepared closer to the start of construction, after a project's design details have mostly been finalized. Often, a CEMP is based on an initial EMP, if one had been prepared, and includes more detailed environmental protection measures due to the specifications of planned construction being more developed.
- Environmental Protection Plan (EPP): An EPP is a document specifically outlining a contractor's plan to adhere to environmental protection requirements, including the requirements outlined in a CEMP or EMP. The EPP is prepared immediately prior to the start of construction and generally applies to a single type of construction activity. A project may have several EPPs in place, all of which are meant to be followed in conjunction with the project EPP and/or CEMP.

Environmental management

The operations environmental management plan (<u>OEMP</u>)

- ✓ An <u>Operations Environmental Management Plan</u> (OEMP) provides specific guidance related to the operational activities associated with the facility. The roles and responsibilities for mitigation, monitoring and performance assessment during the facility operational life are also specified.
- ✓ The OEMP should not become an additional requirement separate from the day-to-day activities of the site, to avoid it to be seen by operations staff as an obstruction to their normal duties and operations, hence it must be part of a facility's routine operations and the environmental requirements should be integrated into existing procedures, rather than becoming a new layer of control.

Environmental management

The operations environmental management plan (<u>OEMP</u>)

The key objectives of OEMP:

- Compliance with environmental law and project commitments
- Avoidance, minimization and or mitigation of environmental impacts
- Facilitate the timely distribution of information and increase awareness
- Manage assets in accordance with design criteria
- Provide a guide to the management and notification of environmental incidents
- Effective response to community requests and complaints; and
- General improvements in environmental maintenance methods.

Environmental management

Components of the OEMP:

- Environmental concerns defining this OEMP are unique to the project's operational phase.
- The OEMP will be prepared in an issues-based format that nominates for each environmental issue or impacting activity, the tasks that are required to be addressed during the operational phases of the development, covering

The operations environmental management plan (<u>OEMP</u>)

- Environmental issue
- Environmental objectives
- Environmental intent
- Control measures
- Responsibility
- Monitoring
- Reporting
- Performance Indicators
- Corrective Action

Environmental management

The decommissioning environmental management plan

- <u>Decommissioning Plan</u> means a plan to retire the physical facilities of the Project, including decontamination, dismantlement, rehabilitation, landscaping and monitoring.
- The purpose of the <u>Decommissioning Plan</u> is to outline the processes and environmental requirements for the removal and closure of temporary designated areas, temporary access roads and quarry areas required during construction of the Project.

Environmental management

- Environmental management tools
- Environmental management systems
- Environmental auditing
- Environmental labelling
- Life cycle assessment: Life cycle assessment or LCA is a methodology for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service
- Environmental indicators
- Environmental policies
- Eco-balances
- Environmental reporting
- Environmental charters

Environmental management tools

- Environmental management tools refer to a range of techniques, strategies, and frameworks used by organizations and individuals to manage and address environmental issues.
- These tools are designed to improve environmental performance, reduce negative impacts on the environment, and promote sustainability.
- Environmental management tools help organizations identify, manage, and mitigate environmental risks, reduce resource consumption, and improve overall environmental sustainability. By implementing these tools, businesses and individuals can contribute to the preservation and protection of the environment

Environmental management tools

Commonly used environmental management tools

- **1. Environmental Impact Assessment (EIA):** EIA is a systematic process that identifies and assesses the potential environmental impacts of proposed projects or activities before they are undertaken. It helps in decision-making by evaluating the environmental consequences and suggesting mitigation measures.
- 2. Environmental Management Systems (EMS): An EMS is a structured approach that helps organizations manage their environmental impacts. It involves setting environmental objectives, implementing procedures, monitoring performance, and continuously improving environmental performance.

Environmental management tools

Commonly used environmental management tools

3. Life Cycle Assessment (LCA): LCA is a comprehensive tool used to assess the environmental impacts of a product, process, or service throughout its entire life cycle. It considers all stages, from raw material extraction to disposal, and evaluates impacts such as energy consumption, emissions, and resource depletion.

4. Environmental Auditing: Environmental auditing involves the systematic examination of an organization's environmental practices, processes, and compliance with environmental regulations. It helps identify areas of improvement, assess performance, and ensure compliance with environmental standards.

Environmental management tools

Commonly used environmental management tools 5. Carbon Footprinting: Carbon footprinting calculates and

measures the greenhouse gas emissions associated with an organization's activities, products, or services. It helps identify emission sources, set reduction targets, and develop carbon management strategies.

6. Environmental Performance Indicators (EPIs): EPIs are measurable parameters used and track to assess an organization's environmental performance over time. They can include metrics such as energy consumption, waste generation, water usage, and emissions.

Environmental management tools

Commonly used environmental management tools

7. Green Procurement: Green procurement involves considering environmental factors when purchasing goods and services. It focuses on selecting environmentally friendly and sustainable products, promoting resource efficiency, and reducing waste generation.

8. Environmental Reporting: Environmental reporting involves the transparent communication of an organization's environmental performance, goals, and initiatives. It provides stakeholders with information on environmental impacts, compliance, and sustainability efforts.

Recommended Resources

- Environmental Management <u>Tools for SMEs</u>: A Handbook : <u>https://www.eea.europa.eu/publications/GH-14-98-065-EN-</u> <u>C/file</u>
- Environmental Management <u>Tools and Techniques</u>: <u>https://info.undp.org/docs/pdc/Documents/BTN/Env%20mgt</u> <u>%20tools%20and%20techniques.pdf</u>

Environmental labelling

 Environmental labels are marks that indicate how products or services contribute to reducing environmental impact.



International ENERGY STAR Program

☑ https://www.energystar.gov/



EcoLeaf Environmental Labels

Attps://ecoleaf-label.jp/english/



Carbon Footprint of Products (CFP)

Attps://ecoleaf-label.jp/english/

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Environmental labelling



Eco Mark (Japan)

☑ https://www.ecomark.jp/



EcoLogo Program (Canada)

https://www.ul.com/resources/ecologocertification-program



Environmental Choice New Zealand (New Zealand)

Ittps://www.environmentalchoice.org.nz/





Attps://greenbuy.epa.gov.tw/Eng/Mark.aspx



Blue Angel (Germany)



Thai Green Label (Thailand)

Attps://www.tei.or.th/greenlabel/en/



China Environmental Labeling Program (China)

http://en.meecec.com/certification/environme



Singapore Green Label (Singapore)

https://sgls.sec.org.sg/

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Environmental labelling



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Environmental labelling

- With <u>eco-labels</u>, we can select products and services according to specific environmental and social criteria. What this means is that as consumers, eco-labels guide our purchasing decisions by providing information about the 'world' behind the product.
- For businesses, eco-labels are a means of measuring performance and also communicating and marketing the environmental credentials of a given product.
- For governments, crucially these tools encourage the behavioural change of producers and consumers towards long-term sustainability.

Recommended Resources

 Understanding <u>environmental</u> labelling: <u>https://www.bda.uk.com/resource/understanding-</u> <u>environmental-labelling.html</u>

Reusing, Recycling, Reducing, and Renewing: Eco-Friendly Terms to Know

The four R's – reusing, recycling, reducing, and renewing – are similar but distinct eco-friendly terms that share the same goal of protecting our environment.

Environmental indicators

Environmental indicator: A parameter or a value derived from parameters that describe the state of the environment and its impact on human beings, ecosystems and materials, the pressures on the environment, the driving forces and the responses steering that system

Environmental indicators

- Environmental indicators are used to measure and assess various aspects of the environment, providing valuable information about its condition and potential impacts.
- Environmental indicators provide valuable information about different aspects of the environment, enabling policymakers, researchers, and organizations to make informed decisions and take appropriate actions to protect and manage natural resources.

Environmental indicators

examples of environmental indicators

- Air Quality Index (AQI): The AQI is a numerical scale used to measure and communicate the quality of ambient air. It takes into account various pollutants such as particulate matter, ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. The AQI provides an indication of air pollution levels and helps assess the potential health risks associated with breathing the air in a particular area.
- Biodiversity Index: Biodiversity indicators measure the variety and abundance of different species in an ecosystem. They can include metrics such as species richness (the number of different species), species evenness (the distribution of individuals among species), and habitat diversity. Biodiversity indicators help assess the health and resilience of ecosystems and the potential impacts of human activities on biodiversity.

Environmental indicators

examples of environmental indicators

- Water Quality Index (WQI): The WQI is a metric used to assess the quality of water resources, such as rivers, lakes, and groundwater. It considers various parameters, including pH, dissolved oxygen, temperature, turbidity, nutrient levels, and presence of pollutants. The WQI provides an indication of water pollution levels and helps evaluate the suitability of water for different uses, such as drinking, irrigation, and aquatic life support.
- Carbon Footprint: The carbon footprint is a measure of the greenhouse gas emissions associated with an activity, product, organization, or individual. It quantifies the amount of carbon dioxide and other greenhouse gases released into the atmosphere, contributing to climate change. By measuring and tracking carbon footprints, it becomes possible to identify and reduce emissions, promoting sustainable practices and mitigating climate change.

Environmental indicators

examples of environmental indicators

Deforestation Rate: Deforestation rate is a measure of the loss of forest cover over a specific period of time. It provides information on the extent of forest destruction, which can have significant environmental consequences, including habitat loss, biodiversity decline, and increased greenhouse gas emissions. Monitoring deforestation rates helps assess the effectiveness of conservation efforts and guide sustainable land-use planning.

Eco-balances

- An <u>eco-balance</u> refers to the consumption of energy and resources and the pollution caused by the production cycle of a given product.
- The product is followed throughout its entire life cycle, from the extraction of the raw materials, manufacturing and use, right through to recycling and final handling of waste.

Eco-balances

- Eco-balances, also known as ecological balances or environmental balances, are assessments or calculations that measure the impact of human activities on the environment. They aim to quantify the overall ecological footprint of a particular activity, product, or process.
- Eco-balances take into account various environmental factors such as resource consumption, emissions, waste generation, and their associated impacts on ecosystems.

Eco-balances

Eco-balances provide a quantitative framework for assessing the environmental impact of human activities. By analyzing various factors such as resource consumption, emissions, and their associated consequences, eco-balances help identify opportunities for improvement and guide decision-making towards more sustainable practices.

Eco-balances

how eco-balances can be applied

- Life Cycle Assessment (LCA): LCA is a commonly used method for conducting eco-balances. It assesses the environmental impact of a product or service throughout its entire life cycle, from raw material extraction to manufacturing, distribution, use, and disposal. For example, when evaluating the environmental impact of a car, an LCA might consider factors like energy consumption, emissions, and waste generation at each stage of the car's life cycle.
- Carbon Footprint: Eco-balances are often used to measure the carbon footprint of various activities. A carbon footprint quantifies the greenhouse gas emissions, particularly carbon dioxide (CO2), associated with a specific entity, such as a company, product, or individual. By analyzing emissions from various sources like energy use, transportation, and waste management, eco-balances help identify opportunities for emission reductions and guide sustainable decision-making.

Eco-balances

how eco-balances can be applied

- Water Footprint: Eco-balances can also be used to assess the water footprint of a product or process. Water footprint analysis quantifies the volume of freshwater used, directly or indirectly, in the production or consumption of goods and services. It considers the water consumed during production, the water required to grow raw materials, and the water polluted in the process. By understanding the water footprint, stakeholders can make informed decisions to minimize water consumption and reduce environmental impacts.
- Biodiversity Impact Assessment: Eco-balances can extend beyond measuring resource consumption and emissions. They can also assess the impact of human activities on biodiversity. For example, an eco-balance may evaluate the effects of deforestation for agriculture or the construction of infrastructure on local ecosystems and species diversity. By quantifying these impacts, it becomes possible to identify strategies to mitigate biodiversity loss and promote sustainable practices.

Environmental charters

An environmental charter contains a set of principles relating to the company's environmental management system. By signing a charter, a company publicly declares its intention to carry out its environmental management activities in accordance with these principles.

Environmental management

- Life cycle assessment: Life cycle assessment or LCA is a methodology for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service.
- Life cycle assessment is a cradle-to-grave or cradle-to-cradle analysis technique to assess environmental impacts associated with all the stages of a product's life, which is from raw material extraction through materials processing, manufacture, distribution, and use.

Group Work: 15/06/2023

- 1) Discuss key terms of environment management.
- Discuss the characteristics of environmental management (Group 1).

5) Discuss the types of environment.

6) Discuss the types of environmental management (Group 3).

3) Discuss the purpose environmental management.4) Discuss the advantages to undertake environmental management. (Group 2)

(40 minutes for research + 10 presentation)

1.2. Describe the environment of earth

Group Work: 15/06/2023

1) Discuss about atmosphere, hydrosphere, lithosphere, and biosphere (Group 4).

1.2. Describe the environment of earth (cont'd)

Atmosphere

- The <u>atmosphere</u> is a mixture of gases that surrounds the Earth.
- It helps make life possible by providing us with air to breathe, shielding us from harmful ultraviolet (UV) radiation coming from the Sun, trapping heat to warm the planet, and preventing extreme temperature differences between day and night.
- Each of the planets in our solar system have an atmosphere, but none of them have the same ratio of gases or layered structure as Earth's atmosphere.

1.2. Describe the environment of earth (cont'd)

Atmosphere

- Gases in Earth's Atmosphere:
- Nitrogen and oxygen are by far the most common gases in Earth's atmosphere.
- > Dry air is composed of about 78% <u>nitrogen</u> (N₂) and about 21% <u>oxygen</u> (O₂). The remaining less than 1% of the atmosphere is a mixture of gases, including Argon (Ar) and <u>carbon dioxide (CO₂)</u>.
- The atmosphere also contains varying amounts of water vapor, on average about 1%.
- There are also many, tiny, solid or liquid particles, called <u>aerosols</u>, in the atmosphere. Aerosols can be made of dust, spores and pollen, salt from sea spray, volcanic ash, smoke, and pollutants introduced through human activity.

1.2. Describe the environment of earth (cont'd)

Atmosphere

Structure:

- The atmosphere can be divided into several layers based on temperature variations.
- The lowest layer is the troposphere, where weather phenomena occur, and it extends up to an average altitude of about 12 kilometers.
- Above the troposphere, there are the stratosphere, mesosphere, thermosphere, and exosphere. Each layer has unique characteristics and plays a specific role in Earth's atmosphere.
Atmosphere



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Atmosphere



Atmosphere

The Troposphere

- The zone in which we live is known as the Troposphere, and this zone influences our daily lives. It contains all of the elements vital to life, plus most of the water vapour in the atmosphere, most of the clouds dust and pollution.
- Much of the atmospheres "weather" occurs here too. On the diagram we can see that temperature decreases rapidly with increasing distance from the Earth's surface.
- This decrease in temperature is the Environmental Lapse rate, which is approximately 6.4°C for every 1000m ascent. This is largely because the Earth is heated from the surface outwards, as it receives incoming solar radiation as UV rays which is converted to heat at the surface (if it is not absorbed by the atmosphere or reflected back out.

Atmosphere

The Troposphere

- In some places reflective losses can be great as some surfaces have very high Albedo, that is, the fraction of insolation reflected by a surface, ice and snow have very high albedos.
- Pressure also decreases with height in this zone, and the amount of Oxygen available decreases (which is why some mountaineers get altitude sickness when mountain climbing).
- This rate of cooling in the troposphere reasonably stable, but the cooling of different air masses is variable from place to place and from time to time however, and links in with other lapse rates and atmospheric stability.

Atmosphere

The Stratosphere

- In contrast to the troposphere, the stratosphere has an increase in temperature with height away from the Earth's surface, largely due to the presence of a layer of Ozone.
- Ozone absorbs a lot of incoming solar radiation, and this causes the atmosphere to warm in the stratosphere.

Atmosphere

The Stratosphere

- Ozone is O3 and is continually destroyed and reformed in this zone.
- Ozone also protects people on the surface, because it absorbs harmful UV rays that could cause cancers and problems for people's cataracts.
- The Stratosphere does have winds, but these are light in the lower layers and increase in strength with height.

Atmosphere

The Mesosphere

- In this zone, temperatures fall rapidly with height from 60km a temperature of -5°C is recorded and this fall to -90°C at 80km up.
- This is largely due to the absence of any materials that can trap the incoming energy from the sun, water vapour, dust and Ozone.

Atmosphere

Thermosphere

The final layer is the Thermosphere, and this zone has an increase in temperature in height, up to 1500°C, because there is an increasing amount of atomic Oxygen which absorbs insolation.

Atmosphere

- Between each of the zones we have Isothermal layers called pauses where temperature barely changes.
- These are respectively called the Tropopause, the Stratopause, and the Mesopause with increasing distance from the Earth's surface.

Atmosphere

Advantages

The atmosphere is a vital component of Earth, providing breathable air, protection from solar radiation, temperature regulation, weather systems, and enabling communication and transportation.

Atmosphere

Advantages

- Breathable air: The composition of the atmosphere, particularly the presence of oxygen, allows humans and other organisms to breathe and survive on Earth. Oxygen is essential for respiration, and the atmosphere provides a continuous supply of it.
- Protection from solar radiation: The atmosphere acts as a shield, absorbing and scattering a significant portion of the Sun's harmful ultraviolet (UV) radiation. This protects life on Earth from excessive UV exposure, which can cause skin cancer and other health issues.

Atmosphere

Advantages

- Regulation of temperature: The atmosphere plays a crucial role in regulating the planet's temperature. The greenhouse gases, such as carbon dioxide and water vapor, trap heat from the Sun, creating the greenhouse effect. This helps to maintain a relatively stable and habitable temperature range on Earth.
- Weather and climate: The atmosphere is responsible for weather patterns and climate systems. It transports heat, moisture, and energy around the planet, leading to phenomena like wind, clouds, precipitation, and storms. Understanding and studying the atmosphere is vital for predicting and adapting to weather conditions and long-term climate changes.

Atmosphere

Advantages

Communication and transportation: The atmosphere enables the transmission of radio waves, allowing for long-distance communication through radio and television signals. It also provides support for flight and air transportation, as aircraft can generate lift and maneuver within the atmosphere.

Hydrosphere (Water)

The hydrosphere refers to the entirety of Earth's water, including its surface water, groundwater, and atmospheric water vapor. It is one of the four interconnected spheres of the Earth system, alongside the atmosphere, geosphere, and biosphere.

Recommended Resources

 Layers in the <u>Earth's Atmosphere</u>: <u>https://www.coolgeography.co.uk/A-</u> <u>level/AQA/Year%2013/Weather%20and%20climate/Structure</u> /Atmospheric%20layers.htm

Hydrosphere (Water)

Composition

The hydrosphere is composed of various forms of water, including oceans, seas, lakes, rivers, glaciers, ice caps, underground water reservoirs (aquifers), and atmospheric water vapor. The most abundant form is saltwater found in the oceans, which makes up about 97% of the Earth's water. The remaining 3% is freshwater, mainly found in ice caps and glaciers, underground aquifers, and surface water bodies like lakes and rivers.

Hydrosphere (Water)

Structure

- The hydrosphere has a dynamic structure and is distributed across different levels.
- It primarily consists of the surface water bodies, such as oceans, seas, lakes, and rivers.
- Beneath the surface, it extends to include groundwater, which is water stored in permeable rock layers called aquifers.
- Additionally, water exists in the form of moisture in the atmosphere, contributing to weather patterns and precipitation.

Hydrosphere (Water)

Advantages

The hydrosphere's abundance and diverse forms of water are vital for sustaining life, regulating the climate, supporting economic activities, and providing recreational and cultural benefits to humans and ecosystems.

Hydrosphere (Water)

Advantages

- Essential for life: Water is a fundamental component for the existence of life on Earth. It plays a crucial role in supporting ecosystems, providing habitats for various organisms, and serving as a medium for chemical reactions required for life processes.
- Climate regulation: The hydrosphere plays a significant role in regulating Earth's climate. Oceans act as heat sinks, absorbing and releasing heat slowly, which helps in moderating temperature extremes. Water vapor in the atmosphere plays a vital role in the formation of clouds, precipitation, and weather patterns.
- Transportation and trade: Water bodies serve as crucial transportation routes, enabling the movement of goods and people between different regions. Oceans and seas facilitate international trade, connecting countries and enabling the exchange of resources.

Hydrosphere (Water)

Advantages

- Renewable energy source: Water provides a renewable energy source through hydropower generation. The kinetic energy of flowing water or the potential energy stored in dams can be harnessed to generate electricity, offering a sustainable alternative to fossil fuels.
- Recreation and tourism: Water bodies offer recreational opportunities and are popular tourist destinations. People engage in activities such as swimming, boating, fishing, and diving, providing relaxation and enjoyment. Coastal areas and beach tourism contribute significantly to local economies.

Hydrosphere (Water)

Advantages

 Water resource for agriculture: The hydrosphere provides water necessary for agriculture through irrigation systems.
Water from rivers, lakes, and underground aquifers is used to irrigate crops, contributing to food production and supporting agricultural economies.

Lithosphere (Land)

- The lithosphere, also known as the land or the Earth's crust, refers to the solid outer layer of the Earth. It encompasses the entire landmasses, oceanic crust, and the uppermost part of the mantle. It is the part of the Earth where human activities and life as we know it predominantly exist.
- The lithosphere is the solid outer layer of the Earth consisting of rocks and minerals. It provides a platform for life, offers valuable resources, shapes the Earth's surface, and plays a critical role in supporting human activities and ecosystems.

Lithosphere (Land)



Lithosphere (Land)

Composition

- The lithosphere is primarily composed of various types of rocks, minerals, and soils. It consists of three major types of rocks: igneous, sedimentary, and metamorphic.
- Igneous rocks are formed from solidification of molten material (magma or lava), sedimentary rocks are created by the accumulation and lithification of sediments, and metamorphic rocks are formed through the alteration of preexisting rocks under high pressure and temperature.

Lithosphere (Land)

Structure

- The lithosphere can be divided into two components: the continental lithosphere and the oceanic lithosphere.
- The continental lithosphere comprises the Earth's continents and the underlying continental crust, which is generally thicker and less dense compared to the oceanic crust.
- The oceanic lithosphere includes the ocean floors and is mainly composed of basaltic rocks, which are denser than continental crust.

Lithosphere (Land)

Advantages

- Habitability: The lithosphere provides a solid surface for habitation and supports various forms of life, including humans, animals, and plants. It offers a platform for human activities such as agriculture, construction, and infrastructure development.
- Natural Resources: The lithosphere is rich in valuable natural resources like minerals, fossil fuels (coal, oil, and natural gas), and metals (such as gold, copper, and iron). These resources play a vital role in supporting economic activities and providing essential raw materials for industries.
- Geological Features: The lithosphere exhibits diverse geological features, including mountains, plateaus, plains, valleys, and canyons. These features contribute to the Earth's scenic beauty, tourism, and recreational opportunities.

Lithosphere (Land)

- Soil Formation: The lithosphere is responsible for soil formation, which is crucial for agriculture and food production. Soil supports plant growth by providing essential nutrients, anchoring plants, and retaining water.
- Geological Processes: The lithosphere is involved in various geological processes, such as plate tectonics, volcanism, and erosion. These processes shape the Earth's surface, create landforms, and influence the distribution of resources.
- Groundwater Storage: The lithosphere contains underground water reservoirs, known as aquifers, which provide a vital source of freshwater. These aquifers sustain ecosystems, support agriculture, and supply drinking water for human populations.

Recommended Resources

Lithosphere:

https://education.nationalgeographic.org/resource/lithospher e/

Biosphere (Living things)

 The biosphere refers to the zone of the Earth where life exists. It encompasses all the ecosystems and living organisms, including plants, animals, microorganisms, and their interactions with the physical environment.

Biosphere (Living things)

Composition

- The biosphere is composed of various living organisms, ranging from microscopic bacteria to large animals and plants.
- It includes all forms of life, from the depths of the oceans to the highest mountains and from the surface of the Earth to a few kilometers above the atmosphere.

Biosphere (Living things)

Structure

- The biosphere is organized into a hierarchical structure. At the smallest level, individual organisms make up populations, which are groups of the same species living in a particular area.
- Populations interact and form communities, which consist of different species living and interacting within an ecosystem. Ecosystems, in turn, are interconnected and form larger biomes, such as forests, grasslands, deserts, and aquatic environments. All these levels of organization are interdependent and contribute to the functioning of the biosphere as a whole.

Biosphere (Living things)

Advantages

- Biodiversity: The biosphere is incredibly diverse, with millions of species that have adapted to various environments and niches. This biodiversity provides stability to ecosystems, enhances resilience to disturbances, and offers potential resources for human use, such as food, medicines, and materials.
- Ecological Services: The biosphere provides numerous vital services to humanity, known as ecological services. These include oxygen production, water purification, pollination of crops, climate regulation, soil fertility, and nutrient cycling. These services are essential for our well-being and survival.

Biosphere (Living things)

Advantages

Interconnectedness: The biosphere is interconnected through intricate food webs, energy flows, and nutrient cycling. Organisms within ecosystems depend on each other for survival, forming complex relationships. This interconnectedness contributes to the stability and balance of ecosystems and supports the overall functioning of the biosphere.

Biosphere (Living things)

Advantages

 Adaptability: The biosphere exhibits remarkable adaptability and resilience. Living organisms can adapt to changing environmental conditions, such as temperature, water availability, and nutrient availability. This adaptability enables the biosphere to recover from disturbances, such as natural disasters, and continue to thrive.

Biosphere (Living things)

Advantages

Human Survival: The biosphere is vital for human survival. It provides us with essential resources like food, water, and raw materials. It also plays a crucial role in regulating the climate, air quality, and overall environmental conditions necessary for our well-being. Understanding and protecting the biosphere is crucial for our own sustainability and the health of the planet.

1.3. Describe Rwanda's environmetal features

Environmental features

- Geographical features:
- ✓ Relief
- ✓ Climate
- ✓ Hydrography
- ✓ Vegetation

Natural environment

- Natural resources and Soil features:
- ✓ Wetlands
- $\checkmark\,$ Forests and protected areas
Environmental features

- Geographical features:
- ✓ Relief
- ✓ Climate
- ✓ Hydrography
- ✓ Vegetation

Natural environment

- Natural resources and Soil features:
- ✓ Wetlands
- $\checkmark\,$ Forests and protected areas

Environmental features

Human environment

- Socio-demographic and economic features:
- ✓ Economic aspect
- ✓ Human settlement

Natural environment

Geographical features:

Relief: Relief refers to the physical characteristics of the Earth's surface, including its elevation, slope, and landforms. It encompasses features such as mountains, hills, valleys, plains, plateaus, and coastlines. Relief plays a significant role in shaping landscapes and influencing various natural processes, such as erosion, weathering, and the distribution of water resources.

Natural environment Geog

Geographical features:

- Climate: Climate refers to the long-term weather patterns observed in a particular region. It is determined by factors such as temperature, precipitation, humidity, wind patterns, and atmospheric pressure. Climate influences the type of vegetation, animal life, and human activities that can thrive in a specific area.
- Different climatic zones include tropical, subtropical, temperate, arid, and polar, each characterized by distinct weather conditions.

Natural environment

Geographical features:

Hydrography: Hydrography relates to the study of water bodies on the Earth's surface, including rivers, lakes, oceans, and other bodies of water. It examines their physical characteristics, such as size, shape, depth, and flow patterns. Hydrography also involves the exploration of water-related processes, such as hydrological cycles, water quality, and the interaction of water with the surrounding environment. It plays a crucial role in determining the availability of freshwater resources and the formation of aquatic ecosystems.

Natural environment

Geographical features:

Vegetation: Vegetation refers to the plant life that covers a particular area or region. It includes various types of plants, such as trees, shrubs, grasses, and other forms of vegetation. Vegetation is influenced by factors such as climate, soil conditions, and altitude. Different regions exhibit diverse vegetation types, such as tropical rainforests, grasslands, deserts, tundra, and deciduous forests. Vegetation not only provides habitat and food for animals but also contributes to environmental processes like oxygen production, carbon sequestration, and soil conservation.

Natural environment

Natural resources and Soil features

- The natural environment encompasses various elements, including natural resources and soil features.
- Our focus will be put on three important aspects: wetlands, forests, and protected areas.

Natural environment

Natural resources and Soil features

Wetlands:

Wetlands are areas where water is the primary factor determining the environment and the associated plant and animal life. They can be found in both coastal and inland regions. Wetlands serve as crucial habitats for a diverse range of species, including birds, fish, amphibians, and plants. They provide various ecosystem services, such as water filtration, flood control, and carbon storage. Wetlands also act as nurseries for many fish species, contributing to fisheries and supporting local communities.

Natural environment

Natural resources and Soil features

Natural resources associated with wetlands include:

- Water: Wetlands help regulate water flow, recharge groundwater, and maintain water quality by filtering out pollutants and sediment.
- Biodiversity: Wetlands provide habitat for numerous species, supporting biodiversity and serving as breeding grounds for migratory birds and fish.
- Timber and Non-timber Forest Products: Wetland forests can provide timber resources, including hardwood and softwood species. They also offer non-timber forest products like berries, medicinal plants, and wild rice.

Natural environment

Natural resources and Soil features

Soil features associated with wetlands include:

- Organic-rich Soil: Wetland soils, known as hydric soils, are often characterized by a high organic content. These soils form in anaerobic (low-oxygen) conditions, promoting the accumulation of organic matter.
- Peatlands: Certain types of wetlands, such as bogs and fens, develop peat soils. Peat is partially decomposed plant material that accumulates over time, creating a unique soil composition with high water-holding capacity.

Natural environment

Natural resources and Soil features

Forests:

Forests are complex ecosystems characterized by a dense and diverse collection of trees, plants, animals, and microorganisms. Forests play a crucial role in maintaining global ecological balance and providing numerous ecosystem services. They are important sources of natural resources and contribute to climate regulation, water management, and soil conservation.

Natural environment

Natural resources and Soil features

Natural resources associated with forests include:

- Timber: Forests are a significant source of timber for construction, furniture, and paper production. Sustainable forest management practices ensure the long-term availability of timber resources.
- Medicinal Plants: Forests are home to a wide variety of medicinal plants, which have been used for centuries to develop pharmaceuticals and traditional remedies.
- Non-timber Forest Products: Forests provide a range of non-timber products, such as fruits, nuts, resins, honey, mushrooms, and wild game, which support local livelihoods and cultural practices.

Natural environment

Natural resources and Soil features

Soil features associated with forests include:

- Organic Matter Accumulation: Fallen leaves, branches, and other organic debris contribute to the buildup of organic matter in forest soils. This organic matter enhances soil fertility and nutrient cycling.
- Soil Erosion Control: Forest vegetation, including tree roots and leaf litter, helps prevent soil erosion by reducing the impact of rainfall, absorbing water, and stabilizing the soil.

Natural environment

Natural resources and Soil features

Protected Areas:

Protected areas, such as national parks, nature reserves, and wildlife sanctuaries, are designated to conserve natural ecosystems and their biodiversity. These areas aim to safeguard endangered species, preserve ecological processes, and provide recreational and educational opportunities for people.

Natural environment

Natural resources and Soil features

Natural resources associated with protected areas include:

- Biodiversity Conservation: Protected areas contribute to the preservation of diverse ecosystems, protecting endangered species and maintaining genetic diversity.
- Ecotourism: Many protected areas attract visitors interested in experiencing nature. Ecotourism generates economic benefits for local communities and promotes conservation awareness.

Natural environment

Natural resources and Soil features

 Soil features associated with protected areas depend on the specific ecosystem and habitat types within them. The soils in protected areas can exhibit a range of characteristics, including varying levels of organic matter content, soil fertility, and nutrient availability.

Natural environment

Natural resources and Soil features

Other key considerations:

- Soil Conservation: Protected areas often prioritize soil conservation practices to minimize soil degradation caused by human activities. These practices include minimizing soil disturbance, controlling erosion through vegetation management, and promoting sustainable land use practices.
- Soil Biodiversity: Protected areas can harbor unique soil biodiversity, including a variety of microorganisms, fungi, and invertebrates. These soil organisms play essential roles in nutrient cycling, organic matter decomposition, and overall ecosystem functioning.

Natural environment

Natural resources and Soil features

- Soil Carbon Sequestration: Protected areas, particularly forests and wetlands, contribute to carbon sequestration, which is the process of capturing and storing carbon dioxide from the atmosphere. Soils in protected areas can act as significant carbon sinks, helping mitigate climate change.
- Soil Water Holding Capacity: Soils in protected areas, especially wetlands, often have high water-holding capacities, allowing them to retain water and contribute to the regulation of water availability and flood control.

Natural resources and Soil Natural environment features

- The natural resources and soil features associated with wetlands, forests, and protected areas are essential components of the natural environment.
- They provide numerous benefits, including biodiversity conservation, water regulation, carbon sequestration, and sustainable resource utilization.
- The preservation and sustainable management of these ecosystems are crucial for maintaining ecological balance and supporting the well-being of both nature and human communities.

Human environment

- Socio-demographic and economic features:
- ✓ Economic aspect
- ✓ Human settlement

Human environment

- The human environment encompasses various aspects of human society, including socio-demographic and economic features.
- Focusing on the economic aspect, it involves the production, distribution, and consumption of goods and services within a society.
- Economic factors play a significant role in shaping human settlements and determining patterns of human activity.

Human environment

Economic Aspect:

The economic aspect of the human environment refers to the overall economic conditions, activities, and systems within a society. It includes factors such as:

a. Economic Systems: Different economic systems exist worldwide, including capitalism, socialism, and mixed economies. These systems determine how resources are allocated, production is organized, and wealth is distributed within a society.

b. GDP and Economic Indicators: Gross Domestic Product (GDP) is a commonly used measure of a country's economic performance. Other indicators such as employment rates, inflation, and trade balance provide insights into the overall economic health and development of an area.

Human environment Economic Aspect:

c. Industries and Sectors: Various industries and sectors contribute to economic activities, such as manufacturing, agriculture, services, and technology. The composition of these sectors varies across regions, impacting employment opportunities and the overall economic structure.

d. Economic Development: Economic development refers to the progress of a society in terms of improving living standards, infrastructure, and overall economic well-being. Factors like industrialization, technological advancements, and investments influence the level of economic development.

Human environment Economic Aspect:

e. Income Distribution: Income distribution examines how wealth and resources are distributed among different segments of the population. Disparities in income distribution can have social and economic implications, affecting access to education, healthcare, and other resources.

Human environment Human Settlements:

- Human settlements are the physical spaces where people reside, work, and interact.
- Economic factors influence the patterns of human settlement in several ways:

a. Urbanization: Economic opportunities often drive people to migrate from rural to urban areas in search of better employment prospects. Urban centers become hubs of economic activity, with a concentration of industries, services, and infrastructure.

b. Rural Areas: Economic factors also shape human settlements in rural areas. Agriculture, farming, and natural resource-based industries determine the distribution and density of rural populations.

Human environment Human Settlements:

c. Residential Patterns: Economic disparities can lead to the development of residential patterns characterized by segregated neighborhoods or areas with distinct socioeconomic profiles.

d. Housing and Infrastructure: Economic factors influence the availability and quality of housing and infrastructure in a given area. Affordability, housing policies, and investment in infrastructure impact the living conditions and accessibility of services for different segments of the population.

Human environment Human Settlements:

e. Migration and Mobility: Economic factors, such as job opportunities and income levels, often drive migration and mobility. People move between regions or countries in search of employment, economic stability, or better living conditions.

Human environment

Human Settlements:

The economic aspect of the human environment encompasses economic systems, indicators, industries, development, income distribution, and how these factors shape human settlements. Understanding these aspects is crucial for analyzing the socioeconomic dynamics within a society and planning for sustainable and inclusive development.

Study questions & Individual Research

- Explain clearly the basics of environmental management in accordance with environmental management tools
- Briefly, explain the main elements of environmental management
- Describe properly the environment of earth refer to environmental geography
- Describe the four main spheres of the earth
- Describe appropriately Rwanda's environmental features refer to Rwanda environmental policy

Group Assignment: To be presented on 16/06/2023

- 1) Discuss the meaning of environmental features (No 1-12)
- 2) Discuss geographical features in Rwanda (No 13-24)
- 3) Identify the natural resources in Rwanda (No 25-36)
- 4) Discuss sociodemographic and economic features (No 37-48)
- (1 day for research + 10 minutes for presentation)

UNIT 2 - ASSESS ENVIRONMENTAL IMPACT

- 2.1. Determine the environmental impact
- 2.2. Conduct environmental impact assessment
- 2.3. Develop environmental impact assessment (EIA) report

Group Work I, 20/06/2023

- Discussion on the key terms of environmental impact (No 1-12)
- Discussion on Categories of environmental aspects (No 13-24)
- Discussion on Categories of environmental impact (No 25-36)
- Discuss ISO 14001, ISO 14001:2015 (No 37-48)

- Environmental aspects
- Environmental impact
- <u>Environmental Aspect</u> is an element of an organization's activities, products or services that can interact with the environment.
- An environmental aspect is the way your activity, service, or product impacts the environment. For example, one of the environmental aspects of car washing may be a cleaning agent that has potential for water pollution (this pollution is the environmental impact).

Examples of connections between activities, services, aspects, and impacts.

Activity, service	Environmental aspect	Environmental impact
Car washing	Cleaning agent in wastewater	Potential water pollution
	Using water	Impact to natural resources
Heating	Emissions from boiler	Air pollution
Storage of fuel in above- or underground tank	Potential for leakage or spill	Contemination of soil and groundwater

The identification of environmental aspects is an important step towards recognizing their impacts on our planet. This proves helpful in setting and formulating objectives, targets, and other programs that may be directed towards solving environmental problems.

Categories of environmental aspects

- Emissions to air
- Pollution of land
- Discharge of water
- Use of materials/natural resources
- Solid waste management
- Hazardous waste
Environmental impact

- Environmental impact: It is the effect of human activity on the environment in the form of creating environmental imbalance.
- Some of the most <u>common</u> <u>environmental impacts</u> are:
- \succ air pollution
- water pollution (seas, rivers, groundwater)
- ➢ soil pollution
- waste production
- noise pollution
- damage to ecosystems and loss of biodiversity

Categories of environmental impact:

- Global warming
- Ozone depletion
- Acidification of soil and water
- Eutrophication
- Photochemical smog

- Depletion of abiotic resourceselements
- Depletion of abiotic resourcesfossil fuels
- > Human toxicity
- Fresh water aquatic ecotoxicity
- Marine aquatic ecotoxicity
- Terrestrial ecotoxicity
- Water pollution
- Air pollution

Why is it necessary to measure the environmental impact of human activity?

- Human well-being depends directly on biodiversity and ecosystems. It is therefore vital to try to measure, plan and minimize any activity that might alter the ecological balance.
- All activities carried out by humans have an impact on ecosystems. Some cause irreversible effects on the environment, such as environmental pollution, extinction of species, depletion of resources and habitat destruction.
- Moreover, as the human population grows, natural resources are being depleted. Improving the sustainability of human development is becoming increasingly urgent, and it is essential to measure, minimize and compensate for these impacts.

Why is it necessary to measure the environmental impact of human activity?



How is environmental impact measured?

- Today, more than 100 countries have legislation that requires an Environmental Impact Assessment to be carried out for any project that may highly impact the ecosystems where it is due to take place.
- The Environmental Impact Assessment was created to evaluate such effects on ecosystems and was designed according to sustainable development indicators.
- In addition, there is an international Natural Capital Coalition that works to enable business organizations to integrate their environmental dependencies and impacts on ecosystems and biodiversity into their finances.

How to reduce the environmental impact ?

- Reducing our environmental footprint: Measuring our impact on the environment and setting objectives for carbon neutrality and reducing emissions.
- Integrating the climate change variable into our business: By including environmental, social and governance (ESG) criteria in both investment and underwriting and defining low-carbon products.

How to reduce the environmental impact ?

- Promotion of the circular economy: Minimize the generation of waste in our activity and positioning ourselves as an agent of change in the transition to this type of economy, by promoting products and services and supporting specialized companies in the sector.
- Biodiversity preservation: We have raise awareness on biodiversity conservation and to support initiatives to protect ecosystems that are more sensitive to the effects of climate change.

Procedures for determining environmental aspects and impacts

- Identify the process associated with activities of workplace
- Consider the potential and actual impacts to the environment from each process and sub-process
- Identify the environmental aspects as the source of each impact to the environment
- Identify legal requirements

- Identify the potential for emergency situations
- Consider the environmental aspects associated with legal requirement
- Consider the ease of changing the environmental impacts

Group Work II, 20/06/2023

- Discussion on the environmental Impact Assessment (No 1-12)
- Presentation on the major environmental issues surrounding our environment (No 13-24)
- Discussion on types of EIA Principles (No 25-36)
- Discussion on Steps of the EIA process (No 37-48)

The major environmental issues surrounding our environment

Climate Change and global Warming:

- Pollution of air,
- Deforestation,
- Industrialization
- Overfilling landfills
- Greenhouse gases

Water pollution:

- Improper sewage
- disposal
- Oil spills
- Disposal of chemical
- Radioactive waste
- Plastic pollution

The major environmental issues surrounding our environment

Loss of biodiversity and Land Use:

Biological resources

Types of EIA Principles

- Polluter Pays Principle(PPP)
- The Precautionary Principle(PP)

Steps of the EIA process:

- Project proposal
- Screening
- Scoping
- Impact assessment and Mitigation
- Impact management
- Environmental impact statement(EIS)
- EIS Review& Licensing
- Monitoring

Environmental impact Assessment

- Environmental impact assessment (EIA): systematic process of identifying environmental, social and economic impacts of a project, before a decision of its acceptance is made.
- <u>Full environmental impact assessment</u>: environmental impact assessment that covers all the steps of environmental impact assessment process.
- <u>Partial environmental impact assessment</u>: environmental impact assessment limited to identification of environmental issues and appropriate mitigation measures.

Environmental impact assessment in Rwanda: instructions, requirements and procedures

 Ministerial Order No 001/2019 OF 15/04/2019 Establishing the list of projects that must undergo environmental impact assessment, instructions, requirements and procedures to conduct environmental impact assessment.
https://www.environment.gov.rw/index.php?eID=dumpFile&t=f&f=4369&token=63e045654a0b3fd0b0cdf2cc35e1b39c09ae-7977

Group work III: 22/06/2023

- Discuss about the EIA report (1-12)
- Discuss about the approach for developing EIA report (13-24)
- Discuss about the structure of EIA report format (25-36)
- Find a sample EIA report in Rwanda and briefly explain how it was developed (37-48)

Group work IV: 22/06/2023

Task: After reviewing the reference report below, especially its terms of reference, choose an agricultural development project, preferably about irrigation and drainage and prepare a draft EIA report based on the environmental impact assessment of your planned project conducted (G1: 1-12, G2: 13-24, G3:25-36, G4: 37-48).

(45 minutes for research, discussion and report writing + 10 minutes for presentation)

Reference report

Group work IV: 22/06/2023

Reference reports

- Reference report for G1 & G3: Environmental and social impact assessment (ESIA) and environmental and social management plan (ESMP) for Karangazi and Rwangingo marshlands rehabilitation and development subproject in Nyagatare and Gatsibo districts : <u>https://lwhrssp.minagri.gov.rw/fileadmin/user upload/Safe Guards Reports/Comple ted Projects/Environment/RSSP/EIA report for Karangazi -Rwangingo marshlands.pdf</u>
- Reference report for G2 & G4: The Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) of works related to the development of irrigation infrastructure for crop production in <u>Rugende</u> marshland : <u>https://lwhrssp.minagri.gov.rw/fileadmin/user upload/Safe Guards Reports/Comple ted Projects/Environment/RSSP/Environmental and Social Impact Asses sment of Rugende Marshland.pdf</u>

EIA report

- EIA report meaning
- Purpose of developing EIA report
- Advantages of developing EIA report

Approach for developing EIA report:

- Structure information
- Interpret the material collected

Structure of EIA report format

- Table of contents
- Acronyms and abbreviations
- Executive summary
- General information
- Project and alternatives description
- Environmental setting

- Assessment of impacts
- Mitigation and monitoring measures
- Environmental management plan
- Commitment statement
- Annexes

UNIT 3 - CONTROL HUMAN PROJECTS IMPACT ON ENVIRONMENT

- 3.1. Adapt the project to environment for its management
- 3.2. Control environmental pollution
- 3.3. Apply climate change mitigation measures

3.1. Adapt the planned project to environment for its management

Group Assignment: 22/06/2023 (Continue from the project chosen during Group work IV: 22/06/2023)

- 1) List the project activities and its impact on environment
- 2) Discussion on ways to protect environment
- 3) Identify adaptation measures of the planned project to environment for its management by using ways to protect environment.
- 4) Link activities of your planned project to the environment by showing how you will protect the environment concerning the nature of your project and its impact.

3.1. Adapt the planned project to environment for its management

Project activities and its impact on environment

- ✓ Nature of project
- ✓ Dimensions of the environment:
- Components
- (physical ad socioeconomic)
- Scale/space
- Time

✓ Nature of impact

3.1. Adapt the planned project to environment for its management

Ways to protect environment

- Reduce, reuse, recycle and renew
- Plant tree
- Consume less
- Compost
- Upcycle more
- Use fewer chemicals

- Walk, bike or carpool
- Conserve electricity
- Use long lasting light bulbs
- Turn off your device
- Use natural sunscreen
- Choose sustainable
- Spend time in your garden
- Conserve water

Group work, June 22, 2023

- Discussion on types of environmental pollution
- Presentation on causes and effects of each type of environmental pollution

Pollution

Environmental pollution is defined as "the contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected.

What are 4 types of environmental pollution?

- The major kinds of pollution, usually classified by environment, are air pollution, water pollution, and land pollution.
- Modern society is also concerned about specific types of pollutants, such as noise pollution, light pollution, and plastic pollution

Types of environmental pollution

- ➤ Air pollution
- Water pollution
- Noise pollution
- Thermal pollution
- Land pollution
- Radioactive pollution

Causes and effects of:

- \checkmark Air pollution
- ✓ Water pollution
- ✓ Noise pollution
- ✓ Thermal pollution
- ✓ Land pollution
- ✓ Radioactive pollution

Ways to control environmental pollution:

• Air pollution

Preventive technique

Effluents control

Ways to control environmental pollution:

• Water pollution

- Physical treatment
- Chemical treatment
- Biological treatment

Ways to control environmental pollution:

• Noise pollution

- Silencers
- > Noise absorbing materials
- Muffs and ear plugs
- Soundproof windows
- Planting trees

Ways to control environmental pollution:

• Thermal pollution

- Cooling ponds
- Cooling towers
- Spray ponds
- Artificial lake

Ways to control environmental pollution:

Land pollution

- Preventing or reducing waste generation
- Recycling
- Incineration
- Compositing
- Sanitary landfill
- Plasma gasification

Ways to control environmental pollution:

- Radioactive pollution
- Radiation exposure protection
- Radiation contamination protection
- Controlled area
- Collection, storage on disposal
Study questions: 23/06/2023

- Discuss about climate change indicators (Surface temperature, Greenhouse gases(GHGs) and Ozone,...).
- Discuss about socio-economic implication of climate change (i.e. natural disasters and human mobility, environmental and health impact,....).
- Discuss about mitigation technology and practice by sector (i.e. energy, transport, building, industry, agriculture, forestry, waste).
- How climate change mitigation measures can be applied in your sector?

Climate change indicators

- Surface temperature
- Greenhouse gases(GHGs) and Ozone

Climate change indicators

- □ Climate change indicators are essential tools used to monitor and assess the changes occurring in the Earth's climate system.
- □ They provide valuable insights into the impacts of human activities on the environment and help scientists and policymakers understand the extent of climate change and its potential consequences.
- □ Three significant climate change indicators are surface temperature, greenhouse gases (GHGs), and ozone.

Climate change indicators

Surface temperature

- Surface temperature is one of the most commonly studied indicators of climate change.
- It refers to the measurement of the Earth's temperature at the land and ocean surface. Rising surface temperatures are a clear signal of global warming.
- Scientists use various methods, such as ground-based observations, satellite data, and climate models, to monitor and analyze temperature changes over time.
- The Intergovernmental Panel on Climate Change (IPCC) reports that the global average surface temperature has increased by approximately 1 degree Celsius since the pre-industrial era. This warming trend is primarily attributed to the increase in GHG concentrations in the atmosphere.

Climate change indicators

Greenhouse Gases (GHGs)

- Greenhouse Gases (GHGs): are gases that trap heat in the Earth's atmosphere, contributing to the greenhouse effect and influencing climate patterns.
- The most significant GHGs include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and fluorinated gases.
- Human activities, such as burning fossil fuels, deforestation, and industrial processes, have significantly increased the concentrations of these gases in the atmosphere.

Climate change indicators Greenhouse Gases (GHGs)

- Monitoring GHG levels is crucial for understanding the drivers of climate change.
- Various methods, including direct measurements from monitoring stations and remote sensing techniques, are used to track GHG concentrations globally and regionally.
- These measurements help assess the effectiveness of mitigation strategies and inform policymaking.

Climate change indicators

Ozone

- Ozone: While surface ozone is a pollutant and harmful to human health at ground level, stratospheric ozone plays a crucial role in protecting life on Earth.
- The stratospheric ozone layer absorbs the majority of the Sun's harmful ultraviolet (UV) radiation.
- However, human activities have led to the release of substances known as ozone-depleting substances (ODS), such as chlorofluorocarbons (CFCs) and halons.

Climate change indicators

Ozone

- These substances destroy ozone molecules in the stratosphere, causing the thinning of the ozone layer.
- The Antarctic ozone hole, discovered in the 1980s, is a wellknown consequence of ODS emissions.
- International efforts, including the Montreal Protocol, have successfully phased out the production and use of ODS, leading to a gradual recovery of the ozone layer.

Climate change indicators

- Surface temperature, greenhouse gases, and ozone are crucial climate change indicators that provide valuable information on the state of the Earth's climate system.
- Monitoring and understanding these indicators help scientists and policymakers make informed decisions regarding climate change mitigation and adaptation strategies.
- By tracking these indicators and taking appropriate actions, we can strive to minimize the impacts of climate change and protect the environment for future generations.

Climate change indicators

Other climate change indicators ?



Climate change indicators

Sea Level Rise: Sea level rise refers to the increase in the average level of the Earth's oceans over time. It is primarily caused by the thermal expansion of seawater due to warming and the melting of ice sheets and glaciers. Monitoring sea level rise provides insights into the impacts of climate change on coastal regions, including increased coastal flooding, erosion, and saltwater intrusion.

Climate change indicators

Ocean Acidification: Ocean acidification occurs when excess carbon dioxide in the atmosphere is absorbed by the oceans, leading to a decrease in pH levels. This process has detrimental effects on marine life, particularly organisms that rely on calcium carbonate for their shells or skeletons, such as coral reefs and shellfish. Monitoring changes in ocean pH helps assess the impacts of climate change on marine ecosystems.

Climate change indicators

Glacial Retreat: Glacial retreat refers to the shrinking and thinning of glaciers worldwide. As temperatures rise, glaciers melt at a faster rate than they accumulate snow, leading to a reduction in glacier size. Glacial retreat is a visible indicator of climate change and affects water availability, sea level rise, and ecosystems that depend on glacial meltwater.

Climate change indicators

Extreme Weather Events: Climate change is associated with an increase in the frequency and intensity of extreme weather events, including heatwaves, droughts, heavy rainfall, and storms. Monitoring changes in the frequency and severity of these events helps understand climate change impacts and assess vulnerability and adaptation strategies.

Climate change indicators

Precipitation Patterns: Climate change affects precipitation patterns, leading to changes in rainfall amounts, distribution, and intensity. Some regions may experience increased precipitation, while others may face more frequent droughts. Monitoring precipitation patterns helps assess changes in water availability, agricultural productivity, and ecosystem health.

Climate change indicators

Arctic Sea Ice Decline: The Arctic region has experienced a significant decline in sea ice extent and thickness in recent decades. Monitoring Arctic sea ice provides insights into the warming trends in the polar regions and their impacts on ecosystems, wildlife habitats, and global climate dynamics.

Climate change indicators

Biodiversity Loss: Climate change poses a threat to biodiversity, with potential consequences for ecosystems and human well-being. Monitoring changes in species distributions, population sizes, and ecological interactions helps understand the impacts of climate change on biodiversity and guide conservation efforts.

Climate change indicators

- These indicators, along with surface temperature, greenhouse gases, and ozone, collectively contribute to our understanding of climate change and its multifaceted impacts on the planet.
- Monitoring and analyzing these indicators help inform policies and actions aimed at mitigating climate change and building resilience to its effects.

Socio-economic implication of climate change

- Natural disasters and human mobility
- Environmental and health impact

Socio-economic implication of climate change

- Climate change has far-reaching socio-economic implications that affect various aspects of human life.
- From natural disasters and human mobility to environmental and health impacts, these consequences are significant and demand urgent attention.

Socio-economic implication of Natural Disasters and Human climate change Mobility

- Natural Disasters and Human Mobility: Climate change leads to an increase in the frequency and intensity of natural disasters such as hurricanes, floods, droughts, and wildfires.
- These events have devastating effects on communities, causing displacement, destruction of infrastructure, and loss of lives.
- People are forced to migrate, becoming climate refugees, which puts additional pressure on already strained resources in the areas they seek refuge.

Socio-economic implication of climate change

Environmental Impact

- Environmental Impact: Climate change disrupts ecosystems, causing habitat loss, biodiversity decline, and the extinction of species. This, in turn, affects various economic sectors such as agriculture, fisheries, and forestry.
- Changes in rainfall patterns and temperature can reduce crop yields, impacting food security and leading to higher food prices.
- The loss of natural resources also affects industries reliant on them, such as tourism and pharmaceuticals.

Socio-economic implication of climate change

Health Impact

- Health Impact: Climate change poses significant risks to human health. Rising temperatures contribute to heatwaves, leading to heat-related illnesses and deaths.
- Changes in precipitation patterns can result in increased waterborne diseases and the spread of vector-borne diseases like malaria and dengue fever.
- Additionally, extreme weather events can damage healthcare infrastructure, disrupt access to medical services, and exacerbate mental health issues.

Socio-economic implication of climate change

Economic Losses

- Economic Losses: Climate change causes substantial economic losses.
- The costs associated with rebuilding after natural disasters, such as repairing infrastructure and compensating for property damage, can be staggering.
- Disrupted supply chains, decreased agricultural productivity, and increased energy demands for cooling or heating contribute to economic instability.
- Moreover, insurance premiums rise as climate-related risks increase, affecting businesses and individuals.

Socio-economic implication of climate change

Inequality and Social Disparities

- Inequality and Social Disparities: Climate change exacerbates existing social and economic inequalities.
- Vulnerable communities, including low-income populations, indigenous peoples, and marginalized groups, often bear the brunt of climate-related impacts due to limited resources and limited adaptive capacity.
- Disasters and environmental degradation further deepen poverty and can lead to social unrest and conflicts over dwindling resources.

Socio-economic implication of climate change

International Relations and Security

- International Relations and Security: Climate change has implications for international relations and security.
- Disputes over access to water resources, land, and energy can escalate tensions between nations.
- Mass migrations driven by climate change can strain the resources and stability of receiving countries, leading to social and political unrest.
- Moreover, competition for natural resources in the face of environmental degradation can fuel conflicts and destabilize regions.

Socio-economic implication of climate change

- Addressing these socio-economic implications requires comprehensive and coordinated efforts. It involves mitigating climate change through reducing greenhouse gas emissions, adapting to changing climatic conditions, and enhancing resilience in vulnerable communities.
- Investing in renewable energy, sustainable agriculture, and green technologies can contribute to a more sustainable and equitable future, while international cooperation is crucial for effective climate action and the protection of human wellbeing.

Mitigation technology and practices by sector

- Energy
- Transport
- Buildings
- Industry

- > Agriculture
- Forestry
- ➤ Waste

Mitigation technology and practices by sector

 Climate change mitigation measures involve a range of technologies and practices across various sectors as outlined below.

Mitigation technology and practices by sector

- Climate change mitigation measures involve a range of technologies and practices across various sectors as detailed below.
- These mitigation technologies and practices, when implemented across sectors, contribute to global efforts in combating climate change by reducing greenhouse gas emissions and promoting sustainable development.

Mitigation technology and practices by sector

Energy Sector

- > Energy Sector:
- Renewable Energy: The adoption of renewable energy sources like solar, wind, hydro, and geothermal power helps reduce greenhouse gas emissions by displacing fossil fuel-based electricity generation.
- Energy Efficiency: Improving energy efficiency in buildings, industries, and appliances reduces energy consumption and associated emissions.
- Carbon Capture and Storage (CCS): This technology captures CO2 emissions from power plants and industrial facilities, transporting and storing it underground to prevent it from entering the atmosphere.

Mitigation technology and practices by sector

Transport Sector

- > Transport Sector:
- Electrification: Shifting from fossil fuel-powered vehicles to electric vehicles (EVs) decreases emissions. Expanding EV charging infrastructure is also crucial.
- Public Transport and Active Mobility: Encouraging the use of public transportation, cycling, and walking reduces individual vehicle emissions.
- Fuel Efficiency and Alternative Fuels: Improving vehicle fuel efficiency and promoting low-carbon alternatives like biofuels and hydrogen can mitigate emissions.

Mitigation technology and practices by sector

Building Sector

- > Building Sector:
- Energy-Efficient Construction: Implementing energy-efficient designs and materials in buildings reduces the energy required for heating, cooling, and lighting.
- Retrofitting: Upgrading existing buildings with insulation, efficient lighting, and appliances can significantly decrease energy demand.
- Smart Grids and Demand Response: Integrating smart technologies into energy grids enables better management of energy consumption and optimizes demand response strategies.

Mitigation technology and practices by sector

Industry Sector

- Industry Sector:
- Improved Industrial Processes: Implementing energy-efficient technologies, optimizing manufacturing processes, and reducing emissions from industrial sources help mitigate climate change.
- Circular Economy: Promoting recycling, waste reduction, and reuse in industries can minimize emissions associated with production and disposal.
- Advanced Materials: Developing low-carbon alternatives and using sustainable materials in manufacturing processes can contribute to emissions reduction.

Mitigation technology and practices by sector

Agriculture Sector

- > Agriculture Sector:
- Sustainable Farming Practices: Encouraging practices like precision agriculture, organic farming, and agroforestry can reduce emissions and increase carbon sequestration.
- Methane Capture: Implementing systems to capture methane emissions from livestock and manure management can mitigate potent greenhouse gas releases.
- Efficient Irrigation: Improving water management and irrigation techniques reduces energy usage and associated emissions.

Mitigation technology and practices by sector

Forestry Sector

- Forestry Sector:
- Afforestation and Reforestation: Planting trees on deforested or degraded land helps sequester carbon dioxide from the atmosphere.
- Sustainable Forest Management: Promoting sustainable logging practices and preventing deforestation contribute to climate change mitigation.
- REDD+ (Reducing Emissions from Deforestation and Forest Degradation): This initiative focuses on financial incentives for developing countries to reduce deforestation and conserve forests.
3.3. Apply climate change mitigation measure

Mitigation technology and practices by sector

Waste Sector

- Waste Sector:
- Waste Reduction and Recycling: Implementing waste management practices that prioritize waste reduction, recycling, and composting minimizes methane emissions from landfills.
- Waste-to-Energy: Converting waste into energy through processes like incineration or anaerobic digestion reduces emissions and produces renewable energy.
- Landfill Gas Capture: Collecting and utilizing methane emissions from landfills for energy generation mitigates greenhouse gas releases.

RECOMMENDED READINGS

- A Sample Environmental Impact Assessment (<u>EIA</u>) Report: <u>https://www.reg.rw/fileadmin/user_upload/EIA_MUSANZE_IN_HOUSE_2.</u> <u>pdf</u>
- A Sample Environmental and Social Impact Assessment (ESIA) Report: https://www.mininfra.gov.rw/fileadmin/user_upload/Mininfra/Document s/Housing and Urban Planning Docs/Environmental and Social Impact Assessment Final Report.pdf

- ESIA & ESMP Samples for marshland rehabilitation:
- Environmental and social impact assessment (ESIA) and environmental and social management plan (ESMP) for Karangazi and Rwangingo marshlands rehabilitation and development subproject in Nyagatare and Gatsibo districts : <u>https://lwhrssp.minagri.gov.rw/fileadmin/user upload/Safe Guards Reports/Comple ted Projects/Environment/RSSP/EIA report for Karangazi -Rwangingo marshlands.pdf</u>

A sample ESIA for feeder roads:

Environmental and social impact assessment (ESIA) for rehabilitation, upgrading and multi-year maintenance works of indicative feeder roads in Rutsiro District, 79 KM (3 Lots): https://www.rtda.gov.rw/fileadmin/templates/publications/Updated Environmental and Social Impact Assessment ESIA for selected feeder roads Rutsiro September 2020 new.pdf

EIA & EMP Sample for Irrigation:

The Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) of works related to the development of irrigation infrastructure for crop production in <u>Rugende</u> marshland : <u>https://lwhrssp.minagri.gov.rw/fileadmin/user upload/Safe Guards Reports/Comple ted Projects/Environment/RSSP/Environmental and Social Impact Asses sment of Rugende Marshland.pdf</u>

- <u>Agro-ecological</u> zones in Rwanda: <u>http://www.tropicultura.org/text/v5n4/153.pdf</u>
- <u>ATLAS OF RWANDA</u> Agriculture Land Boundaries: <u>https://tecan.minagri.gov.rw/fileadmin/user_upload/Atlas_land_final4.pd</u> <u>f</u>
- Land use map of Rwanda: <u>https://www.fao.org/3/au280e/au280e.pdf</u>
- Law N°48/2018 OF 13/08/2018 on environment: <u>https://rema.gov.rw/fileadmin/templates/Documents/Law on environments</u> <u>nt.pdf</u>
- 7 Years Government Programme: National Strategy for Transformation (<u>NST1</u>):

https://www.nirda.gov.rw/uploads/tx_dce/National_Strategy_For_Trsansf ormation_-NST1-min.pdf

- Rwanda <u>State of Environment</u> and Outlook Report 2021: <u>https://www.rema.gov.rw/fileadmin/user_upload/Rwanda_SOER_Final-</u> <u>05February2022-LR.pdf</u>
- General <u>guidelines and procedure</u> for environmental impact assessment: <u>https://www.rema.gov.rw/fileadmin/user_upload/13-</u> <u>RW_EIA_Guidelines_Final_versionl_Nov_2006.pdf</u>
- Law N° 70/2013 OF 02/09/2013 <u>Governing Biodiversity</u> in Rwanda: <u>https://rema.gov.rw/fileadmin/templates/Documents/rema_doc/Laws%20and%2</u> <u>ORegulations Updated/Laws/Law%20Governing%20Biodiversity%20in%20Rwanda</u> <u>.pdf</u>
- Ministerial order N°004/16.01 OF 24/05/2013 determining the list of <u>water</u> <u>pollutants</u>: <u>https://rema.gov.rw/fileadmin/templates/Documents/rema_doc/Laws%20and%2</u> <u>ORegulations_Updated/Ministerial%20Orders/Ministerial_list%20of%20water%20</u> <u>pollutants.pdf</u>

- National <u>Environment and Climate Change</u> Policy: <u>https://rema.gov.rw/fileadmin/templates/Documents/rema_doc/Laws/R</u> <u>wanda%20National%20Environment%20and%20Climate%20Change%20P</u> <u>olicy.pdf</u>
- Atlas of <u>Rwanda's Changing Environment</u>: Implications for Climate Change Resilience: <u>https://www.rema.gov.rw/fileadmin/templates/Documents/rema_doc/Atl_as/Atlas%202011%20Final.pdf</u>
- <u>Environment</u> and <u>climate</u> change in Rwanda: <u>https://www.rema.gov.rw/resources</u>