Creation Care in a Maasai Context Prepared by Mwl. Lais Joseph

Lesson Plan #3) Integrating Climate Science in Maasailand **Context: Form 2 Biology**

Lais' Introduction

- This part of the research project is organized by Mama Anya, a former MGLSS teacher, together with Mwalimu Lais Joseph at MGLSS.

Lesson 3) Integrating Climate Science for a Maasai Context

Name	**3) Integrating climate science for a Maasai context**	**Teaching Equipment Needed**	• Whiteboard and markers ○ ~~Maps showing the geographical distribution of Maasailand, climate zones, and environmental features.~~
Context	Form 2 Biology	**Student Supplies/ Handouts**	• ~~Questions to stimulate classroom discussion about the integration of climate science and traditional knowledge~~

Main Point	SCIENCE	**Climate change is impacting the Maasai community's traditional way of life, but integrating climate science with cultural and environmental knowledge can support mitigation and adaptation for sustainable living.**
Learning Outcomes	As a result of this lesson, the learner will:	
Cognitive: Know 	**Science** SCIENCE • **Review:** Understand the core concepts of climate science (i.e., climate change, greenhouse effect, human caused GHGs) and their effects on ecosystems and humans. • ~~Understand further how climate change affects biodiversity, water sources, and weather patterns.~~ • **Review:** Understand the main impacts of climate change upon ecosystems and humankind • Know the difference between climate change mitigation (prevention) and adaptation (reducing risk to the bad effects) • Understand core principles of sustainable pastoralism **Maasai** MAASAI • **Review:** Understand how climate change affects the pastoralist Maasai traditional way of life • Understand how integrating science and traditional environmental knowledge (TEK) can help the Maasai with adaptation to the bad effects climate change and support sustainable living	

	Biblical Creation Triangle • Understand how climate science can support creation care with its spiritual and ethical dimensions of environmental stewardship described in biblical teachings. **Hope** • Understand that climate scientists and environmentalists have hope that human efforts can mitigate climate change, which encourages hope. • Know key Bible texts that teach that God has promised to never abandon creation and will result in its ultimate reconciliation and restoration • Realize that our efforts to address climate change are part of working towards God's hopeful future while being faithful to God's commission to care for creation.
Affective: Feel	• **Appreciation** for Maasai traditional environmental knowledge TEK • **Responsibility** toward preserving the environment for future generations • **Hopeful** for the future with human efforts and God's promises
Applicative: Do	• Have students brainstorm practical actions that the Maasai community could take to adapt to climate change, such as water conservation methods, sustainable grazing practices, or diversifying their livelihoods.

Time	Content
5	**1) HOOK** (Attention getter) "Have you ever wondered what would happen if the Earth's temperature kept rising, or if our weather started changing in ways we couldn't predict? Imagine floods, droughts, and stronger storms becoming more frequent—how would our world look then? What if this was already happening, and it's up to us to help stop it?" **Notes to teachers** • *By starting with a **question** about climate change, it invites students to consider the reality of the issue. This is followed by vivid **imagery** of what could happen as a result of climate change. The key is to create an emotional connection and intrigue, prompting curiosity about the topic.* **Helpful information for teachers** • *When the rains come, the Maasai move their herds to new pastures, allowing the land to recover and grow fresh grass. This rotational grazing ensures that the land remains fertile and productive. The Maasai have inherited this practice from their ancestors, who understood that balance and respect for the land were key to their survival.* • *In the dry season, when the earth cracks under the relentless sun, the Maasai must travel long distances to find water sources for their herds. The Maasai know where to find hidden springs and seasonal rivers, passed down through generations of*

<table>
<tr><td></td><td>knowledge. Water is not just a resource; it is a lifeline, a critical element that shapes their movements and daily routines.
• The Maasai community, known for their rich cultural heritage and traditional pastoralist lifestyle, has long depended on the natural environment for their livelihood. However, in recent years, the effects of climate change such as unpredictable rainfall, prolonged droughts, and diminishing grazing lands have posed significant challenges to their way of life. Therefore, integrating climate science into the Maasai context is crucial for understanding these changes and developing strategies to adapt and thrive in a changing environment.
• By blending modern climate science with the Maasai’s traditional ecological knowledge, we can create a holistic approach that respects cultural practices while promoting sustainable solutions. This integration not only empowers the Maasai to protect their environment and sustain their livelihoods but also enriches their understanding of the world around them, fostering resilience in the face of climate challenges.</td></tr>
<tr><td>1</td><td>Transition statement: (connecting Hook to Main Point).
• But what happens when that environment begins to change in ways we don’t expect?
• Let’s explore how climate science can help us understand these changes and find ways to protect the Maasai way of life.</td></tr>
<tr><td>12</td><td>2) BOOK (Bible observation and/or core content)
Review: the students to basic climate science concepts, including the definition of climate change/global warming, the meaning of greenhouse effect, and common GHGs. Use examples that are relatable to the Maasai context, such as changes in rainfall patterns, drought, and the availability of grazing land.

Climate Change/Global Warming


Let’s review our core climate science concepts.

• Who can give me a definition of climate change?
o Climate change refers to long-term changes in temperature, precipitation, wind patterns, and other aspects of the Earth’s climate system.
o It includes both natural processes and human activities that alter the Earth’s climate over extended periods.
o This is a natural process that keeps the Earth warm enough for life. However, climate change is primarily driven by human activity:
▪ like cutting down trees (reducing the taking up of CO_2), mining, bad methods of farming including the use of chemical fertilizer in excess
▪ and burning fossil fuels (petrol, oil, coal) which release extra Earth-warming gases into the air.
o This causes the Earth to trap too much heat, leading to global warming and climate change, called the “greenhouse effect.”</td></tr>
</table>

- **Now a new concept: Climate change** is different than **global warming**.
  - Global **Warming** is a major factor contributing to the broader phenomenon of **Climate Change**, but climate change also includes non-temperature related changes, such as shifting rainfall patterns, ocean acidification, and more.
  - **Global warming** refers to the increase in the Earth's average surface temperature due to human activities, particularly the emission of greenhouse gases.

- Who can give me a definition of **the greenhouse effect?**
  - The **greenhouse effect** is when the Earth's surface warms up.
  - It occurs when certain gases in the Earth's atmosphere, known as greenhouse gases (GHGs), trap heat from the sun.
  - The gases let sunlight in but prevent some of the Earth's heat from escaping back into space, thus keeping the planet warmer than it would be otherwise.

- Who can tell me some of the **greenhouse gases?**
  - These gases include carbon dioxide (CO_2), methane (CH_4), and water vapor (H_2O).
  - Lesser known and less important for this less:
    - Nitrous Oxide (N_2O): This gas is emitted from agricultural activities, especially the use of synthetic fertilizers, and from fossil fuel combustion.
    - Fluorinated Gases: These synthetic gases, used in industry and refrigeration, have a high global warming potential but are present in smaller quantities.

- What is the **difference between mitigation and adaptation**?[1]
  - **Mitigation** measures are those actions that are taken to reduce greenhouse gas emissions.
  - **Adaptation** measures are based on decreasing vulnerability to the effects of climate change.
  - Thus, Mitigation seeks to **reduce** the *causes* of climate change,
    while adaptation seeks to make people more **resilient** or **less vulnerable (less risk)** to the *impacts* of climate change.

- Who can tell me some of the **effects of climate change?**
  - **Increased temperatures**: Human activities like burning fossil fuels release CO_2 and other GHGs into the atmosphere, trapping heat and causing global temperatures to rise. This disrupts natural climate patterns and leads to more frequent and severe weather events.
  - **Changing rainfall patterns:** With climate change, rains have become more erratic, leading to droughts or floods.
  - **Extreme weather events**, like floods or droughts can damage the environment, further upsetting the natural balance.
  - **Resource depletion:** Increased temperatures and prolonged droughts contribute to the degradation of grazing lands by overgrazing.
  - **Ecosystem disruption**: Higher temperatures and altered precipitation patterns affect ecosystems, leading to habitat loss, species migration, and changes in food chains. These disruptions harm biodiversity and the balance of natural systems.
  - **Loss of biodiversity:** As the climate shifts, some species that are not able to survive in warmer or disrupted ecosystems.
  - **Ocean changes**: Warming temperatures and increased CO_2 levels result in ocean warming and acidification, which damage marine ecosystems, including coral reefs.

- **Melting ice and rising seas**: The warming climate causes glaciers and ice caps to melt, contributing to rising sea levels. This disrupts coastal ecosystems and threatens human and wildlife communities.

- Here's some new information: The scientists say that **climate change will affect humans** in many ways, including:
  - **Famine and food insecurity**, due to droughts and flooding that ruins crops
  - **Freshwater shortages**
  - **Health problems**
    - **More malaria** and other climate-sensitive diseases
    - **Poor air quality** causes respiratory diseases
  - **Heat waves** that are longer and hotter than normal which causes
    - **Heat related health problems**, especially for pregnant and older women
    - **Death** for vulnerable people, especially the sick and elderly
  - **Destruction of homes**, due to flooding and extreme weather
  - **Migration or "climate change refugees"** due to migration caused by lack of water, crop failure, extreme weather, etc.

7

Effects of Climate Change on the Maasai

- Now, let's talk about these effects of climate change and how they affect the pastoralist Maasai.
- Of the things we just mentioned, who can tell me one way how the Maasai will be affected? I want to hear from many of you with one concept each.
  - **Increased temperatures**: This disrupts natural climate patterns and leads to more frequent and severe weather events, including droughts that reduce grazing areas.
  - **Extreme weather events**, like floods or droughts can damage the environment, further upsetting availability of the natural resources upon which pastoralist livelihoods are dependent.
  - **Changing rainfall patterns:** The Maasai rely on predictable seasonal rains for grazing their livestock.
    - Disruption of the availability of pasture and water directly threatens the survival of their herds, which are central to Maasai culture and economy.
    - To cope with reduced grazing areas and water sources, the Maasai may have to move their herds more frequently or over longer distances.
  - **Resource depletion:** Increased temperatures and prolonged droughts contribute to the degradation of grazing lands by overgrazing, driven by the need the Maasai people to find adequate pasture.
  - **Loss of biodiversity:** As the climate shifts, some species that are vital to the Maasai ecosystem may become endangered or extinct. This loss of biodiversity disrupts the delicate balance of nature that the Maasai have long maintained, affecting everything from grazing patterns to the availability of medicinal plants.
  - **Ecosystem disruption**: Higher temperatures and altered precipitation patterns affect ecosystems, leading to habitat loss, species migration, and changes in food chains.
  - **Various effects on humans**: famine, water shortages, more malaria, other diseases will increase, etc., and the need to sell livestock for medical treatments.

7

3) LOOK (interpretation/reflection on core content)

Integrating Climate Science and Maasai TEK

SCIENCE

MAASAI

Maasai Adaptations

- Due to climatic changes, the pastoralists are integrating climate science and developing the following:
  - **Sustainable pastoralism:** Maasai may have to move their herds more frequently or over longer distances. They are adapting by incorporating modern weather forecasts with traditional knowledge to better plan grazing and water use.
  - **Drought-Resistant Grazing Systems:** Developing grazing systems that are resilient to drought can help manage limited resources more effectively.
  - **Water Conservation Efforts/ Efficient Water Use:** The Maasai are exploring new methods for conserving water, such as rainwater harvesting and improving traditional well construction to secure a more reliable water supply during dry periods. Improving water storage and usage practices, such as building more efficient wells and using water-saving technologies, supports the stewardship of water resources.
    - See "Smile Pits" in Resources below
  - **Greener Energy:** In an effort to reduce burning wood, which releases the GHG, CO_2, some Maasai are using:
    - **fuel efficient stoves**, which:
      Reduces the burning of firewood by 60% (less work to collect and haul wood) and
      Reduces the smoke in the home by 90% (less respiratory diseases) and
      Reduces the number of children burned by cooking fires.
      See Resources below.
    - **solar panels.**
  - **Diversified Livelihoods:** In response to changing conditions, the Maasai are looking at diversifying their sources of income and food, including integrating new agricultural practices, such as eco-farming, or supplementary income sources to reduce their reliance on traditional pastoralism alone.
  - **Educating the Maasai community** about climate science and its implications fosters a deeper understanding of their role as caretakers of the land. This education helps them make informed decisions that honor their stewardship responsibilities while adapting to environmental changes.
  - **Creation Care/Stewardship:** The Maasai—especially youth—are developing their understanding that being a steward of God's creation means integrating their science teachings that encourages actively participating in environmental conservation efforts, such as volunteering for clean-up projects, participating in tree-planting initiatives, or joining environmental projects.

3

- **Review:** Reflect on how caretaker of the earth is emphasized in the Bible (e.g., Genesis 2:15, where God places Adam in the Garden of Eden to "work/serve it and take care of it").

BIBLE

- The biblical mandate to "work/serve it and take care of it" reflects a call to active and responsible stewardship.
- Discuss how the Maasai can apply these principles to protect their environment align with biblical creation care.
  - For the Maasai, this means continuing their traditional practices while embracing new knowledge and technologies that support environmental sustainability.

8

Look continued: Hope[AA1] **How to teach info?**

Hope in Climate Science

- Climate scientists emphasize the interconnectedness of humans and nature and highlight the urgent need for action to protect the planet.
  The message from climate science parallels the biblical call for creation care, underscoring the role of humanity in maintaining environmental health and ensuring sustainability.
- From the perspective of climate scientists, there is hope that if we change our behaviors—through sustainable practices, green technologies, and conservation efforts—we can reverse or mitigate some of the damage done to the planet.
  - **Hope lies in our collective ability to care for the environment in a way that ensures future generations can enjoy a thriving, healthy world.**
- **Wangari Maathai,** Nobel laureate and Kenyan environmentalist, wrote in The Challenge for Africa:
  "Indigenous knowledge and traditions can teach us valuable lessons in environmental stewardship and how to live in harmony with the land, honoring both creation and the Creator."

Biblical Hope

- Through scripture, we are reminded that God has promised to never abandon creation and will result in its ultimate reconciliation and restoration.
  - **The God of hope will never abandon the creation**
    - Know that God is the Creator and Sustainer of the world, who will never abandon God's creation but will reconcile all things to Jesus Christ. **Colossians 1:15–20**
    - Know that "hope" in the Bible is not wishful thinking, but the hopeful expectation that what God has promised will be fulfilled (and promised glory revealed). Romans **8:19–25**
  - **Resilience of God's creation**
    - Realize that there is amazing resilience in God's creation. Despite huge and ongoing effects of human-caused climate change, we are called to faithfully continue the creation care mandate of **Genesis 2:15** to nurture the restoration.
    - Know that **creation care works,** we need more of it. So that many people working together in little ways can make a big change.
    - Realize that our efforts to address climate change are part of **working towards God's hopeful future** while being faithful to God's commission to care for creation.

- **The cosmic power of the Holy Spirit for transformation and re-creation**
  - Understand that **the greatest challenge** is not lack of science, technology, or resources, but **rather greed and apathy**—and these need a spiritual transformation by the power of the Holy Spirit.
  - Know that the power that raised Christ from the dead is available to us who believe. **Ephesians 1:19–20**
  - Know that God will restore creation when Jesus Christ returns. **Romans 8:21**; **Revelation 21:1–5**

4) TOOK (Application: what do DO/take away)

Encouragement

**

- Dr. **Katharine Hayhoe**, a climate scientist, explains:
  "Caring for the earth is an expression of our love for God and for our neighbors, and should be an essential part of the Christian mission in the world."
  - Just as the Bible calls us to love our neighbors and care for God's creation, climate science shows that taking responsibility for environmental health is essential to ensuring the well-being of current and future generations.

BIBLE

Activity

SCIENCE MAASAI

- Have students brainstorm practical actions that the Maasai community could take to adapt to climate change, such as water conservation methods, sustainable grazing practices, or diversifying their livelihoods.
- For the Maasai community, adapting to climate change involves implementing practical actions that align with their traditional practices while integrating modern techniques to ensure sustainability.
- Here are some practical actions that the Maasai could take:
  - **Install rainwater harvesting systems:** Collect and store rainwater from rooftops and other surfaces using tanks or cisterns. This water can be used during dry periods for drinking and irrigation.
  - **Create pans and dams:** Build small dams or water pans to capture and store runoff water from rain. These structures can help replenish groundwater and provide water during dry seasons.
  - **Efficient water use:**
    - **Improve well construction:** Reinforce traditional wells with modern materials to reduce evaporation and contamination. Ensure proper maintenance to maximize their lifespan.
    - **Drip irrigation:** Use drip irrigation systems for any agricultural activities, which delivers water directly to the plant roots, reducing water wastage.
  - **Water-saving techniques:**
    - **Promote water-use efficiency:** Educate the community on water-saving practices, such as fixing leaks, using water-efficient fixtures, and minimizing water use where possible.

	○ **Enhance rotational grazing:** Refine traditional rotational grazing methods to ensure that pastures are given adequate time to recover. Implement systems that rotate grazing areas more frequently based on vegetation health and soil condition. ▪ Reseed and restore degraded lands: Plant drought-resistant grass species and restore degraded pastures to improve their productivity and resilience. ▪ Monitor and manage overgrazing: Use scientific methods to monitor the condition of grazing lands and manage herd sizes to prevent overgrazing and land degradation. ▪ Grow and store fodder: Cultivate drought-resistant fodder crops and store them for use during dry periods. This ensures that cattle have adequate nutrition even when pasture is scarce. ○ **Develop eco-tourism:** Promote eco-tourism initiatives that leverage the Maasai's rich cultural heritage and natural landscapes, providing an alternative source of income while conserving the environment. ○ **Craft and artisanal products:** Encourage the production and sale of traditional Maasai crafts and artisanal products, which can serve as a source of income and preserve cultural heritage. ○ **Agroforestry:** Integrate trees and shrubs into agricultural systems to improve soil fertility, reduce erosion, and provide additional sources of income. • Encourage students to think of ways they can contribute to environmental conservation in their own lives.
15	**Song competition (MGLSS and Moringe Sokoine 2025)** ○ Get in the same groups from the first lesson, continue writing your song to the same traditional Maasai tune. You have 10 minutes to work together. ○ Your first verse was about God commissioning us to care for God's good creation. ○ The **second verse** was about traditional Maasai environmental knowledge and practices that are also best practices of climate change mitigation (reduction). ○ **Now, write the third verse** of a song **about best practices of climate change mitigation (reduction) and/or adaptation (resilience)** that is: 1) informed by climate science and 2) appropriate for a traditional Maasai context. ○ **Or** you can write a verse about how **we can find something we are passionate about and work with friends, so that together we can make a difference.** And we can find hope knowing that many other small groups around the world are joining with us to make a difference in caring for God's creation. This option could also be a fourth verse! ○ Remember, the guidelines are: ○ Take a traditional Maasai tune and write new words based on this lesson. ○ You can adapt the traditional Maasai tune, but it must be something that your family back in Maasailand will enjoy. ○ The language must be Maa. ○ The content of the verses needs to connect to the lesson content. ○ There will be a minimum of 3 verses, one for each lesson. ○ Your group must be a minimum of 3 Maasai students who are in the classroom now. You can have more people. ○ Later, we will have a competition judged by Dr. Seth Sululu, a Maasai professor of music at Tumaini University Makumira. ○ The winning group will have their song professionally produced at the Cultural Arts Center at TUMA for free distribution in Maasailand.

	○ To repeat our task:
	  ○ **Write the third verse** of a song about **best practices of climate change mitigation** (reduction) **and/or adaptation** (resilience) that is: 1) informed by climate science and 2) appropriate for a traditional Maasai context.
	  ○ **Or write a verse—or fourth verse—about how everyone working together can make a big difference.**
	○ *After 10 minutes*: Can we have 1 or 2 groups share their verse with us?
	○ Only volunteer if you are ready and can sing it without delay.
	○ I encourage you to work on developing your song. Later, we will make an announcement about the music competition!
	
	Ending: Remember, everyone working together can make a big difference!

2	Heavenly Creator, We come before you with hearts full of gratitude for the gift of creation and the beauty of the land we call home. We acknowledge your role as the Creator and Sustainer of all things. Lord, we seek your wisdom as we face the challenges brought by climate change. We ask for guidance in understanding the signs of our changing environment and for the knowledge to integrate science with our traditional practices. Help us to adapt with grace and to use the knowledge you have provided us to care for our land and water. Grant us the strength and courage to implement sustainable practices, such as conserving water, managing our grazing lands wisely, and diversifying our livelihoods. May our efforts honor your creation and reflect our commitment to being good stewards of the resources you have entrusted to us. Bless our community with unity and cooperation as we work together to protect our environment and preserve our way of life for future generations. Let us be inspired to embrace both our cultural heritage and the insights from climate science to achieve a harmonious balance. In your name, we pray for wisdom, strength, and protection. Amen.
60	**End of Class**

Follow-up survey

- Anonymous surveys were taken at the beginning of lesson 1. After this lesson, the same survey will be taken—anonymously. This follow-up survey is NOT to evaluate you students, but rather the survey will help us teachers know how to improve the effectiveness of the lessons for the future.
- As we lay out the surveys on the table, you will see your animal sticker on the paper. It is the same sticker attached to your first survey with the extra sticker. That sticker is for you!
- This animal sticker system is so that now, when you take the survey again, you can find your animal. We can keep the surveys anonymous but also study individual learning over time (before, after, and a few months later)—not just one large group.
- When you are done with the survey, turn the survey over, so the animal sticker is face down on your desk.
    - **Form 2 Biology and Confirmation students**: While ALL students are welcome to join in on the lessons, ONLY Maasai students can take the survey, as the research project is for the Maasai.

- **Form 2 Biology and Confirmation students**: Because of ethical research requirements, ONLY students who have a parent's or guardian's permission with a signed "informed consent" form will be able to take the surveys. (The informed consent form and process will be presented earlier with information for each student to also give one's own consent.)
- Let's take the survey. Do not write your name on the survey.

TEACHING NOTES:

More teaching resources (if more time)

- Engage in activities that promote environmental conservation within the Maasai context. By doing the following:
  - **Study and teach others about the Maasai:** including traditional practices, beliefs, and their deep connection to the land. Understanding their cultural heritage helps appreciate their way of life.
  - **Engage with Maasai community leaders and members** to hear their perspectives on climate change and environmental issues. Their traditional knowledge and experiences provide valuable insights into adapting to changes.
    - "How did our ancestors take care of the land and animals to ensure they stay healthy?"
    - "What natural signs do you look for to know when it's time to move the cattle or plant crops?"
    - "How do you make sure that water sources and pastures are used wisely and not overused?"
    - "What lessons from the past can we use today to protect nature and our way of life?"
    - "How did the elders in our community teach you to care for the environment when you were young?"
    - "In your view, how has the climate changed over the years, and what did you do to adapt?"
    - "What role do stories and traditions play in helping us understand how to care for creation?"
  - **Real-Life Examples**:
    Take students on a visit to a Maasai community or a local farm where they can see how people are adapting to climate change. This helps them learn directly from the community's practices.
  - **Talk to Elders**:
    Students can ask their grandparents (babu or koko) about how they adapt to changes in the weather and environment. These stories can be shared in class to learn from past generations. Here's a question that students can ask their grandparents (babu or koko) about adapting to changes in the weather and environment:
    - "Babu/Koko, how did you and people in your time adjust to changes in the weather or environment? Have you noticed any differences in how the weather is now compared to when you were younger?"
    - This question encourages grandparents to reflect on their personal experiences and observe any environmental changes over time, helping bridge the generational gap and connect traditional knowledge with current environmental shifts.
  - **Story**
    Here's a simple and engaging story that students can ask their grandparents about, which can also be shared in class to learn from past generations: **"The Changing Seasons."**
    - Once upon a time, in a small village, there lived a young girl named Amina. She loved to visit her grandfather, Babu, who lived on a farm. Babu always had fascinating stories

to tell about how the land, animals, and seasons had changed over the years. One day, Amina asked him, "Babu, how did you know when it was time to plant the crops, or when the rain would come?"

- Babu smiled and sat down beside her. He said, "When I was younger, we didn't have weather apps or fancy tools. We watched the clouds, the winds, and the animals. The birds would fly in a certain way before it rained. The trees would shed their leaves in the dry season, and the cows would graze in different areas when the rains were coming."
- Amina was curious. "Did the weather always stay the same, Babu? Did it ever change?"
- Babu looked out at the horizon and said, "Yes, my dear, the weather has changed over the years. When I was a young man, the rains came just when we expected them. The dry season was not as long, and the floods were not so fierce. But in recent years, we've noticed the rains are unpredictable. Sometimes we wait for them for so long, and other times, they come too suddenly. We have had to change how we farm, how we store water, and how we take care of the animals."
- Amina listened carefully and asked, "What do we do now to adapt, Babu?"
- Babu chuckled softly and said, "Well, we keep learning from the old ways, but also use new ideas. We conserve water, plant trees to protect the soil, and we use better tools to help us plan for the seasons. We also work together as a community, because when the weather changes, we all face it together."
- Amina smiled and said, "It sounds like we need to care for the earth, just like you did, Babu."
- Babu nodded. "Yes, Amina. The earth is our mother, and we must care for her, whether it's by planting trees, saving water, or simply listening to the winds and birds like we did before. The earth has always taught us, we just need to listen."

- **Class Discussion:** After the story, students can discuss the following questions:
  - What were some ways Babu adapted to changes in the weather when he was young?
  - How have things changed in the weather and environment over time according to Babu?
  - What can we learn from Babu's story about caring for the earth and adapting to change?
  - How can we use old knowledge and new tools to take care of the environment today?
- This story helps students appreciate how past generations adapted to environmental changes and can spark meaningful discussions on how to protect the earth today.

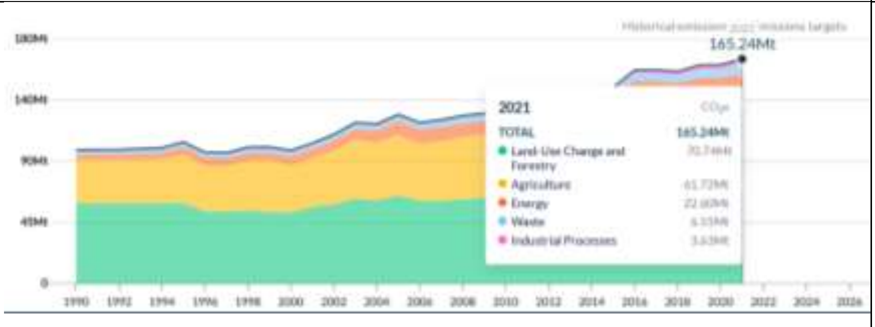
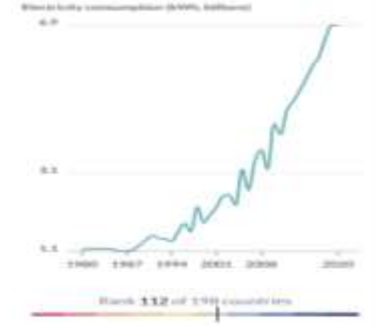
TEACHING NOTES on GREENHOUSE GASES

Greenhouse gases percent effect on climate change

- Source: https://commons.wikimedia.org/wiki/File:Greenhouse_Gases.jpg; Public Domain (modified, expanded info)

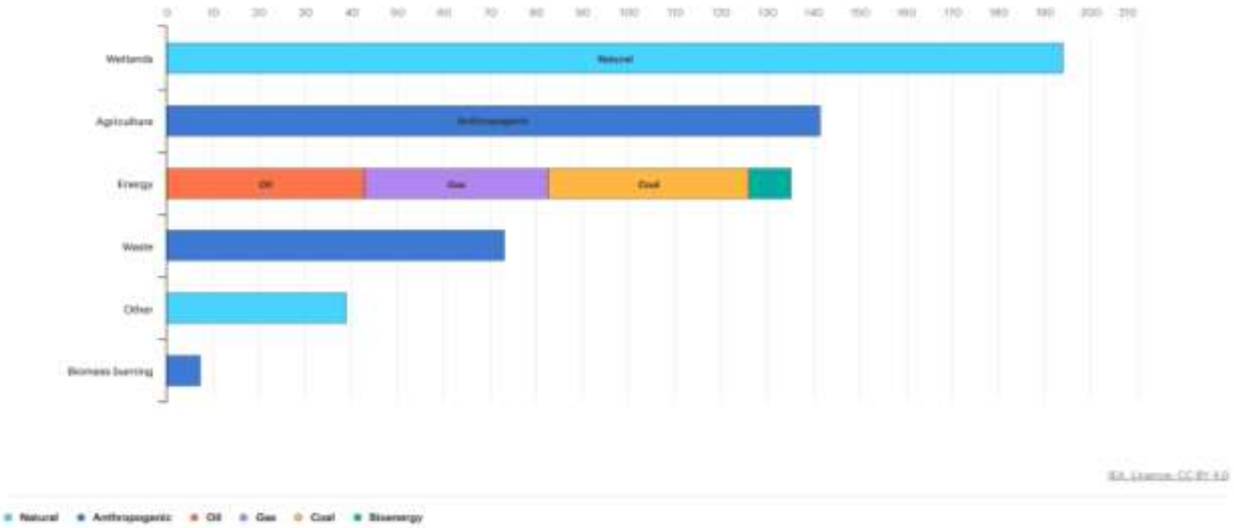
Effect on climate	Chemical formula	Name	Source
60%	CO_2	**carbon dioxide**	burning fossil fuels (like coal and petrol in cars) deforestation, wildfires, burning wood
16%	HFCs	**hydrofluorocarbons**	refrigerants, aerosol propellants in medicinal applications, and degreasing solvents.
15%	CH_4	**methane**	wetlands, organic waste, livestock, modern agriculture, burning biomass [See more info below.]
5%	N_2O	**nitrous oxide**	fertilizers, fuels, medical uses, rocket propellants, and motorcar racing
2%	PFCs	**perfluorocarbons**	paint, textile and aluminum production
1%	SF_6	**sulpher hexaflouride**	Electrical industry, rubber production
1%	H_2O	**water vapor**	irrigation, evaporation of rain, ice melting

Tanzania

"In 2021, Tanzania emitted 158.82 million tons of CO_2 equivalent representing 0.33% of global emissions."	Increase in electricity consumption
	
Souce: https://www.climatewatchdata.org/countries/TZA?end_year=2021&start_year=1990	https://www.climatewatchdata.org/countries/TZA?end_year=2021&start_year=1990

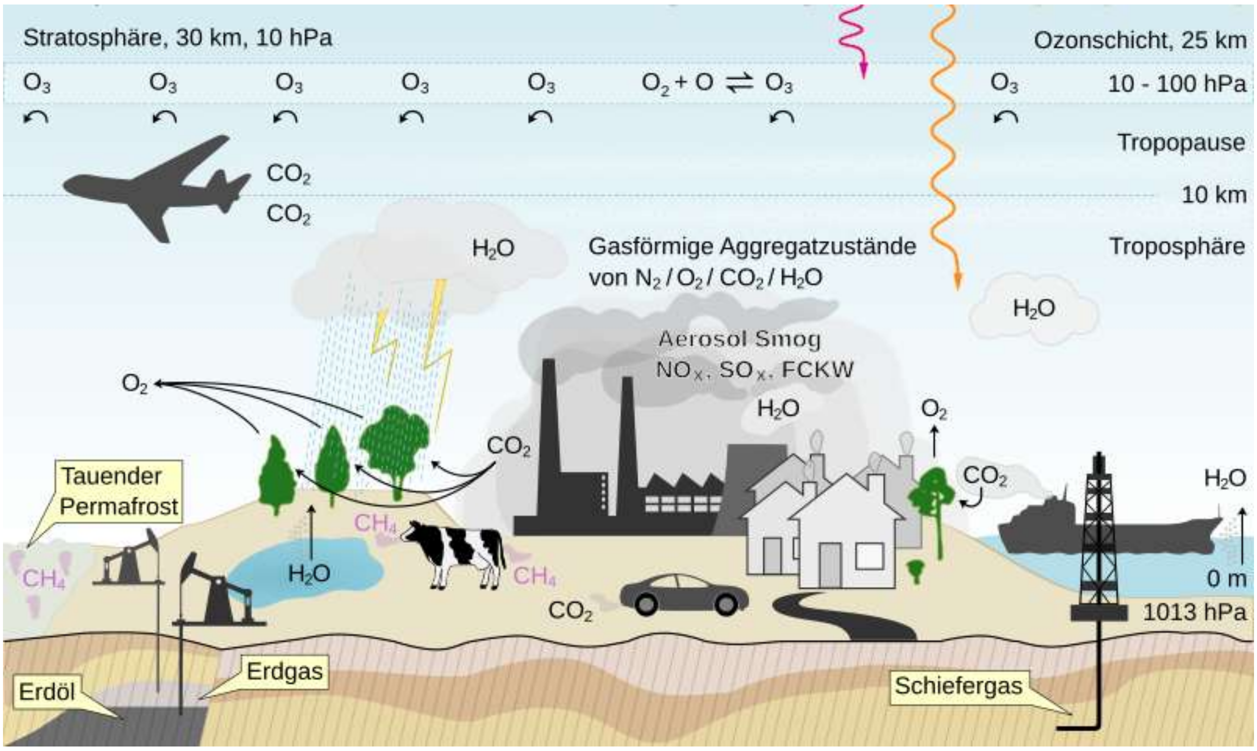
Methane

- Approximately 40% is from natural sources.
- The remaining 60% originating from human activity, known as anthropogenic emissions. The largest anthropogenic source is agriculture, responsible for around one quarter of emissions, closely followed by the energy sector, which includes emissions from coal, oil, natural gas and biofuels. (https://www.iea.org/reports/global-methane-tracker-2022/methane-and-climate-change)



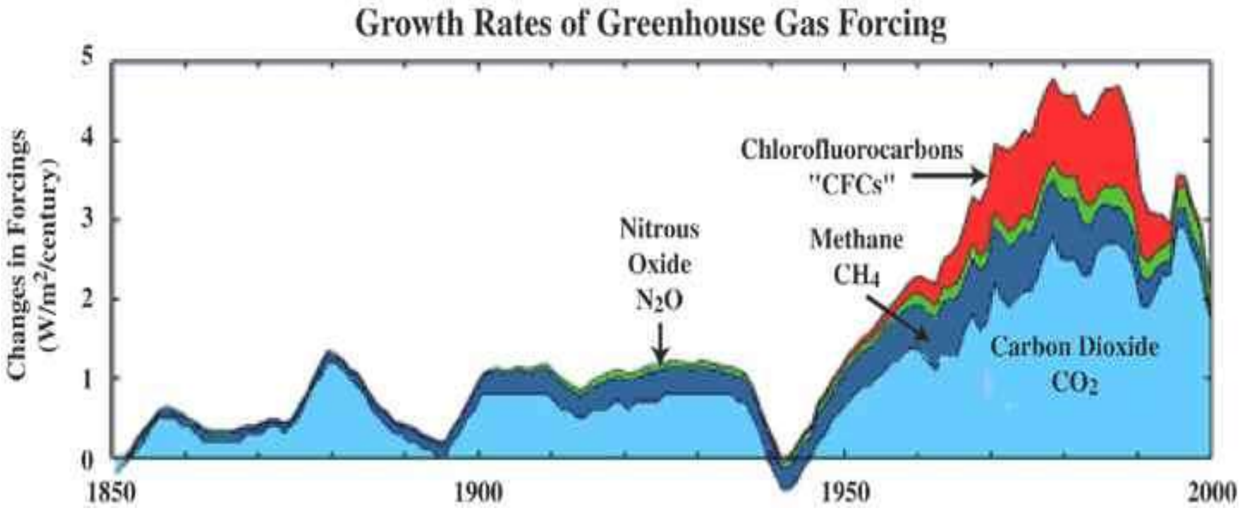
Sources of Greenhouse Gases Image

- Source: https://commons.wikimedia.org/wiki/File:Greenhouse_gases.svg Author: MagentaGreen, Creative Commons Attribution-Share Alike 4.0 International license.



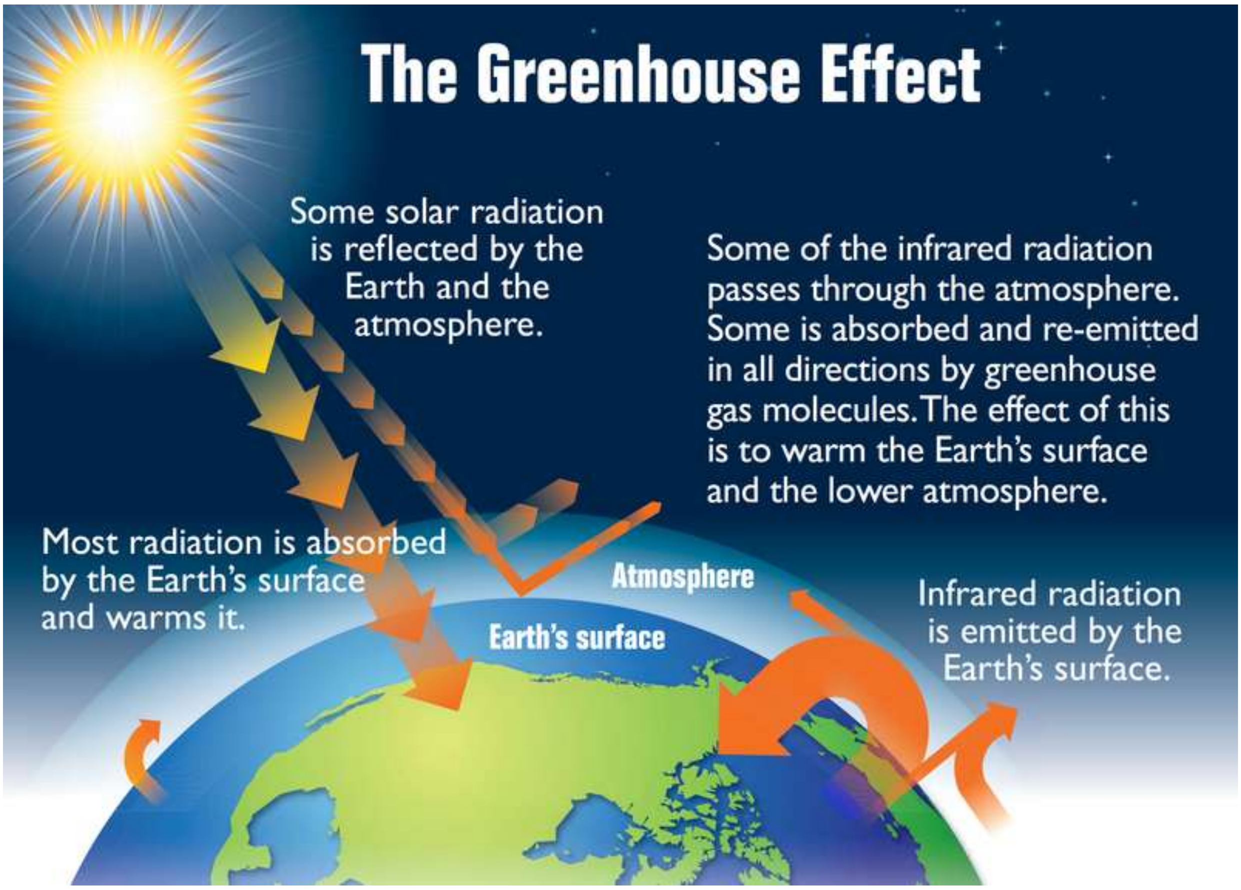
Growth Rates of Greenhouse Gases

Source: https://commons.wikimedia.org/wiki/File:Growth_rates_of_greenhouse_gases_figure1m.jpg Author: NASA - Goddard Space Flight Center Scientific Visualization Studio, http://svs.gsfc.nasa.gov/site_usage/credits.html; Public Domain



The Greenhouse Effect

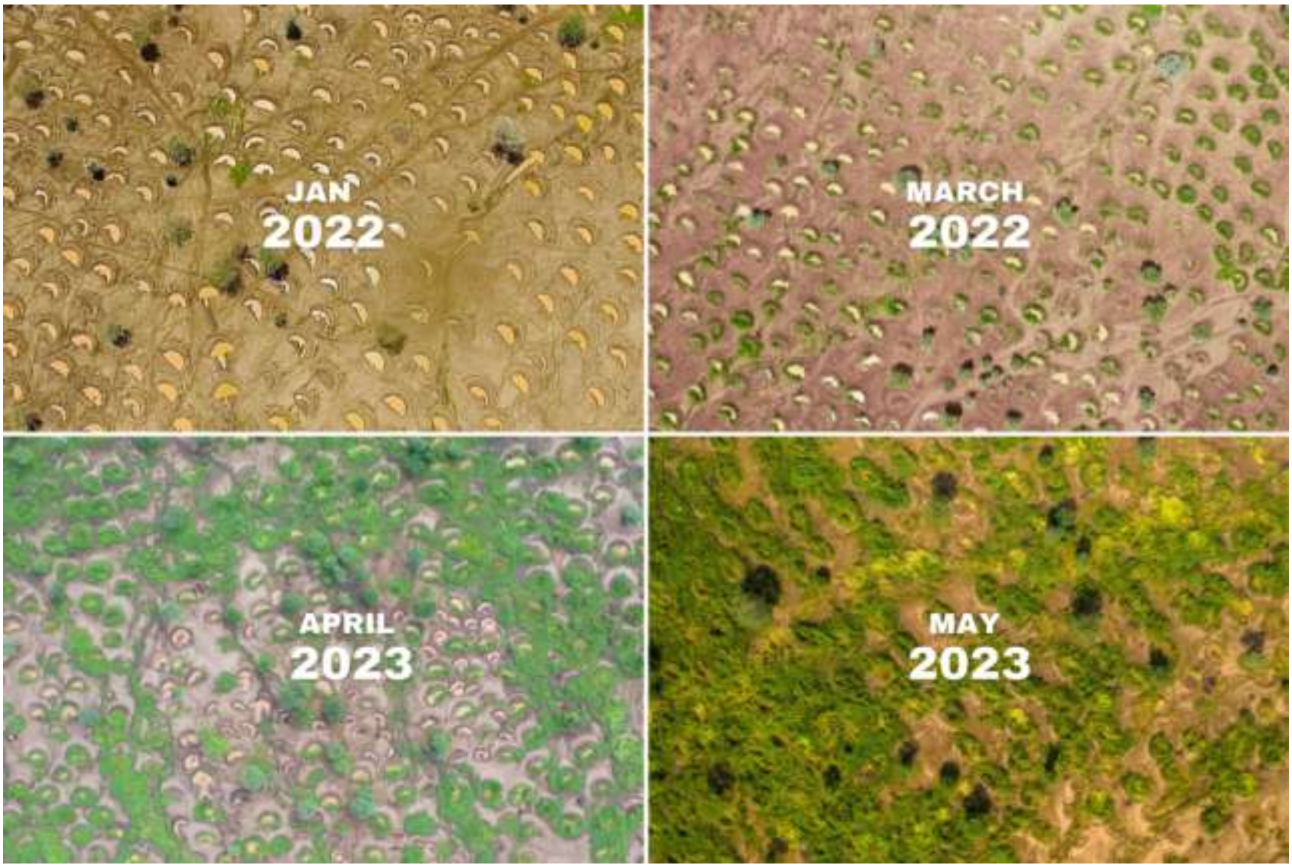
Source 1: https://commons.wikimedia.org/wiki/File:Earth%27s_greenhouse_effect_(US_EPA,_2012).png Author US EPA; Public Domain



TEACHING NOTES on MITIGATION (prevention)

"Smile" pits (Mitigation)

- Digging many small 2-meter wide half circles—"smile" pits—"regreens" the area with plants that take out CO_2 from the air (and also reduces soil erosion).
  - One recent example from the Lead Foundation: The Regreening Arusha Program's "goal is to reach more than 3,600 households in Monduli district and restore at least 86,400 trees and 440 hectares of rangeland. This is achieved by reversing the process of desertification and degradation of ecosystems through the techniques of Kisiki Hai and Rainwater Harvesting in order to improve livelihoods and climate change resilience.
  - See the amazing picture below from the Regreening Arusha Program. Source: https://leadfoundation.org/service/regreening-arusha-program/
  - See a short documentary of this Lead Foundation project in Engaruka, https://www.youtube.com/watch?v=RPJ9T4yAEGs&t=4s (7:08 minutes)



Fuel-efficient stoves for the Maasai (Mitigation)

- These fuel-efficient stoves:
  - Reduce the burning of firewood by 60% (less work to collect and haul wood) and
  - Reduce the smoke in the home by 90% (less respiratory diseases) and
  - Reduce the number of children burned by cooking fires.
  - Source: https://internationalcollaborative.org/news-resources/

- In Ketumbeine, Maasai women in the Naapok Women's Cooperative have been trained to build the fuel-efficient stoves. (Photo: Beth E. Elness-Hanson)

TEACHING NOTES on ADAPTATION (resilience, reducing risk)

Water Catchment or Reservoir (Resilience)

- This reservoir is in the Nanja area at the family boma of Selina Leyan (MGLSS Form 6 graduate 2004). This reservoir is hand dug with the cooperation of 3 or 4 neighboring bomas who all share the water.
- The rain collects during the rainy season and fills the reservoir. The thorn fence keeps animals out, so it is cleaner water. The water sustains them for most of the dry season. They then dig out the bottom, bringing the soil to the top of the sides of the reservoir to make it deeper. (Photo: Beth Elness-Hanson)

TEACHING NOTES on HOPE

Wangarĩ Maathai

- Wangarĩ Muta Maathai (/wænˈɡɑːri mɑːˈðaɪ/; 1 April 1940 – 25 September 2011) was a Kenyan social, environmental, and political activist who founded the Green Belt Movement, an environmental non-governmental organization focused on the planting of trees, environmental conservation, and women's rights. In 2004 she became the first African woman to win the Nobel Peace Prize.
  Source: https://en.wikipedia.org/wiki/Wangar%C4%A9_Maathai)

Nobel Peace Prize 2004:

- "for her contribution to sustainable development, democracy and peace."
  Wangari Maathai was the first African woman to receive the Nobel Peace Prize. She was also the first female scholar from East and Central Africa to take a doctorate (in biology), and the first female professor ever in her home country of Kenya. Maathai played an active part in the struggle for democracy in Kenya, and belonged to the opposition to Daniel arap Moi's regime.
- In 1977 she started a grass-roots movement aimed at countering the deforestation that was threatening the means of subsistence of the agricultural population. The campaign encouraged women to plant trees in their local environments and to think ecologically. The so-called Green Belt Movement spread to other African countries, and contributed to the planting of over thirty million trees.
- Maathai's mobilisation of African women was not limited in its vision to work for sustainable development; she saw tree-planting in a broader perspective which included democracy, women's rights, and international solidarity. In the words of the Nobel Committee: "She thinks globally and acts locally." (Source: https://www.nobelprize.org/prizes/peace/2004/maathai/facts/)

Prof. Wangarĩ Maathai

Kenyan

Awarded the 2004 Nobel Peace Prize[1]

“The 30 million trees planted by Green Belt Movement volunteers—mostly rural women—throughout Kenya over the past 30 years are a testament to the individuals’ ability to change the course of environmental history.

“Working together, we have proven that sustainable development is possible; the reforestation of degraded land is possible; and the exemplary governance is possible when ordinary citizens are informed, sensitized, mobilized and involved in direct action for their environment.”[2]

---

[1] Wangari_Maathai_Receives_the_Nobel_Peace_Prize.png Author: Nobel Committee; Creative Commons Attribution-Share Alike 4.0 International

Jane Goodall


https://en.wikipedia.org/wiki/Jane_Goodall_Institute

began her career in 1960 in Gombe National Park, Tanzania.

"Hope is what enables us to keep going in the face of adversity" *The Book of Hope,* (2022).

"I truly believe, and I'm not alone as a scientist, that we have a window of time when if we get together and take action, we can at lease slow down climate change and loss of biodiversity…

I can't save the world, but what can I do locally?…Whatever it is you care about, get together with some friends and take action. Do what you can do to solve what you are passionate about and you will find you make a difference."

https://www.youtube.com/watch?v=LXXb5MjPbPI

Enabling Sustainable Pastoralism

The rising global demand for livestock products (meat, milk, fat, fiber, hides) underlines the urgency for transformation in the production and consumption of livestock products towards greater sustainability. At the same time, the increasing degradation of rangelands highlights the need for sustainable solutions for the conservation and sustainable use of such ecosystems. The Post_2015 Agenda provides an opportunity to work globally towards enabling sustainable pastoralism on healthy rangelands, and to provide a significant share of livestock products in local and international markets. Investment in enabling sustainable pastoralism will rest upon the following six pillars:

1. Innovation in the provision of basic services that are appropriate to the mobile production systems of pastoralists, including renewable energy, mobile health and veterinary services, long distance schools and communications, and safe water for humans and animals;
2. Legal protection of collective land and natural resource rights, and private rights, to manage grazing areas, wildlife, water sources and livestock movement corridors, risk and resilience, and to enable land use planning and ecosystem management by pastoralists;
3. Equitable value chains and market access that provide economic opportunities to pastoralists through information, diversification, certification, niche markets, payments for ecosystem services, sustainable tourism, and local and sub-regional marketing infrastructure;
4. Empowered pastoralist institutions and systems through respect for indigenous knowledge and breeds, enabling knowledge sharing and networking, professional certification of herders and shepherds in sustainable land management, Free, Prior and Informed Consent, and improving representation in decision making;
5. Supportive policies and fair trade by creating a more level playing field with other sectors — where subsidies are fair, tariffs are levied for environmental costs of different sectors, and banking, credit and insurance are available;
6. Awareness of consumers and producers to respect the environmental values of rangeland biodiversity, genetic diversity of breeds, the cultural values of pastoralism and the health benefits of pastoral products.

Source

WISP (World Initiative for Sustainable Pastoralism) with support from IUCN, UNEP and IFAD, has worked to bring the science of pastoralism to the stage of policy makers. .

References

Books

Combining Climate Science and Maasai Knowledge

- **Homewood, Katherine and Trench, Pauline.** *Climate Change and the Future of Pastoralism in Africa: A Maasai Case Study.* Routledge, 2022.
  Explores how blending climate science with Maasai traditional knowledge helps address climate change's impacts on pastoralism.
- **Brockington, Dan, and Jim Igoe.** *Pastoralism and Climate Change: Bridging Science and Indigenous Knowledge.* Routledge, 2017.
  Highlights how connecting science with Maasai traditions creates culturally relevant climate solutions.
- **Leach, Melissa, and Scoones, Ian.** *Sustainable Livelihoods and Climate Change: The Maasai and Beyond.* Routledge, 2021.
  Focuses on merging climate science with indigenous systems to build effective adaptation strategies.

Building Adaptation and Resilience

- **Gibson, Craig C., and Stephen A. Marks.** *Integrating Climate Adaptation into Maasai Pastoralism: Policy and Practice.* Cambridge University Press, 2019.
  Examines how scientific and traditional insights can foster resilience against environmental challenges.
- **Nugent, Paul.** *The Climate Crisis and Pastoralism: Insights from the Maasai.* Oxford University Press, 2020.
  Discusses adaptive strategies that integrate scientific and ecological practices of the Maasai.

Articles

Combining Traditional Knowledge and Climate Science

- **Moss, Keith.** "Climate Change Adaptation Strategies Among the Maasai: Integrating Traditional Knowledge and Climate Science." *Global Environmental Change*, vol. 40, 2022, pp. 100–112.
  Discusses how blending Maasai knowledge with climate science creates culturally suitable and effective adaptation strategies.
- **Boas, Ingrid.** "Adaptation to Climate Change in Maasai Communities: A Synthesis of Climate Science and Local Knowledge." *Journal of Climate*, vol. 33, no. 14, 2020, pp. 3054–3071.
  Highlights the value of combining science and Maasai knowledge for deeper insights and better climate adaptation.
- **Ogutu, Joseph O., and Owen-Smith, Norman.** "Integrating Indigenous Knowledge and Climate Science for Pastoralist Adaptation: Lessons from the Maasai." *Pastoralism: Research, Policy and Practice*, vol. 9, no. 1, 2018, pp. 23–37.
  Explores how integrating indigenous knowledge and science can strengthen resilience and adaptation.

Maasai Adaptation Strategies and Resilience

- **Homewood, Katherine.** "The Impact of Climate Change on Maasai Pastoralism: A Review of Current Knowledge and Future Directions." *Environmental Science & Policy*, vol. 70, 2021, pp. 1–10.
  Reviews how combining science with Maasai practices aids in addressing climate variability impacts.
- **Ndegwa, Samwel.** "Climate Change and Pastoralism: Analyzing the Maasai Adaptation Strategies in the Context of Climate Science." *African Journal of Environmental Science and Technology*, vol. 15, no. 2, 2018, pp. 91–105.
  Examines how Maasai strategies informed by both tradition and science showcase the potential for integrated climate management.

[1] "Climate Change Mitigation and Adaptation," 13.
[2] Maathai, *The Green Belt Movement*, xi.