MEKI CATHOLIC SCHOOL

Grade 12 Geography Exam Based Short Note

"Success doesn't come from what you do occasionally, but from what you do consistently. Study hard today, so your future self will thank you tomorrow." 🚀📚

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Unit 2: Climate Change

Introduction

Climate change is a pressing global issue affecting ecosystems, economies, and societies. Unit 2 explores its basic concepts, trends, causes (both natural and human-induced), consequences, and strategies for adaptation and mitigation. It also covers international agreements and Ethiopia's climate-resilient green economy framework, emphasizing the interplay between human activity and environmental change.

2.1 Basic Concepts of Climate Change

Learning Objectives

- Define climate change and related terms.
- Differentiate between weather and climate.

Key Terms

- **Climate**: Long-term average of weather patterns (temperature, precipitation, humidity) over decades or centuries.
- **Weather**: Short-term atmospheric conditions (e.g., daily temperature or rainfall).
- **Climate Change**: Significant, long-term shifts in climate patterns, often due to human activity or natural processes.
- **Global Warming**: Increase in Earth's average surface temperature due to greenhouse gas emissions.

Overview

- **Climate vs. Weather**: Weather is immediate and local (e.g., a rainy day), while climate is a regional or global average over time (e.g., 30-year rainfall trends). Climate change refers to persistent alterations in these averages.
- **Scope**: Includes rising temperatures, shifting precipitation patterns, and extreme weather events, driven by both natural variability and human actions.

Key Processes

- **Greenhouse Effect**: Natural process where gases (e.g., CO_2, methane) trap heat in the atmosphere, maintaining Earth's temperature. Enhanced by human emissions, it leads to global warming.
- **Carbon Cycle**: Circulation of carbon through atmosphere, oceans, soil, and organisms. Human activities (e.g., burning fossil fuels) disrupt this balance, increasing atmospheric CO_2.

2.2 Trends in Global Climate Change

Learning Objectives

- Identify historical and current trends in climate change.
- Analyze temperature and precipitation data.

Overview

- **Historical Trends**: Earth's climate has fluctuated naturally (e.g., Ice Ages), but recent changes are unprecedented in speed and scale.
- **Current Trends**:
  - **Temperature Rise**: Global average temperature has increased by about 1.1°C since pre-industrial levels (1850-1900), per IPCC reports.
  - **Precipitation Changes**: Wetter regions (e.g., northern Europe) are getting wetter, while dry regions (e.g., the Mediterranean) are drying.
  - **Extreme Events**: Increased frequency of heatwaves, droughts, floods, and storms.

Evidence

- **Temperature Records**: Data from thermometers, satellites, and ice cores show a clear warming trend since the 20th century.

- **Sea Level Rise**: Melting ice caps and thermal expansion have raised sea levels by about 20 cm since 1900.
- **Glacial Retreat**: Glaciers (e.g., in the Alps, Himalayas) are shrinking rapidly.

2.3 Natural and Human-Induced Climate Change

Learning Objectives

- Distinguish between natural and anthropogenic causes.
- Assess their relative impacts.

Key Terms

- **Natural Variability**: Changes due to Earth's internal processes (e.g., volcanic eruptions).
- **Anthropogenic**: Human-caused changes (e.g., industrialization).

Natural Causes

1. **Solar Variability**: Changes in solar radiation output (e.g., sunspot cycles) affect climate, though their impact is minor compared to human factors.
2. **Volcanic Eruptions**: Release ash and gases (e.g., SO_2), temporarily cooling Earth by reflecting sunlight (e.g., Mount Pinatubo, 1991).
3. **Orbital Changes**: Milankovitch cycles (Earth's tilt, orbit shape) drive long-term climate shifts like Ice Ages over millennia.
4. **Plate Tectonics**: Continental drift alters ocean currents and atmospheric circulation over geological time.

Human-Induced Causes

1. **Greenhouse Gas Emissions**:
   - **CO_2**: From fossil fuel burning (coal, oil, gas) and deforestation.
   - **Methane (CH_4)**: From agriculture (e.g., rice paddies, livestock) and landfills.
   - **Nitrous Oxide (N_2O)**: From fertilizers and industrial processes.
2. **Deforestation**: Reduces carbon sinks, releasing stored CO_2.
3. **Industrialization**: Increases emissions from manufacturing and energy production.
4. **Urbanization**: Heat island effect and land-use changes amplify warming.

Comparison

- **Natural**: Slow, cyclical, less impactful in short term (e.g., centuries to millennia).
- **Human**: Rapid, exponential, dominant since the Industrial Revolution (e.g., last 200 years).

2.4 Consequences of Climate Change

Learning Objectives

- Evaluate impacts on ecosystems, economies, and societies.
- Identify vulnerable regions.

Overview

Climate change disrupts natural systems and human livelihoods, with effects varying by region and intensity.

Environmental Impacts

1. **Rising Temperatures**: Alters habitats, stressing species (e.g., coral bleaching).
2. **Melting Ice**: Loss of polar ice and glaciers raises sea levels, flooding coastal areas.
3. **Extreme Weather**: More intense hurricanes, droughts, and floods (e.g., Hurricane Katrina, 2005).
4. **Biodiversity Loss**: Species extinction due to habitat shifts (e.g., polar bears).

Economic Impacts

1. **Agriculture**: Reduced crop yields in warmer, drier regions (e.g., sub-Saharan Africa).
2. **Infrastructure Damage**: Storms and floods destroy roads, buildings (e.g., 2018 Kerala floods).
3. **Insurance Costs**: Rising claims from natural disasters strain economies.

Social Impacts

1. **Displacement**: “Climate refugees” from sea level rise (e.g., Pacific islands) or desertification.

2. **Health Risks**: Heatwaves, vector-borne diseases (e.g., malaria spread).
3. **Conflict**: Resource scarcity (e.g., water wars in Darfur).

Vulnerable Regions

- **Low-lying Areas**: Bangladesh, Maldives (sea level rise).
- **Arid Regions**: Sahel, Horn of Africa (droughts).
- **Polar Regions**: Arctic (ice melt).

2.5 Adaptation and Mitigation Strategies to Climate Change

Learning Objectives

- Define adaptation and mitigation.
- Propose strategies for each.

Key Terms

- **Adaptation**: Adjusting to climate change effects (e.g., building seawalls).
- **Mitigation**: Reducing causes of climate change (e.g., cutting emissions).

Adaptation Strategies

1. **Infrastructure**: Flood-resistant buildings, elevated roads.
2. **Agriculture**: Drought-resistant crops, efficient irrigation (e.g., drip systems).
3. **Water Management**: Rainwater harvesting, desalination.
4. **Health**: Early warning systems for heatwaves, disease control.

Mitigation Strategies

1. **Renewable Energy**: Solar, wind, hydro to replace fossil fuels.
2. **Reforestation**: Planting trees to absorb CO_2.
3. **Energy Efficiency**: Green buildings, fuel-efficient vehicles.
4. **Carbon Pricing**: Taxes or cap-and-trade systems to limit emissions.

Comparison

- **Adaptation**: Reactive, manages impacts (short-term focus).
- **Mitigation**: Proactive, prevents worsening (long-term focus).

2.6 International Conventions and Agreements on Climate

Learning Objectives

- Outline major climate agreements.
- Assess their goals and effectiveness.

Key Agreements

1. **UNFCCC (1992)**:
   - **Goal**: Stabilize greenhouse gas concentrations.
   - **Outcome**: Framework for global cooperation, annual COP meetings.
2. **Kyoto Protocol (1997)**:
   - **Goal**: Legally binding emission cuts for developed nations (e.g., 5% below 1990 levels by 2012).
   - **Effectiveness**: Limited by non-participation (e.g., USA) and exemptions for developing nations.
3. **Paris Agreement (2015)**:
   - **Goal**: Limit warming to below 2°C, ideally 1.5°C, with voluntary Nationally Determined Contributions (NDCs).
   - **Effectiveness**: Broad participation (196 countries), but enforcement is weak.

Challenges

- **Compliance**: Lack of penalties for missing targets.
- **Equity**: Debate over responsibility (developed vs. developing nations).
- **Funding**: Insufficient support for poorer countries' transitions.

2.7 Pillars of Climate Resilient Green Economy of Ethiopia

Learning Objectives

- Explain Ethiopia's CRGE strategy.
- Identify its key pillars.

Overview

Ethiopia's Climate Resilient Green Economy (CRGE, 2011) aims to achieve middle-income status by 2025 while keeping emissions low and building resilience.

Pillars

1. **Sustainable Agriculture**:
   - Improve crop and livestock practices (e.g., terracing, agroforestry).
   - Reduce emissions from farming.
2. **Forestry**:
   - Reforestation and afforestation to sequester carbon.
   - Protect existing forests (e.g., Bale Mountains).
3. **Renewable Energy**:
   - Expand hydropower (e.g., Grand Ethiopian Renaissance Dam), solar, and wind.
   - Reduce reliance on biomass (e.g., wood burning).
4. **Energy Efficiency and Transport**:
   - Promote electric vehicles, efficient stoves.
   - Develop low-carbon urban systems.

Goals

- **Economic**: Boost GDP sustainably.
- **Environmental**: Limit emissions to 150 Mt CO_2e by 2030 (vs. 400 Mt in a business-as-usual scenario).
- **Social**: Enhance resilience to climate shocks (e.g., droughts).

Unit Summary

Unit 2 examines climate change as a multifaceted challenge. It contrasts weather and climate, tracks global warming trends, and separates natural causes (e.g., volcanism) from human drivers (e.g., emissions). Consequences span ecosystems, economies, and societies, necessitating adaptation (coping) and mitigation (prevention). International efforts like the Paris Agreement guide global action, while Ethiopia's CRGE integrates green growth with resilience, focusing on agriculture, forestry, energy, and efficiency.

Review Questions Preparation

1. Differentiate between climate and weather with examples.
2. Describe two historical and two current trends in climate change.
3. List three natural and three human-induced causes of climate change.
4. Discuss three environmental and three social consequences of climate change.
5. Compare adaptation and mitigation, providing two examples of each.

6. Outline the goals of the Kyoto Protocol and Paris Agreement.
7. Explain two challenges facing international climate agreements.
8. Identify and describe the four pillars of Ethiopia's CRGE strategy.
9. How does deforestation contribute to climate change?
10. Why are low-lying regions particularly vulnerable to climate change?

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