

ECOSYSTEM HEALTH





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Preface

This module is One of the 16 One Health Training Modules developed by the One Health Central and Eastern Africa Network (OHCEA). OHCEA is an international network, currently of 24 institutions of higher education in public health, veterinary sciences, pathobiology, global health and environmental sciences. These are located in 16 universities in 8 countries in Eastern, Central and Western Africa regions.

The universities currently forming OHCEA are: Universite des Montagnes and University of Buea (Cameroon), University of Lubumbashi and University of Kinshasa (DRC), Jimma University, Addis Ababa University and Mekelle University (Ethiopia), Moi University and University of Nairobi (Kenya), Université Cheikh Anta Diop (Senegal), Muhimbili University of Health and Allied Sciences and Sokoine University of Agriculture (Tanzania), University of Rwanda and University of Global Health Equity (Rwanda), Makerere University and Mbarara University of Science and Technology (Uganda).

The OHCEA network's vision is to be a global leader in One Health, promoting sustainable health for prosperous communities, productive animals and balanced ecosystems. OHCEA seeks to build capacity and expand the human resource base needed to prevent, detect and respond to potential pandemic disease outbreaks, and increase integration of animal, wildlife and human disease surveillance and outbreak response systems.

The overall goal of this collaboration is to enhance One Health policy formation and implementation, in order to contribute to improved capacity of public health in the region. OHCEA is identifying opportunities for faculty and student development as well as in-service public health workforce that meet the network's goals of strengthening One Health capacity in OHCEA countries.

The 16 modules were developed based on One Health core competencies that were identified by OHCEA as key elements in building a skilled One Health workforce. This network is supported by two United States University partners: Tufts University and the University of Minnesota through the USAID funded One Health Workforce Project.



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OHCEA extends her gratitude to those who participated in earlier works that informed the development of this module as well as reviewers and editors of the module. Sections/parts of the materials for this course were adopted from RESPOND SEAOHUN One Health Course Modules: https://seaohunonehealth.wordpress.com/ecosystem-health/

General Introduction

Training the Current and Future Public Health Workforce Using a One Health Approach

There is abundant evidence that no single sector or department can sufficiently manage the challenges of public health in any country, region or continent. Experiences from the fight against Ebola and the highly pathogenic avian influenza in the past few years demonstrated the effectiveness of multi-sectoral, multiagency approaches and the need for specific training targeting multi-sectoral and multi-disciplinary public health professionals not limited by national or regional borders in dealing with public health threats. In response to this challenge, the One Health approach has been advocated as the global framework for strengthening collaboration and capacities of the sectors and actors involved in health service delivery.

One Health Central and Eastern Africa (OHCEA) is a network of universities in Central, Eastern and Western Africa which are collaborating to build One Health capacity and academic partnerships between the member institutions in the region and with governments. The overall goal of this collaboration is to enhance One Health policy formation and implementation, to contribute to improved capacity of countries to respond to any emerging pandemics in the region.

OHCEA seeks to expand the human resource base needed to prevent, detect and respond to potential pandemic disease outbreaks, and increase integration of domestic animal, wildlife and human disease surveillance and outbreak response systems. OHCEA has identified One Health core competencies and developed modules based on the identified competencies that are key to delivering knowledge and skills to a multidisciplinary workforce and building a framework on which One Health curricula can be designed and implemented. They combine human health, animal health, infectious disease management with principles of ecology, social and environmental sciences.

A total of 16 modules have been developed including One Health soft skills such as communication, culture, leadership, gender and core technical skills such as



One Health is defined as the collaborative effort of multiple disciplines working together locally, nationally, and globally to attain optimal health for people, animals and the environment

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The One Health paradigm emerged from the recognition that the wellbeing of humans, animals and the ecosystem are interrelated and interdependent and there is a need for more systematic and cross sectoral approaches to identifying and responding to global public health emergencies and other public health threats arising at the human animal ecosystem interface.



ecosystem health, infectious disease epidemiology, One Health concepts and outbreak response. The modules are intended to:

- create a framework for One Health curriculum.
- improve workforce capacity to prevent, detect and respond to threats posed by infectious diseases and zoonosis.
- generate a shift in countries' workforce culture and training structure.
- enable working across sectors and disciplines for a stronger and more effective public health sector.
- allow universities to be key drivers of the future workforce as they forge partnerships and drive change.
- combine human health, animal health and infectious disease with principles of ecology and environmental sciences.

The modules can be used at both pre-service and in-service levels as full courses, workshops or integrated into course materials for professionals who impact disease detection, prevention and response, allowing them to successfully function as an integral part of a larger, multi-disciplinary, team of professionals. This is key to creating a stronger sustainable Public Health workforce.

Each module contains a Facilitator Guide, Student Guide, PowerPoint slides and a folder of resources/ references for users. These modules are iterative and are continuously being revised.

These 16 modules were developed by collaborative efforts of multiple disciplines and teams of people from seven different OHCEA partner countries with the support of two US university partners namely Tufts University and University of Minnesota. A team of 66 people were engaged in the development of these modules. All the materials represent contribution by the faculty and leadership of the OHCEA network institutions and the technical and managerial support of the OHCEA Secretariat.

The modules were built off previous One Health modules developed by SEAOHUNnetwork: <u>https:// seaohunonehealth.wordpress.com/ecosystem-health/</u> with addition of more Africa-specific materials, examples and case studies relevant and applicable to the region. Each module was reviewed by OHCEA network faculty including US university partners with technical expertise as well as partners with field experience that allows for One Health application and appreciation of the local African context. For any inquiries, please email: <u>OneHealthModules@ohcea.org</u> or wbikaako@ohcea.org

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Overview of the Ecosystem Health Module

Globally, One Health and Ecosystem Health are being used as integrated approaches and effective responses to addressing complex global health challenges. It is now an on-going process and purposes to understand the major global health risks that arise from how humans, animals and ecosystems interact as part of socio-ecological systems and pathways.

One Health is defined as the collaborative effort of multiple disciplines working locally, nationally and globally to attain optimal health for humans, animals and our environment. The One Health paradigm emerged from the recognition that the wellbeing of humans, animals and ecosystems are interrelated and interdependent, and so there is need for more systematic and cross-sectoral approaches to identify and respond to global public health emergencies and other health threats arising at the human-animal ecosystem interface. The One Health concept is, therefore, a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment. The synergism, if achieved, will advance health care for the 21st century and beyond by accelerating biomedical research discoveries, enhancing public health efficacy, expeditiously expanding the scientific knowledge base, and improving medical education and clinical care. When properly implemented, it will help protect and save untold millions of human and animal lives in the present and future generations.

The development of intensively managed, genetically engineered (specialized) breeds of livestock, selected for non-health-linked production traits is taking place in many countries in an effort to meet rising demand and preference for animal products. Pathogens rapidly evolve in such homogenous communities, occasionally spilling back into the ecosystem and becoming redistributed to other susceptible species. Furthermore, the ability for the ecosystem, including animal populations, to absorb and act as a buffer against such emerging diseases has become unpredictable due to a breakdown in the natural resilience through co-evolution of hosts and parasites as a result of human interference. This scenario, whose evolution is intensifying, could potentially and significantly threaten global public and animal health.

Ecosystem approach to health (Eco-Health), therefore, considers human health that is closely linked to animal and environmental health and their interactions. It involves biological communities of interacting organisms and their physical environment, including ecosystem challenges and their impact on human and animal health, and economic development. Thus, Eco-Health is a trans-disciplinary field that aims to improve the health of humans, animals and ecosystems to address complex challenges facing our planet. Eco-Health emphasizes, on the one hand, holistic understanding of social and ecological systems and drivers of social determinants of health and ecosystem changes. On the other hand, One Health approaches aim at improving health and well-being through the prevention of risks and the mitigation of the effects of crises that originate at the interface between humans, animals and diverse environments. Hence, One Health promotes coordinated, collaborative, cross-sectoral, and 'whole-of-society' approaches to health hazards.

One Health Central and Eastern African (OHCEA) network recognizes that One Health and Eco-Health are integrated approaches that need to address local, national, regional and global complex health challenges. The current global health challenges are a result of increased human, animal and ecosystem interactions which require in-depth understanding of the dynamics at the interface through Eco-Health Module. Hence, OHCEA through One Health Workforce, is investing resources to develop an Eco-Health short course among the 19 OHCEA One Health modules.

The purpose of this module is to impart knowledge and skills to the participants on how the various ecological interactions affect animal, human and environmental health. In addition, the module will provide techniques for practical assessment of ecosystem health as well as policies that govern provision of ecosystem health services. The module will further explore and discuss the relationship between climate change and ecosystem health.

Ecosystem Health Course Goals

By the end of the course, the participants shall have a sufficient understanding of ecosystems dynamics so that they can work with environmental professionals to analyze how natural and anthropogenic changes to the environment can affect animal and human health locally, regionally and nationally. In addition, the participant should be able to:

- i) learn the principles, terminologies, concepts and definitions used in One Health and Ecosystem Health.
- ii) learn the ecosystem processes and different levels of ecosystem.
- iii) understand and appreciate the influence of the interactions of humans, animals and environment in an ecosystem.
- iv) understand the risks of disrupted ecosystem services on human and animal health.
- v) learn and appreciate the effects of climate change on ecosystem health.
- vi) integrate gender responsiveness to Ecosystem Health approaches.

Course Objectives

- i) To explain One Health approach and the application of One Health Core Competencies in multiple disciplines.
- ii) To define terminologies used in One Health and Ecosystem Health.
- iii) To explain principles and concepts of Ecosystem Health.
- iv) To describe ecosystem processes and different types of ecosystems.
- v) To explain bio-physical, cultural, gender, socio-economic and ecological factors and their influence on human, animal and environmental health.

- vi) To apply the principles of Ecosystem Health and the concept of human animal environmental interface to the strengthening of global health equity.
- vii) To identify the risks of ecosystem disruption to human and animal health.
- viii) To describe mitigation measures to counteract ecosystem health disruption.
- ix) To describe effects of climate change on ecosystem health.
- x) To describe strategies for climate change mitigation and adaptation.
- xi) To identify gender basic principles and their application in Eco-Health disciplines.
- xii) To apply gender analysis tools in Ecosystem Health approaches.

Target Audience

The module can be used by undergraduate and post-graduate learners, middle cadre trainees and in-service personnel from multiple disciplines and sectors (private, NGOs, and Civil Society Organizations). It can also be adopted for continuous professional development by health professional organizations such as medical, veterinary, pharmaceutical, nursing, public health, environmental and technological.

Session 1	Session 2	Session 3	Session 4	Session 5
Principles, Terminolo gies and Concepts used in One Health and	Ecosystems – Values and Services Biotic Cycles	Learning and Applying Gender Analysis Tools in Eco-Health	Risks of Ecosystem Disruption on Human, Animal and Environmental Health	Climate Change and Ecosystem Health
Eco-Health Understan ding Ecosystem Processes (Abiotic and Biotic Cycles)	Discovering Basic Gender Aspects and their Application to Eco-Health			

Training Program

4

	Goal (GO)	Learning	Instructional Activition	Time
		Objectives (LO)	(mode of delivery)	(Min)
01	Learn the principles, terminologies, concepts used in Ecosystem Health and One Health	1. Introduce One Health and Ecosystem Health and define terminologies used in both Ecosystem Health and One Health	 Brainstorming using sticky notes to define Ecosystem Health terminologies Use video and sticky notes to demonstrate One Health Use pictures to demonstrate Ecosystem Health terminologies 	25
		2. Explain principles and concepts of Ecosystem Health	 Lecture in PowerPoint presentation to explain principles and concepts of Ecosystem Health Paper reviews in groups 	60
02	Understand and appreciate the influence of the interactions of humans, animals and environment in an ecosystem	3. Explain different ecosystem process (abiotic and biotic cycles	 Lecture in PowerPoint presentation demonstrates the interaction of different factors Case study depicting factors influencing human, animal and environmental health 	40
		4. Describe different types of ecosystems	 Documentary/video clip to show different types of ecosystem Group discussion on ecosystem types 	10
		5. List human actions and behavior that	 Pictionary game to illustrate animal, human and 	30

		impact on ecosystem health	•	environmental interactions Mime to depict behavior Photos to demonstrate the impact on Echo- Health by human activities	
04	Discovering basic gender aspects to Eco- Health/One Health	6. Identify basic gender principals and related concepts including sex, gender roles, equity and life cycle			40
05	Application of gender analysis tools in Eco- Health	 Select appropriate gender tools Apply gender tools in Eco- Health approaches 			60
06	Appreciate the risks of disrupted ecosystem services on human and animal health	9. Identify the risks of ecosystem disruption to human and animal health	•	Documentary/video clip showing examples of healthy and disrupted ecosystems Group discussion Case study on disease outbreaks linked to ecosystem disruption Visiting physical sites showing clear impacts of ecosystem disruption	45 360
		10. Describe mitigation measures to	•	Video showing mitigation measures to counteract	35

		counteract ecosystem health disruption	ecosystem health disruption • Small group discussion on mitigation measures	
07	Learn and appreciate the effects of climate change on ecosystem health	11. Identify drivers of climate change	 Documentary/video clip showing drivers of climate change Group discussion Invite guest speaker specialized in climate change 	60
		12. Describe effects of climate change on ecosystem health	• PowerPoint presentation with examples describing effects of climate change	40
		13. Describe strategies for climate change mitigation and adaptation	 Video clips Group discussions on strategies for climate change mitigation and adaptation 	20

Materials

- Chairs
- Computer
- Flipcharts
- Laptop
- LCD
- Markers
- Multicolored sticky notes
- Per diem for the speaker
- Printed paper
- Tables
- The Internet access or modem

Opening Session

Activity/Topic **Facilitator Notes** (More facilitator notes are provided at end of session)

Registration Registration of Participants

- i) Let the participants sign the attendance register.
- ii) Explain logistics (e.g., breaks, meals, etc.)
- iii) Provide administrative guidance to the participants.
- iv) If the short course is residential, prepare for accommodation.



Time

20 min

Facilitator's Welcoming Remarks and Introduction

- i) In pairs, have the participants tell each other his/her:
 - name.
 - where he/she is from.
 - work and position.
 - story of his/her experience that made him/her aware of human, animal and environmental interactions.
 - _ prepare 1-minute introduction of his/her partner to the class.
- ii) Go around the room and have each pair present his/her partner to the class.

10 min

Expectations and Concerns

Set up:

- i) Get two flipcharts in the front part of the room: one titled "Expectations" and the other "Concerns."
- ii) Give each participant two different colored sticky notes.
- iii) Ask the participants to write down their expectations for the short course on one of the sticky notes (specify color) and their concerns about the course on the second one (specify color).
- iv) Let the participants place their expectations sticky notes on a flipchart titled "Expectations" and their concerns sticky notes on another flipchart titled "Concerns".

- v) Organize the sticky notes according to common themes.
- vi) Explain the agenda for the week and the goals of the short course, highlighting the expectations that will be met over the week and those that will not be met. Comment and address the concerns.
- vii) Explain that this course was developed under OHCEA with support from the United States Agency for International Development.
- OHCEA is the One Health Central and Eastern Africa network comprising 16 academic institutions from eight African countries including schools of public health and veterinary schools and two US partner universities: Tufts University and University of Minnesota.
- OHCEA's vision is to be a global leader in One Health by promoting sustainable health for the prosperity of communities, for productive animals and balanced ecosystems. OHCEA seeks to expand the human resource base needed to detect and respond to potential pandemic disease outbreaks.
- OHCEA has identified Ecosystem Health as a critical competency to achieving their vision. For this reason, they supported the development of this course.

Guest Speaker and Pre-Test

- i) In advance, be sure the speaker is prepared to address the group. Share with the speaker the goals of the short course, the desired outcomes and what you would like the speaker to emphasize in her/his address.
- ii) Introduce the invited guest speaker to "officially open the course."
- iii) Pass out copies of the pre-evaluation. Tell the participants that they have 15 minutes to complete the pre-evaluation. Explain that a pre-evaluation is used to gauge how much they learned over the week, and that a post-evaluation will be administered at the end of the course. The two evaluations will be compared. There is no grade associated with the preevaluation. After the participants have finished, they can begin their break.



Speaker and Pre-Test

Guest

 $15 \min$

Session 1a: Principles, Terminologies and Concepts used in One Health and Eco-Health

Session Overview

This opening session will provide an overview of the goals of the short course and an opportunity for the participants to learn more about each other's background, disciplines and skills. They will be introduced to One Health and Eco-Health principles, terminologies and concepts. The relationship between Eco-Health and One Health will be scanned and explained.

Session Learning Objectives

By the end of this session, participants should be able to:

- i) define basic principles of One Health and related concepts including the role of interdisciplinary teams with focus on the human, animal, ecosystem interdependence.
- ii) define One Health Core Competencies, domains and their applications.
- iii) define terminologies used in Ecosystem Health.
- iv) explain principles and concepts of Ecosystem Health.

Module Overview and Definition of One Health and Eco-Health Terminologies





Introduction Introduction to One Health

- i) Divide the participants into groups. (utmost 5 people per group)
- ii) Give each group a blank piece of paper.
- iii) Let the participants brainstorm and draw on it a picture that they think represents One Health (that in their opinion can be understood by a community member).

- iv) Let the participants tape the drawing against the wall.
- v) All the participants should then review the drawings and grade them.
- vi) The grades are 1-5 with 5 being the highest or what is considered best.
- vii) Select the best pictures and discuss with the participants why they think they are the best. (As extra incentive, give a prize to the group with the best picture.)
- viii) Pick out key words from the discussion of their drawings that they used to define One Health.

What is One Health

i) Begin the session by having the participants watch the following videos:

One Health: From Concept to Action by CDC https://www.youtube.com/watch?v=TG0pduAYESA

One Health: From Idea to Action: https://www.youtube.com/watch?v=gJ9ybOumITg&t=4s

- ii) Briefly discuss the two videos with the participants.
- iii) Have each participant take 5-7 minutes to think about and legibly write down on separate sticky notes the answers to the following questions:
 - 1. Define One Health approach.
 - 2. Identify two examples of One Health in practice.
 - 3. Identify two to three advantages of multiple disciplines working together to promote One Health.
 - iv) Let them display these sticky notes on the wall in the three separate sections. Then in a plenary review the following:
 - 1. What are the common things identified?
 - 2. What are the differences?
 - 3. Is there anything that surprised anyone?
 - v) Come up with a group description of what One Health is.
 - vi) There are many different definitions of One Health by different health organizations, but for



Health?

Discovery

What is One

Activity:

the purpose of the course we will adopt the American Veterinary Medical Association definition (AVMA) of One Health. (www.avma.org) **AVMA** defines One Health as the integrative (collaborative) effort of multiple disciplines working together locally, nationally and globally to attain optimal health for humans, animals and the environment. Together, the three make up the One Health triad, and the health of each is inextricably connected to the others in the triad.

vii) The common theme of One Health is multiple disciplines working together to solve problems at the human, animal and environmental interface. Collaborating across sectors that have a direct or indirect impact on health, involves thinking and working across silos and enhancing resources and efforts while valuing the role each different sector plays. To improve the effectiveness of the One Health approach, there is a need to create a balance and a greater relationship among existing groups and networks, especially between veterinarians and physicians, and to amplify the role that environmental and wildlife health practitioners, as well as social scientists and other disciplines play to reduce public health threats.



Definitions of Terms Related to One Health and Ecosystem Health

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- Definitions of Terms Related to One Health and Ecosystem Health
 - i) Instruct each participant to conduct an Internet search to define the following terms and write down the local, regional and international organizations that operate in each sector (this will take 10-20 minutes depending on the Internet speed):
- •

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- Global Health
- Ecosystem

Eco-Health

- One Health
- Health Environmental
- Planetary
- Health
- Health
- пеани
- ii) Have the participants read aloud the definitions they found to the class and then capture the key points on a flipchart or whiteboard. Ask them to note the areas

of overlap among the concepts, as well as the major differences.

iii) It is important to define other terms that are closely linked to One Health. Remember One Health is not a discipline but an approach, so it is easy to confuse all these terms since many times people tend to use them interchangeably. In the facilitator notes, definitions of these terms are provided.

PowerPoint Presentation on One Health

- i) Give a PowerPoint presentation (PPP No. 1) on One Health.
- This presentation introduces One Health, the interdependence between humans, animals and the environment and why disciplines need to work together.
- iii) It also answers the questions: Why One Health and why now?
- iv) Debrief the session by asking the participants to reflect on what One Health is and any questions they may have related to the PowerPoint presentation.

Discovery Activity on Ecosystem Health

- i) Ask the participants watch the video: "Virunga" the night before coming to the session. This video will form the introduction to ecosystem health. (The video can also be watched in class if the participants do not have access to the video online.)
- ii) The participants should also read the article:

MEAs conservation and conflict. A case study of Virunga National Park, DRC by Alec Crawford and Johannah Bernstein, International Institute for Sustainable Development

http://www.iisd.org/pdf/2008/meas_cons_conf_virunga.pdf Virunga is the Oscar nominated true story of park rangers risking their lives to save Africa's most precious national park and its endangered gorillas in the face of conflict and economic hardships.

Large Group Discussion

PowerPoint

Presentatio

n on One

Health









Discovery

Activity:

What is





Discussion on Virunga Ecosystem

- i) Discuss the threats to Virunga National Park. These should include: high human population density, limited buffer zone, high levels of poverty, conflict and insecurity.
- Start a discussion on Virunga as an ecosystem, the challenges humans, animals and environment face and the possible impact on the long-term ecosystem.

iii) Some of the topics for discussion should include:

- Habitat loss: The Rwandan sector of the Virunga ecosystem has been drastically reduced: total reduction of 54%—150Km² remaining. Most of the loss is in the lower elevation zones. Therefore, the associated loss of biological diversity has been significant.
- Habitat disturbance (cattle grazing, water collection and wood cutting).
- Poaching (for local subsistence, gorillas ensnared in traps).
- Disease cross over from humans to wildlife and domestic animals especially with all the different populations.

Stakeholder Analysis

Stakeholder

Analysis of

Virunga

Video

 $45 \min$

- i) You have been provided with a set of sticky notes.
- On a sticky note, write the name of a stakeholder or player in the Virunga study scenario: one name per note. Write as many stakeholders as you can think of. Identify them by their roles. Consider their gender as well especially at the community level.
- iii) Line the sticky notes on a plain piece of paper as international, national, regional or local.
- iv) Using a red marker, draw a circle around those stakeholders with lots of power and authority.
- v) Draw a square around those players with the most interest in the activity, or who are impacted the most.
- vi) Using a red marker, draw arrows that show the flow of decision making (power and authority) from one stakeholder to another.

- vii) Using a green marker, draw arrows that show the flow of resources (funding) from one stakeholder to another.
- viii) Using a blue marker, draw arrows that show communication flow from one stakeholder to another. Let the groups discuss the map and the following questions:
 - 1. Who has power and authority?
 - 2.Who do you think should have power and yet does not?
 - Who is being left out of the different arrows and 3. yet considered important, and how do you include them?
 - 4. Can you identify any gender differences in power, communication flow and resource flow?

The above exercise was adopted from the One Health Systems Mapping (This tool/activity was adopted from the OH-SMART toolkit developed by the University of Minnesota in collaboration with the United States Department of Agriculture: https://www.vetmed.umn.edu/centersprograms/global-one-health-initiative/one-healthsystems-mapping-and-analysis-resource-toolkit and from work done on Policy Field analysis by Professor Jodi Sandfort of the University of Minnesota.





What is

Ecosystem

Give a brief PowerPoint presentation (PPP No. 2) on Virunga as a case study based on the reading material provided, and summarize key highlights of Virunga as a suitable study for an ecosystem project.



What is Ecosystem Health?

Give a brief overview of what ecosystem health is, including a discussion on Ecosystem Health Module Core Competencies.

- Understand fundamental ecological/ecosystem principles.
- Recognize interrelationships among ecosystems, • animal health and human health.

• Analyze the effects of direct impact on the environment.

Introduction to Ecosystem Health

- i) Give a brief introductory lecture on ecosystems, ecosystem health and the relationship between ecosystems and One Health. See the Module PowerPoint slides for detailed notes on these concepts.
- ii) In this lecture, you will cover the following topics:
 - Definition of ecosystem, Ecosystem Health, One Health and other related terms: Ecosystem, abiotic, biotic, habitat, biodiversity, symbiosis and adaptation
 - Primary attributes of an ecosystem
 - Components, structure and functions of an ecosystem
 - Ecosystems and One Health
- iii) In closing the lecture, ask the participants to respond to the following questions:
 - 1. What are the ecosystems in the area around this institution?
 - 2. How do you derive benefits from these ecosystems?
 - 3. How does your health depend on ecosystems?



Ecosystem

Health

Lecture

Lecture

20 min



- iv) Show a video from Eco-Health Alliance to demonstrate the importance and the need for the Eco-Health approaches. <u>http://www.dailymotion.com/video/x30i7xp</u>
- v) Guide the participants through brainstorming sessions/reflections on the Eco-Health concepts presented during the lecture and video. Allow everyone to participate and share their lessons.

Session 1b: Understanding Ecosystem Processes (Abiotic and Biotic Cycles)

(Parts of this section were adopted from the South-East Asia One Health University SEOHUN module on Ecosystem Health):

(https://seaohunonehealth.wordpress.com/ecosystem-health/)

Session Learning Objectives and Activities

By the end of this session, participants should be able to:

- i) describe abiotic cycles of an ecosystem: water, carbon and nitrogen.
- explain the concept of biotic cycles and food webs. ii)

Time Activity/Topic **Facilitator Instructions**

Abiotic and Biotic Factors



Abiotic and Prior to starting this section, let the participants watch the following brief video on abiotic and biotic factors. This is a YouTube video.

https://www.youtube.com/watch?v=E1pp_7-yTN4



Prework

Biotic

Factors

Importance of Cycles



Divide the participants into three groups and assign each group one of the three abiotic cycles: water, carbon or nitrogen. Each group is required to review the topic and deliver a presentation to the class on the subject. Each group should be prepared to discuss the importance of the cycles and the effects that disruptions in the cycles can have on human and animal health.

(adopted from SEAOHUN Ecosystem Health module)

Introduction to Abiotic Cycles



i) Begin the session by outlining the concepts that will be covered in this session:

- Ecology, ecosystem and ecosystem ecology
- Abiotic cycles (water, carbon and nitrogen) •
- How physical and chemical factors make up non-• living or abiotic environment
- ii) Tell the participants that they will review biotic environments and different types of ecosystems in later sessions.



Abiotic Cycles: Water, Carbon and Nitrogen

30 min









 $30 \min$



Ecosystem Assignment

Small Group Activity

Abiotic Cycles: Water, Carbon and Nitrogen

Following the introduction, give the participants a few minutes to meet with their work groups and prepare presentations. Each group will present their assigned topic, and after each presentation the participants will discuss the importance of each cycle and how disruptions to the cycle can affect human and animal health.

Note: You should review the section notes of the module PowerPoint prior to class session and make sure that the presentations of the participants cover each critical topic, and that their facts are accurate. Ensure that the presentations cover the terms and concepts.

At the end of this section, the participants should watch the following video and debrief on abiotic factors. https://www.youtube.com/watch?v=SwS9zjNv3q0

Overview of Biotic Cycles, Food Webs

- i) Deliver a lecture on biotic cycles that covers the topics outlined below.
- ii) Review the module PowerPoint (PPP No. 3) slides for detailed lecture notes.
 - Ecosystem Components: Abiotic and Biotic Cycles
 - The Energy Cycle
 - Trophic Levels, Food Chains and Food Webs
 - Ecosystem Services
 - Ecosystem Value
- iii) After the lecture, divide the participants into three teams and ask each team to take on the role of one of the East African ecosystems: tropical rainforests, the savannah grassland and aquatic. They are responsible for becoming experts on that ecosystem and must understand the following aspects:
 - Nutrient cycling
 - The food web
 - Status in their country (as applicable)
 - The threats to the ecosystem
 - Services that the ecosystem provides
 - Things that can disrupt the functioning of the ecosystem

- The way the ecosystem interacts with animals and humans
- iv) Each group is required to do a ten-minute presentation on their assigned ecosystem. The rest of the class will be allowed 5 minutes to comment or make suggestions.



Ecosystem Food Web

- i) For the next class, each team must present to the class a food web for their ecosystem. The participants should conduct research in a library or online with their group and ensure that all of their facts are accurate. Often, overviews of an ecosystem found online or in a book can include animals and plants that are not located in East Africa. The participants should make sure that the food web is accurate for their region. Presentations should be approximately 5 minutes.
- ii) Suggest the following sites for the participants to visit and conduct their research:
 - Food and Agriculture Organization of the United Nations (FAO) – <u>www.fao.org</u>
 - Science Direct <u>www.sciencedirect.com</u>
 - World Resources Institute (WRI) <u>www.wri.org</u>
- iii)A list of additional resource links is included in the Student Guide and in the Module PowerPoint.

Ecosystem Food Web Presentations

- Let the participants deliver their presentation assignments from the previous session. Take time after each presentation to allow the rest of the participants to ask questions. Give approximately 5 minutes per presentation.
- ii) In addition to preparing the ecosystem food web presentations, the participants should review the following documents prior to class session. They do not need to read the documents thoroughly but to skim through so that they are familiar with the topics and concepts.
 - Skim reading Ecosystems and human wellbeing: health synthesis. World Health Organization (2005)

- Skim reading The value of the world's • ecosystem services and natural capital, Costanza, R., d'Arge, R. and de Groot, R. (1997)
- Skim reading Ecosystem functions and services • in Sodhi, N.S. and Ehrlich P.R. Conservation Biology for All.

Carbon

Carbon

dioxide

Sources

(CO2)

Sinks

Pool/reserv

Flux

oir

Abiotic Cycle: Water

- The different forms of precipitation
- Infiltration/percol ation
- Surface water
- Groundwater
 - Springs
- Glaciers
- Interception
- Evaporation
- Transpiration
- Aquifer

Case Study - Haiti 30 min

WATCH VIDEO

O

Case Study - Has Environmental Degradation in Haiti Led to A Failed State?

i) Let participants watch the following two videos on Haiti

https://www.youtube.com/watch?v=NiDwCQGwB_M; Has environmental degradation in Haiti led to a failed state? https://www.youtube.com/watch?v=kLmpFHSsGD0: World: Haiti's Legacy of Environmental Disaster | The New York Times

ii) A bottom line indicator of the economic and environmental stresses we are facing in the world is the number of failing states. One of the best examples of this is Haiti. Once self-sufficient in food, uncontrolled logging and extreme soil erosion ensured food production could not be sufficient. This eventually led to a failed state. In groups, discuss the case of Haiti, and also if the participants agree with this conclusion. If not, what are other driving factors that contribute to Haiti's situation?

Abiotic Cycle: Abiotic Cycle: Nitrogen

- Mineralization •
- Denitrification
- Fixation
- Nitrification
- Leaching
- Plant Update/Crop Removal

iii) After watching this video, the participants should come up with similar examples that they know, or from their own backgrounds. Discuss at least three different examples in class that show a change in people's life due to an environmental event. This event can be human causes, or natural causes like earth quakes, tsunamis, el Niño.

iv) Provide the participants with the palm oil case study. They should read it overnight and prepare to discuss



Homework Assignement

End of session evaluation

the following day.

Facilitator Notes for Session 1

Definition of One Health

There are many different definitions of One Health by different health organizations, but for the purpose of the course we will adopt the American Veterinary Medical Association (AVMA) definition. (www.avma.org). **AVMA** defines One Health as the integrative (collaborative) effort of multiple disciplines working together locally, nationally, and globally to attain optimal health for people, animals, and the environment. Together, the three make up the **One Health** triad, and the **health** of each is inextricably connected to the others in the triad.

The common theme of One Health is multiple disciplines working together to solve problems at the human, animal and environmental interface. Collaborating across sectors that have a direct or indirect impact on health involves thinking and working across silos and enhancing resources and efforts while valuing the role each different sector plays. To improve the effectiveness of the One Health approach, there is a need to create a balance and a greater relationship among existing groups and networks, especially between veterinarians and physicians, and to amplify the role that environmental and wildlife health practitioners, as well as social scientists and other disciplines play to reduce public health threats.

In less than 10 years, One Health has gained such significant momentum that it is now a fast growing movement. The approach has been formally endorsed by the European Commission, the US Department of State, US Department of Agriculture, US Centers for Disease Control and Prevention (CDC), World Bank, World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO), World Organization for Animal Health (OIE), United Nations System Influenza Coordination (UNSIC), various Universities, NGOs and many others.

The current One Health movement is an unexpected positive development that emerged following the unprecedented Global Response to the Highly Pathogenic Avian Influenza. Since the end of 2005, there has been increasing interest in new international political and cross-sectoral collaborations on serious health risks. Numerous international meetings and symposia have been held, including major initiatives in Winnipeg (Manitoba, Canada, March 2009), Hanoi (Vietnam, April 2010), and Stone Mountain (Georgia, US, May 2010), as well as five international One Health scientific congresses, the last of which took place in Saskatoon, Canada, in 2018.

References

WHO (2007). "Addressing Sex and Gender in Epidemic-Prone Infectious Diseases" from www.who.int/csr/resources/publications/SexGenderInfectDis.pdf.

OCDE (2012) "Tackling the Root Causes of Gender Inequalities in the Post-2015 Development Agenda," from

www.worldwewant2015.org/file/287499/download/311690.
FAO (2013). "Understanding and Integrating Gender Issues into Livestock Projects and Programmes: Checklist for Practitioners," from

www.fao.org/docrep/018/i3216e/i3216e.pdf.

- Ebola's lasting Legacy by Erika Check Hayden: Nature: volume 519, 5 March 2015. Gender issues in Human Animal and Plant health using an Eco Health perspective by
- Brigitte Bagnol, Robyn Alders and Robyn Mcconchie: Environmental and Natural Resources Research Vol 5 No1, 2015.
- What the solution isn't: the parallel of Zika and HIV viruses for Women: Susan T. Fried and Debra J. Liebowitz: the Lancet global health blog; February 2016.

Definitions of Different Terms

- **Global Health** is the health of populations in a global context and transcends the perspectives and concerns of individual nations. In global health, problems that transcend national borders or have a global political and economic impact are often emphasized. Global health has been defined as "... the area of study, research and practice that places a priority on improving health and achieving equity in health for all people worldwide." Thus, global health is about worldwide improvement of health, reduction of disparities, and protection against global threats that disregard national borders (www.who.org).
- Environmental **Health** is that branch of public health concerned with all aspects of natural and built environment that may affect human health. Other phrases that refer to or concern the discipline of environmental health include environmental public health and environmental protection. The field of environmental health is closely related to environmental science and public health. Both environmental health and environmental science are concerned with environmental factors affecting human health. Environmental health addresses all the physical, chemical and biological factors external to a person, and all the related factors impacting behaviors. It encompasses the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments. This definition excludes behavior not related to the environment, as well as behavior related to the socio-cultural environment and to genetics.
- Ecological **Health (Eco-Health)**: The Eco-Health approach focuses, above all, on the place of human beings within their environment. It recognizes that there are inextricable links between humans and their biophysical, social and economic environments, and that these links are reflected in the state of health of the population (International Development Research Centre). The mission of Eco-Health is to strive for sustainable health of people, wildlife and ecosystems by promoting discovery, understanding and trans-disciplinarity. Eco-Health Alliance works at the intersection of ecosystem, animal and human health through local conservation programs, and develops global health solutions to emerging diseases. It is an international organization of scientists dedicated to the

conservation of biodiversity. Eco-Health Alliance focuses efforts on innovative research, education and training, and accessibility to international conservation partners.

- **Ecosystem Health** is a metaphor used to describe the condition of an ecosystem. Ecosystem conditions can vary as a result of fire, flooding, drought, extinctions, invasive species, climate change, mining, overexploitation in fishing, farming or logging, chemical spills, and a host of other reasons. There is no universally accepted benchmark for a healthy ecosystem; rather the apparent health status of an ecosystem can vary depending upon which health metrics are employed in judging it and which societal aspirations are driving the assessment.
- **Planetary Health** is the newest kid on the block. It is defined as the achievement of the highest attainable standard of health, well-being, and equity worldwide through judicious attention to the human systems—political, economic, and social—that shape the future of humanity *and* the earth's natural systems that define the safe environmental limits within which humanity can flourish (Planetary Health Alliance).
- **One Health** is defined as the integrative (collaborative) effort of multiple disciplines working locally, nationally, and globally to attain optimal health for humans, animals, and the environment. Together, the three make up the One Health triad, and the health of each is inextricably connected to the others in the triad.

Organizations Operating in the One Health Sphere

- World Health Organization (WHO)
- Food and Agriculture Organization (FAO)
- World Organization for Animal Health (OIE)
- One Health Initiative
- United States Centers for Disease Control (CDC)
- Eco-Health Alliance
- United States Agency for International Development (USAID)
- OHCEA- One Health Central and Eastern Africa
- South-East Asia One Health University Network (SEAOHUN)
- Universities Departments, Centers, etc.
- Ministries of Health, Agriculture, Environmental Resources, etc.
- Medical or Health Professional Associations

Conclude with the slides showing the definitions of One Health and the One Health Initiative by One Health Initiative and CDC (adopted from SEAOHUN modules: <u>https://seaohunonehealth.wordpress.com/</u>). The One Health concept is a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment. The synergism achieved will advance health care for the 21st century and beyond by accelerating biomedical research discoveries, enhancing public health efficacy, expeditiously expanding the scientific knowledge base, and improving medical education and clinical care. When properly implemented, it will help protect and save untold millions of lives in our present and future generations (One Health Initiative).

The One Health concept recognizes that the health of humans is connected to that of animals and the environment. CDC uses the One Health approach by working with physicians, ecologists, and veterinarians to monitor and control public health threats. It does this by learning about how diseases spread among humans, animals, and the environment (United States Centers for Disease Control).

Session 2a: Ecosystems – Values and Services Biotic Cycles

Session Overview

This session will provide an overview of ecosystem values and their impact on the world socially, economically and politically.

Session Learning Objectives and Activities

By the end of this session, participants should be able to:

- i) identify and compare values and services of ecosystems using relevant examples across the globe.
- ii) appreciate the differences in values and services in different regions.

Ecosystems — Values and Services



Activity/Topic Facilitator Instructions Ecosystem

Ecosystem Protection



Protection

- i) Review the last session of the previous day on Haiti and then ask the participants to form three groups. Flip a coin and identify at least three scenarios where ecosystem protection has been successful and led to better living conditions for people or societies.
- ii) Inform the participants that they have 20 minutes to discuss. They are free to do the Internet search to assist them.
- iii) In their groups, the participants should present their scenario to the rest of the class.

Case Study: The Environment and Orangutans



i) Provide the participants with the case study of the environment and the Orangutans: Give them 20 minutes to read through the case study and then discuss the questions provided below.

This case study was developed by C.E. Hidalgo, T.M. Haller, K.A. Kurth and A.L. Sharkey, students in the Masters in Conservation Medicine class of 2016, at Tufts University Cummings School of Veterinary Medicine. The full case is included in the Appendix)

ii) To enhance their knowledge about threats to the environment caused by the palm oil, have them watch the following video on the Malay Archipelago https://www.youtube.com/watch?v=FsNaljGmvCA

iii) Discuss the following questions with the participants:

- 1. Why are Orangutans as an umbrella species important to the overall biodiversity of the Malay Archipelago?
- 2. Could any other species in the area be considered an umbrella species?
- 3. Do the individual health and economic benefits of palm oil outweigh the global detriment caused by palm oil production?

Ecosystem **Ecosystem Values Review** Values

- i) Conclude the session with a review of ecosystem values. Tell the participants that humans and communities attain many benefits from ecosystems which can improve mental health, provide a subjective sense of culture and place, and enhance knowledge of natural and social sciences. Ecosystems provide value to humans through:
- Aesthetic

15 min

- Motivation
- appreciation
- Genetic resources
 - Culture and
- Tourism Recreation •
- spirituality
- Education

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ii) Ask the participants: Consider our community, nation and region. How do ecosystems provide us value in the areas mentioned above? Take a few responses for each category and write them down on a whiteboard or flipchart.





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Participant Led Rapid Research Project

The following three ecosystems are common in South-East Asia: Mangroves, coral reefs, and tropical rain forests. In three groups, let the participants do a quick search on the Internet of a published article related to one of these ecosystems. Every member of the group should identify at least two articles and quickly summarize them to the group.

Session 2b: Discovering Basic Gender Aspects and their Application to Eco-Health

Session Overview

Key gender, Eco-Health and emerging pandemic threat (EPT) terms and concepts are introduced as participants explore the different roles men and women play in the health and health care of a family.

Session Learning Objectives and Activities

By the end of this session, participants should be able to:

- i) explore basic gender principles and related concepts including sex, gender, gender roles, equity, equality and life cycle.
- explore basic principles and related concepts including the role of interdisciplinary teams and a focus on the human, animal, ecosystem interdependence in responding to a EPT.

Time Activity/Topic Facilitator Instructions

حکے 30 min

Discovery Activity: What Does It Mean to be Gender Sensitive?

i) Divide the participants into four groups. Provide each group with a separate activity. Allow them 5 minutes to review the activity provided and then have them discuss it and present their findings to the rest of the teams.

What Does It Mean to be Gender Sensitive?

- ii) The teams should be able to respond to the following questions:
 - 1. Can you identify any gender related actions in these activities?
 - 2. What should be done to address the gender issues?

Group 1: In this community, there is conflict between the people and the national parks, because the community is collecting medicinal plants and firewood from the national parks—an area that is protected. The wildlife in the park has also been destroying the villagers' crops and killing their domestic animals. The national park management decides to create awareness about the role of wildlife by delivering a training and awareness program, primarily through night classes.

The awareness is done through night classes which limits women who are care providers for children from attending. In some communities, women are not even allowed to go out at night. The Park does not consult the community members on its plans. Considering the fact that since most of the people who collect medicinal plants and firewood are women, they should be a key stakeholder in the decision making.

Group 2: There is an outbreak of Avian Influenza in this community. The government decides that in order to completely eradicate this disease, they will slaughter all birds, be they ducks or chickens. It also decides to compensate all bird owners with more than 50 birds. Backyard poultry farmers are not compensated because most of them do not have more than 50 birds.

In this scenario, most backyard poultry farmers and people who keep less than 50 birds are women. If they are not compensated and yet they have lost their birds, they lose their livelihoods. As a result of this policy, whenever the women detect any sick birds, they quickly slaughter them and bring them to the markets for sale, thereby spreading the disease and exposing more people.

Group 3: The government in the country you work in wants to target farmers for training in poultry production and management on Avian Influenza prevention and control. They ask the animal health workers in the communities to identify people for training. Since men are the heads of households and the decision-makers, they are selected to attend the training.

In most communities that were affected by Avian Influenza, the poultry caretakers were women. Therefore, women should have been the key target for disease prevention training. However, since they are not part of the leadership circle in many communities, they are not involved in identifying trainees and cannot voice their opinion. But even if the men are trained, they will not deliver the information to the women, and so the disease will still spread.

Group 4: There is an outbreak of brucellosis in this community. Humans have been presenting at the health center with undulating fevers. They also have increased abortions among their animals. The disease is transmitted through contaminated milk and milk products. There have also been increased abortions reported in the buffaloes in the neighboring national park. The department of human health decides to create awareness by informing people through the radios that they should boil their milk and cook the meat thoroughly. They are puzzled when the outbreak continues.

In this community, women do not generally listen to the radio. In fact, most radios are owned by men who usually listen to the news communally when they have men's gatherings between the hours of 2 and 5pm at the marketplace. Women are not allowed in these gatherings. This is also the time when women are busy completing other household chores like collecting firewood.

Daily Activity Clock

i) Refer back to the story of Virunga National Park and show the following two slides:





ii) Looking at the above two pictures, and based on what has been discussed on the Virunga ecosystem,



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Discovery

Activity:

develop an activity clock of how the families and community members who live next to the national park spent their time from morning till evening. Identify the roles of the men, women, boys and girls. Put these on a flipchart for discussion.

- iii) Start by focusing on "facts," that is, how time was spent. Identify activities including non-caring (e.g., working outside the house, non-paid work that benefits the household, leisure, rest, etc., and the caring activities identified earlier in the session.
- iv) Next focus on similarities and differences in the activities performed by men and women (e.g., similarities and differences between men and women in "caring" for the child; similarities and differences in non-caring activities). Identify differences related to age, class and education.
- v) Then ask about environmental related activities:
 - 1. Who collects firewood?
 - 2. Who goes hunting for food?
 - 3. Who gets medicinal plants?
 - 4. Who fetches water from inside the park?
 - 5. Who has close contact with the gorillas?
 - 6. Who works on the farms?
 - 7. Difference in contact with people outside the home.
- vi) Debrief the activity by asking the group about:
 - areas of agreement/disagreement among team members as they create the activity clock.
 - surprises.
 - the differences in activities among men, women, boys and girls, and what differences these mean to you as someone involved in ecosystem health.
 - why these differences exist and are maintained.



of Gender

15 min

Roles

Consequences Consequences of Gender Roles

i) Do a PowerPoint presentation (**PPP No. 4**) for 15 minutes on the basic definition of the following terms: gender, sex, reproductive and productive roles, equality and equity. The presentation should also introduce the concept of gender. This should lead into a discussion of the gender tree. After this introduction, have the participants play the gender game to differentiate between sex and gender.

- ii) Move into the discussion on the gender tree.
- iii) In society, women are considered "caring" most of the time. As a consequence, they are often given the responsibility to take care of the sick and the elderly—unpaid work that is valuable in the health of the household. Because women regularly come into contact with sick people, they are more likely to become infected. They spend a great deal of their time in the caring activities which involve feeding, cleaning, washing and preparing food. As a consequence, women and young girls are often less likely to be involved in political, educational and professional activities. Because they are less educated and informed, their knowledge about the disease is often less than what men have.



30 min

Gender Tree

Activity

The Gender Tree

To understand the reasons for the differences and the impact of the differences in the roles men and women play, use the metaphor of a tree.

- The roots of the tree answer the question why there are gender role differences. Answers should include: culture (stereotypes, myths), religion, legal system and politics.
- The trunk of the tree is differences in gender roles that you have just identified in caring for sick people.
- Branches of the tree answer the question: what institutions, legislation, policies create and maintain those gender differences?
- The leaves are the consequences of institutionalized gender differences. The leaves can represent: the spread of disease (sickness, illness), food insecurity, poverty, or lack of education for women.
- i) Divide the participants into three groups.
- ii) Give each group a piece of flipchart paper and markers.
- iii) Give them three topics related to Virunga to discuss.
 - Access to communication
 - Access to education
 - Conflict zone

- iv) Based on their topic, let them draw the tree in which they describe the following areas in greater detail:
 - Why there are role differences between men and women. (ROOTS)
 - The different roles of men and women. (TRUNK)
 - What institutions, legislation policies, create and maintain gender differences? (BRANCHES)
 - The consequences of institutionalized gender differences. (LEAVES)

v) Post the trees and do a gallery walk highlighting:

- similarities
- differences
- missing aspects

Note: Use the tree below to make sure the participants have a complete and accurate understanding of gender roles and sex. When reviewing the tree, provide definitions for gender and sex. Emphasize that as result of culture, gender roles are not static.



vi) Debrief the session by asking the participants to reflect on:

- Which part of the tree they would target for longterm, systemic intervention in order to have a sustainable ecosystem.
- What they would do.

کل 15 min

Quick

and EPT

Quick Facts about Gender, One Health and EPT

Facts about
Gender,
One HealthProvide the participants with a handout on basic gender
terms and definitions.



Comments

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Concluding Concluding Comments

Understanding the interaction between gender roles, One Health and Ecosystem Health can lead to important insights into disease transmission patterns, ecosystem sustainability, strategies for prevention and control and the use of a multidisciplinary approach to inform policy and practice. Today's focus on gender, One Health and EPT terms and concepts has allowed the participants to critically analyze the convergence of gender and One Health using practical tools such as the 24-hour calendar and the tree metaphor.

Evaluation

- i) Create the flipchart shown below.
- ii) Ask the participants: "How did it go today?"

How did it go today? ©©© Comments:

References

- WHO (2007). "Addressing Sex and Gender in Epidemic-Prone Infectious Diseases" from www.who.int/csr/resources/publications/SexGenderInfectDis.pdf
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www.worldwewant2015.org/file/287499/download/311690

FAO (2013). "Understanding and Integrating Gender Issues into Livestock Projects and Programmes: Checklist for Practitioners," from www.fao.org/docrep/018/i3216e/i3216e.pdf

Ebola's lasting Legacy by Erika Check Hayden: Nature: volume 519, 5 March 2015

- Gender issues in Human Animal and Plant health using an Eco Health perspective by Brigitte Bagnol, Robyn Alders and Robyn Mcconchie: *Environmental and Natural Resources Research Vol 5 No1, 2015*
- What the solution isn't: the parallel of Zika and HIV viruses for Women: Susan T. Fried and Debra J. Liebowitz: The Lancet global health blog; February 2016.

Session 3: Learning and Applying Gender Analysis Tools in Eco-Health

Session Overview

The session flows with a succession of analysis tools being introduced and applied. The session uses gender analysis concepts that were presented in the previous session.

Session Learning Objectives and Activities

By the end of this session, the participant should be able to:

i) use the gender tool.

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to Gender

Indicators

and Gender

Analysis

ii) understand the importance of using gender tools and conducting gender analyses.

Time Activity/Topic Facilitator Instructions



Opening Comments

Introduce today's topic by saying: "This session flows with a succession of analysis tools being introduced and applied. The session uses most of the concepts that were already discussed in the previous session in the specific context of disease surveillance, response, prevention and control. The participants work in the same four groups all day (at least four groups so that surveillance, response, prevention and control can be covered), and apply the tools to an imaginary rural community according to the disease that was assigned to them. They will use a gender lens to collect relevant data in the context of health. Then the data accumulated in relation to the fictional community will allow them to develop a gender sensitive intervention. Use tools to understand the community and in the next session use tools to develop an intervention to mitigate the impact of the disease."



Introduction Introduction to Gender Analysis and Gender Indicators

- i) Give a brief PowerPoint presentation (PPP No.5) on gender analysis, gender indicators and gender sensitive indicators and statistics.
 - ii) Also discuss the different gender analysis concepts. iii) Discuss what a good analysis should provide:



- Gender awareness—understanding of gender relations and their implications for development policy and implementation
- Analysis of the division of labor—activities, access and control
- A review of women's priorities—restraining and driving forces
- Recommendations to address women's practical needs and/or strategic interests
- Productive and unpaid/reproductive work



Gender Analysis Tools

The session will focus on the following tools:

- Gender analysis matrix
- Access control and benefit over resources
- Social network analysis
- Communication profile
- Gender continuum

Gender Analysis Matrix

i) During the session, the participants will be divided into four groups: surveillance, response, prevention, and control. Each group will work with the same fictional community. They will use gender tools to collect relevant data in the context of health. The

Analysis Matrix 30 min

Gender

data will be used to develop a gender-sensitive intervention.

- ii) Briefly introduce the gender analysis matrix.
- iii) Divide the participants into four groups:
- iv) Ask for four volunteers (2 women and 2 men)
- v) Let the volunteers come to the front of the classroom.
- vi) Ask each volunteer pick someone from among the participants he/she has not worked with yet and he/she does not know well. That person stands behind the original volunteer.
- vii) Ask the second person in line to pick someone he/she has not worked with yet and does not know well.
- viii) Continue until everyone is on a team.

Activity 1: Gender Matrix - Vulnerability Exposure and Response to Disease Outbreak

- i) Ask the participants to select a specific urban or rural setting and a different community in different countries.
- Assign different diseases to different groups participants to select a disease. The diseases include: brucellosis, TB, Ebola or bilharzia.
- iii)In their selected setting, the participants should complete the handouts, identifying the vulnerability, exposure and response to disease outbreak as it affects men and women, the household and different communities.
- iv) The groups should also write down the activities performed by the different genders, for example, under labor: what do men spend their time doing in that community? What resources do they have access to? What are the cultural issues that affect men and women differently in that community?
- v) Each group should present this information on a flipchart.
- vi) The discussion should emphasize the fact that men and women are often not involved in the same social activities. While men are more likely to be involved in hunting, growing commercial crops, keeping large livestock and formal employment; women are gathering wood, edible and medicinal plants, caring for small livestock, and producing subsistence food. Women are also responsible for the nutrition and

<u>کک</u> 20 min

> Disease Outbreak

Activity 1:

Gender

Matrix-Vulnerability

and Response to

Exposure

health of their households, especially when preparing daily meals and taking care of the sick and the elderly (both as paid professionals, and as unpaid and untrained persons). Livestock, crops, natural resources and activities, are thus "gendered" as well as the risk to contract disease as a result of these activities. Distinguishable exposure is often the result of patterns of activities resulting from socially defined gender roles that influence the timing of the contact with the infectious agent within the cycle of the outbreak.



Activity 2:

Control and

Access.

Benefit

Resources

Over

Activity 2: Access, Control and Benefit Over Resources

- i) Introduce the exercise by showing Slide 14 of PPP No.
 5 and review the data on gender differences in an Ebola outbreak.
- ii) Refer to Activity 2 in the annex.
- iii) Use the table with data on Tanzania and Zambia as an example of some of the resources to consider.
- iv) Instruct the participants to complete Activity 2, and to discuss the implications of the data on the impact of disease and the provision of health care and education about the effects of treatments for their assigned focus (e.g. outbreak, surveillance, prevention, response, control).
- v) Each group should prepare a five-minute presentation.

Group Presentations

- i) In plenary, ask the different groups to present their findings.
- ii) Discuss gender differences relating to the impact of disease and provision of health care and knowledge about the effect of treatments.

Gender does not only impact on the risk of contracting diseases, but also influences the likelihood of accessing information and treatment, resources to get access to treatment, the evolution of the disease and the outcome of the treatment.

Access to services depends on several factors that include, among others, gender, class, religion and education. While women regularly go to the health center when they are pregnant or with young children whom they take for weighing or immunization, they are less likely than men to go to the



health center for their own health problems. Often, they do not have the resources to do so and require a formal authorization from their partners. Also, in some cases with particular norms of social behavioral, women may not have the decision-making authority to take their children to the health center and to consult the health center for their own health issues.

While some groups can be more prone to infection by a disease, some others, such as pregnant and breastfeeding women, find themselves in a situation where the side effects of the medicine on them, the fetus and the breastfeeding child are not always well known.

Stigma can also affect men and women differently. Discrimination and stigmatization are important issues in highly pathogenic Avian Influenza (HPAI), Ebola (WHO, 2007), Marburg and HIV.



Activity 3: Activity 3: Social Network Analysis

Give a PowerPoint presentation (Slides 27-39 of PPP No. 5) and briefly introduce the social network analysis tool. Have the participants discuss this tool and how they can use it in their work.



and Resource Use Mapping

Social

Network

Analysis

Stakeholder Stakeholder and Resource Use Mapping

This is a mapping tool to help people understand, visualize, discuss and improve situations in which many different actors influence outcomes. This social network analysis will specifically focus on participants identifying what they consider are places of significance in a community for different stakeholders.

- i) Divide the participants into four groups: women, men, children (noting differences in/with girls and boys, medical personnel (again noting differences in women personnel vs. male personnel). They should assume they are residents close to Akagera National Park in Rwanda.
- ii) Each group should then map out the stakeholders and specific resources/places they consider important to them or they will use the most to meet their needs.
- iii)They should identify:
 - similarities in groups

42

- differences in groups
- significance of those differences
- how the differences affect access to and control over resources.

Vulnerability to Risk Mapping

It is essential to identify who is most vulnerable in an unstable ecosystem and why; which capacities need to be strengthened; what relief and services are needed. Vulnerabilities and capacities of individuals and social groups evolve over time and determine people's abilities to cope with and recover from disaster.

- i) Each group should map out the risks faced by their teams (women, men, children, medical personnel).
- ii) Also identify/map out signs of those risks in the community.
- iii) Add resources that can be used to mitigate those risks to the maps in different colors.

Activity 4: Communication Profile

This is a very simple tool that provides information on how women and men access and share information.

- i) Based on the community they are working in, have the participants fill out the communication matrix for their community.
- ii) They should then display this communication matrix and discuss it with the rest of the class.

Activity 5: Gender Continuum Tool

- i) Give a brief introduction of PowerPoint presentation on what the gender continuum is. This gender equality continuum tool shows the ways that programs can address gender, or not.
- ii) Some programs are gender blind—they do not address gender at all.
- iii)Other programs are aware of how gender norms/inequalities influence behavior and address those norms in their activities.
- iv) Gender accommodating programs work around gender norms and dynamics.



Vulnerability to Risk Mapping







Activity 4:

Communica

tion Profile



v) Gender transformative programs seek to change gender norms and dynamics.

These programs also may be synchronized or may intentionally work with women and men in mutually reinforcing ways to address and challenge gender norms.

Programs can include both gender accommodating and transformative elements to address gender inequalities that are barriers to healthy behavior.

Let the participants select an activity or project that they work on or an organization that is doing work related to the ecosystem. It could be WWF, Kasoke project, Akagera National Park, REDD+. They should spend about 20 minutes and analyze it against the continuum.

- 1. Are they gender:
 - blind/aware?
 - exploitative?
 - accommodating? _
 - transformative?
- 2. Ask them to begin to think of ways to make them transformative.
- 3. Ask them about the specific action items they can come up with.



GENDER EQUALITY CONTINUUM TOOL



Group Presentations Presentations

- i) In plenary, ask the different groups to present their findings.
- ii) Regroup and analyze the groups' findings.



Group

Summary of the Session

- i) Review gender analysis tools
- ii) Review activities
- iii) Ask participants:
 - 1. What stood out as key learnings?
 - **2.** What surprised you?
 - 3. How do you see yourself using gender analysis tools and techniques in your work?



Evaluation

i) Create the flipchart shown below.

ii) Ask the class: "How did it go today?"

How did it go today? 098 Comments:

References

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Session 4: Risks of Ecosystem Disruption on Human, Animal and Environmental Health

Most parts of this section were adopted from the South East Asia One Health University SEOHUN Module on Ecosystem Health); (https://seaohunonehealth.wordpress.com/ecosystem-health/

Session Overview

Session 4 will discuss in details the causes of ecosystem disruption and associated risks to human and animal health. It will further discuss mitigation measures to address, avoid and reverse some of the impact of the ecosystem disruption. The participants will be able to learn and use tools for the ecosystem assessments.

Session Learning Objectives and Activities

By the end of this session, the participant should be able to:

- i) identify the risks of ecosystem disruption to human and animal health.
- ii) describe mitigation measures to counteract ecosystem health disruption.
- iii) identify method(s) of ecosystem health assessments.
- iv) describe tools used for ecosystem health assessments.
- v) prepare and disseminate reports of ecosystem health assessments.

Activity/Topic Facilitator Instructions Time

Activity



Pre-session **Pre-session Activity**

Have the participants read the following article: Loss of large predators has caused widespread disruption of ecosystems (included in Annex: ews.ucsc.edu/2011/07/apexconsumers.html) and discuss it.

Changes in ecosystem services influence all components of human wellbeing, including the basic material needs for a good life, health, good social relations, security, and freedom of choice and action (CF3). Humans are fully dependent on the earth's ecosystems and the services that they provide, such as food, clean water, disease regulation, climate regulation, spiritual fulfillment and aesthetic enjoyment. The relationship between ecosystem services and human well-being is mediated by access to manufactured, human and social capital. Human well-being depends not only on

ecosystem services, but also on the supply and quality of social capital, technology and institutions. These factors mediate the relationship between ecosystem services and human well-being in ways that remain contested and incompletely understood. The relationship between human wellbeing and ecosystem services is not linear. When an ecosystem service is abundant relative to the demand, a marginal increase in ecosystem services generally contributes only slightly to human well-being (or may even diminish it). But when the service is relatively scarce, a small decrease can substantially reduce human well-being.



- i) Let the participants watch the video on disruption of ecosystem through use of pesticides (http://study.com/academy/lesson/use-of-pesticidesbenefits-and-problems-associated-withpesticides.html) and prepare to discuss what would happen if the scenario in the movie unfolded in reallife and happened in their country.
- ii) In groups, the participants should look for factors that disrupt the following ecosystem found in Africa: Savannah grassland, African equatorial rain forests, coral reefs, Sahara, wetlands, woodlands
- 20 min

45 min



Factors

Ecosystem

WATCH VIDEO

0

that Disrupt

- iii)To introduce the factors that can disrupt an ecosystem, ask the participants the following questions:
 - 1. (Optional) How does the movie portray ecosystems and factors that disrupt ecosystems?
 - 2. What ecosystems have you experienced and what are the factors that can cause those to change?
 - 3. What is biodiversity?
 - 4. Why is biodiversity important?
 - 5. What would happen if we logged all the forests of (*country name*)?
 - 6. Why do we need natural areas?
 - 7. We all know that it would be bad to remove all the forests, but what are the reasons for doing so?
 - 8. How would human health be affected?

Lecture

iv) Introduce the lecture on factors that disrupt ecosystems by discussing how most environmental $20 \min$



problems can be traced back to poverty, conflict, population growth and affluence. Refer back to the Virunga case study, and the case study of Haiti, and how conflict and poverty can lead to disruption of ecosystems. With affluence comes an increase in resource use, which increases production and consumption of goods. Overpopulation, overconsumption, development and industrialization are intertwined and are key drivers that disrupt ecosystems.

- v) Discuss the following in a lecture presentation:
 - a) Factors that directly drive change to ecosystems include:
 - · Changes in local land use and cover
 - Changes in climate
 - Species introduction or removal
 - Fishing
 - Nutrient loading from activities such as fertilizer, pest control, irrigation
 - Modification of rivers
 - Water withdrawal
 - Pollution
 - b) Indirect drivers to change in ecosystems include:
 - Population growth
 - Economic (e.g., globalization, trade, market and policy framework)
 - Socio-political (e.g., governance, institutional and legal framework)
 - Science and technology
 - Cultural and religious (e.g., beliefs, consumption)
 - c) Five major effects to the biodiversity of ecosystems include:
 - Habitat destruction/alteration
 - Overharvesting/overexploitation
 - Pollution
 - Introduction of exotic species
 - Climate change
 - d) The critical changes in ecosystems that affect human health and their examples.
- vi) Let the participants discuss the factors above that disrupted their specific ecosystems and present these to the entire class.

- 1. What are the factors disrupting your ecosystem? What functions are being disrupted and how do they affect health locally, regionally and nationally?
- 2. What actions should be taken to address the health consequences of ecosystem change?

Let the participants review the case study: On shore oil and

gas exploration in African national parks: the gain and loss

Factors Disrupting My Ecosystem

<u>45 min</u>

 $45 \min$

Factors Disrupting

my Ecosyste m



Activity:

The Price

is Right

to the stakeholders involved. This case was developed by Ally Wright, David Krucik, Irene Galan, and Kathryn Rasp, Students in the Masters in Conservation Program at Tufts University, Cummings School of Veterinary Medicine, Class of 2016 Case study is included in the Facilitator Notes.

Activity: The Price is Right

- i) You can use a very simple variation of the TV game show "The Price is Right" to teach the participants the economics of oil and gas exploration in national parks. The idea will be to estimate the value of the various economic elements relating to the conflict.
- ii) Divide the participants in groups of 4–5. Groups have one minute to discuss each question within the group.
- iii) In a large lecture hall, you should encourage the participants to discuss with their neighbors. In a large lecture hall, a system similar to Socrative, or iClicker, should be used to collect answers.

It is up to you to decide the kind of prize for the group winner. Each question is rewarded! The participants will guess the answer to each question and the group that has the most approximate answers wins the price.

Examples:

- 1. What is the value of the fishery industry to Uganda?
- 2. How much is a refinery?
- 3. What is the value of Uganda's biodiversity?
- 4. How much does biodiversity cost Uganda?
- 5. What is the value of the schools, health clinics and the roads the oil companies built?
- 6. What is the value of the fishery industry to Uganda?
- 7. What is the value of a house in Uganda?

- 8. How much income may agriculture lose?
- iv) The answers to these questions will depend on current market price. (Possible answers to these questions are provided at the end of the session.)

Discussion Questions

Complete this activity with the following questions. The questions can be handed out to individual participants or can be discussed in a group session.

- 1. Is the oil development, as it is currently being undertaken, worth it? How would you change the progress of oil development to operate in a more sustainable way?
- 2. Is there a solution, utilizing key stakeholders, to ensure sustainable development?
- 3. The economics of the situation seem skewed heavily in favor of oil production. Are there any economically viable alternatives for the local inhabitants for improving livelihoods?
- 4. Are there any simple, even if difficult to achieve, solutions to the issues of corruption plaguing the oil development?

Block Analysis

This case study touches on issues based on conservation and problem-solving including:

Environmental and human conflict

Certain activities can cause issues with humans and the environment. It is important to understand how oil, fishing, and pollution can cause environmental impact that would intervene with human interests.

Economic value of wildlife

There are direct and indirect costs associated with the environmental economics and the benefits received from the natural resources. In order to determine the true economic cost of an activity, like oil exploitation, both forms of cost will need to be considered.

Sustainable development

Sustainable development is progress without depleting non-renewable resources. In this case, this would be

generating energy without depleting the resources of the land (biodiversity, income by farming and fishing, etc.). Oil exploitation itself is a non-sustainable field. However, companies have the ability to make their actions more sustainable, but this sustainability might hinder maximum profits.

Conflict resolution

Conflict can occur in several scenarios and can involve many stakeholders. Involving a neutral party to help evaluate the stakeholders and their concerns is necessary for many conflicts. United Nations can be seen as a neutral party that would evaluate a conflict within Uganda.

Stakeholder analysis

A stakeholder is an individual/group/institution invested in the project/program/activity, who will either gain or lose from it. A stakeholder analysis systematically gathers and analyzes both quantitative and qualitative information to determine interest and categorize the individual/group/institution.

Eco-Health in Action: Is My Problem Real?

Karatu Case Study

- i) Provide the participants with the case scenario of Karatu district in Arusha, Tanzania: This case study focuses on the use of pesticides and how they disrupt the ecosystem: human, animal and environment in Karatu, Tanzania. It has also links in the social and economic issues that are drivers for this disruption.
- ii) Let them read and analyze the case study and discuss it by reflecting on the following questions. Record the answers on a flipchart.
 - 1. What is the problem?
 - 2. Who is affected?
 - 3. Is there a social, economic and political angle to this?
 - 4. What key One Health issues can be identified?
 - 5. What sectors are involved?
 - 6. Are there any policy implications?
 - 7. What measures can be taken to protect the health of humans, animals and the environment?



- 8. Can you give similar examples from your own background/work?
- 9. How did you deal with it?





iii) Let each group deliver their presentation and give the other participants, time for questions, answers and comments. As the facilitator, be sure that the discussion addresses the challenges at the local, national and regional scales.

Session 5: Climate Change and Ecosystem Health

Session Overview

This session will focus on climate change and its effects on ecosystem health.

Session Learning Objectives

By the end of this session, participants should be able to:

- i) describe effects of climate change on ecosystem health.
- ii) describe strategies for climate change mitigation and adaptation.

Time Activity/Topic Facilitator Instructions



i) Select one or more of the following papers on the impact of climate change for the participants to read before this session:

- From Failure to Success: Reframing the Climate Treaty by William Moomaw.
 - http://www.fletcherforum.org/2014/02/10/moomaw/
- 350 Africa: 8 Ways Climate Change is Already Affecting Africa: <u>http://350africa.org/8-ways-</u> <u>climate-change-is-already-affecting-africa/</u> (In the annex)
- ii) Ask participants to read the assigned paper(s) and prepare a quick presentation on how climate change affects ecosystem health.



Effects of Effects of Climate Change



- i) Introduce the session on climate change with CDC video killer outbreaks feature called "Valley of death". After a huge earthquake hits California, a deadly fever is spreading quickly, and it is likely caused by a fungus released by the earthquake.
- *ii)* Then have the participants watch the following YouTube video on 7 Insane Effects of Climate Change on Your Life.
- https://www.youtube.com/watch?v=7mYJ9GJMgaw
- iii) Discuss the videos and the effects of climate change. Have the participants come up with effects of climate change that they have seen or experienced.

25 min Definition of Terms

Definition Definition of Terms

system.

Give a brief lecture defining the terms: weather, climate, climate system, and climate change. Humans have altered something that has caused a change in climate, such as:

It is very important to make it clear to the participants that climate change is the result of changes in the climate

- An increase in global temperatures
- An increase in melting of Greenland and glaciers
- A rise in sea level
- An increase in melting of Arctic sea ice
- An increase in ocean acidification
- A reduction in the ozone layer

Weather is the day-today manifestation of climate in a particular place at a particular time.

Climate is the average state of the atmosphere and the underlying land or water in a particular region over a specific time period. It is measured by the thirty-year average of weather metrics, such as temperature and precipitation. (Source: world meteorological organization)

Climate system is a set of components that together determine the global and local climate.

Climate change is a statistically significant variation in either the mean state of the climate or in its variability, persisting over an extended period (typically decades or longer).

Climate variability refers to variations around the mean state of climate, including the occurrence of extreme weather events.

Source: WHO, 2003, Methods to Assess Climate Change Effects on Human Health.

The two images below show drastic changes that have occurred in the two different regions of the world over the past 50 years.

Upsala Glacier Patigonia Argentina





Image © EarthKAM

"Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased." (IPCC OR5 quote)



Impact of Climate Change on Animal Habitats Climate

watch video

Change on Animal Habitats

i) Let the participants watch the video, which looks at the impact of changing climate on animal habitats around the world, showing how different creatures are responding to changing temperatures and precipitation patterns. The video is packaged with background materials, transcript, standards, teaching suggestions, etc. the video includes background information, links, learning objectives and an article for teachers.



Green

House and

the Carbon

Cycle

http://changingthebalance.thinkport.org/changing_climate_c hanging_habitatstc.htm.

- ii) Do a feedback discussion from the participants on the video for about 10 minutes. Discuss these from a One Health perspective and how human, animal and environment are linked.
- iii) After viewing this video, the participants should be able to explain how changes in temperature and precipitation can impact habitat distribution in the cases of the Edith's checkers pot butterflies, malariacarrying and West Nile virus-carrying mosquitoes and polar bears.

Green House and the Carbon Cycle

iv) Then, ask the participants the following question:
"Why does climate change occur?" List the responses from the participants and then give a summary answer by presenting the slides emphasizing greenhouse gas and the carbon cycle in the Module PowerPoint (PPP No. 3).



15 min

Challenges in Dealing with Climate Change and Humanitarian Emergencies

Divide the participants into four groups. Present them with the following 4 scenarios. Every group will be given two hours to research their specific area and come up with a presentation lasting utmost 15 minutes.

- The immediate aftermath of the earthquake in Kathmandu, Nepal 2011
- The hurricane in Southern Haiti in 2016

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- Hurricane Maria in Puerto Rico in 2017
- Flooding in Pakistan

In these 4 complex emergencies the groups should:

- i) describe briefly the nature of the emergency and the geographical region that is affected and the most vulnerable populations.
- ii) describe why it qualifies as a complex humanitarian crisis and therefore worthy of global solidarity and support.
- iii) describe any historical or direct and indirect drivers that could have led to its occurrence.
- iv) describe the major players and sectors needed to respond in the first 24 hours, the first 7 days, the first 30 days and the next 12 months.
- v) describe briefly the key steps needed to stabilize the emergency, prevent it getting worse, deal with secondary events, and eventually restore the situation to normalcy.
- vi) with a health lens, describe those activities required to prevent diseases, manage diseases and promote health in each of these emergencies.
- vii) describe the long-term investments needed in each of these situations.

How can a One Health approach be used to help respond to these emergencies or in the aftermath? Their presentations should be well-thought-out and interesting. A team of judges will review to decide the best presentation. Briefly present the following information to the participants

(PPP No. 8):



to Climate

Change:

Creating Creating Resilience to Climate Change Resilience

Resilience is the capacity to respond to altered conditions so as to minimize damage to human society and natural systems, or to ensure that the economic, societal and environmental factors retain their "functionality". There are four strategies of creating resilience:

- **Mitigation**—reduction in carbon dioxide emissions from fossil fuels and bio-energy and from deforestation, degradation of soils and from industrial sources.
- Adaptation—altering practices to perform in the changed circumstances resulting from altered climate systems.

- **Geo-engineering**—modifying the planet or its processes to slow climate change.
- **Restorative development**—fixing what is broken while meeting individual and societal needs.
- i) Divide the participants into four groups. Have each group discuss one of the topics above and come up with ideas and an example of each.
- ii) Briefly discuss some of the policies that have been put in place to limit climate change, both locally and internationally: PARIS-COP-21

Addressing Addressing Climate Change

Climate Change





Conclusio n to the Module and Participa nt Evaluatio

 \mathbf{ns}



Sharing

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the

https://www.ted.com/talks/al_gore_on_averting_climate_cris is

This video spells out 15 ways individuals can apply to address climate change immediately, from buying a hybrid to inventing a new, hotter "brand name" for global warming.

- i) Have the participants get back into their final groups and complete the team evaluation in their guide book.
 - ii) Tell the participants that as a team, they need to come to consensus on how effective they were:
 - as a team.
 - using tools they learnt in the course.
 - using a One Health perspective.
 - iii) Each team should prepare to share their responses to the open-ended questions at the end of the team evaluation.
 - What the team did well in the response and areas that were challenging.
 - Anything as a team you would do differently the next time you are responding to an emerging pandemic threat.
 - How you might use the information learnt from the simulation in your work.



Sharing the Learning

Learning In plenary, have the teams take three minutes to share: i) what the team did well and what the team found

challenging.
- ii) anything the team would do differently the next time it is responding to this kind of public health threat.
- iii)how team members can use information learnt from the course in their work.



15 min

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Closing

Session

Course Evaluation

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and

Post-test Post-test

- i) Handout post-test/survey
- ii) Tell the participants they have 10 minutes to complete the post-test.
- iii) If they finish early, ask them to remain quiet until everyone has completed.

Closing Session and Course Evaluation

- i) Have the participants form a circle and ask each of them to say in one or two words what new thing they learnt
- ii) Pass out certificates
- iii) Pass out OHCEA event evaluation
- iv) Tell the participants to place their completed evaluations in an envelope.
- v) Seal the envelope and give the evaluations to the OHCEA Course Coordinator.



Goodbyes/End of Module

Facilitator Notes

Palm Oil Case Study: The Environment and Threats to the Orangutans

Ellie collapsed into her bunk. She was exhausted, frustrated, homesick and downright angry; her mind racing back to where it all started. Ellie had been five and a half years old when her mother decided they could no longer stand watching a singing mermaid. That fateful day Ellie's favorite cartoon had been replaced by her mother's favorite – The Jungle Book. From the moment Ellie saw King Louie, the resident orangutan and swing music aficionado, she was hooked. That day she was working her dream job, or so she thought.

"Go to Sumatra. Work with orangutans,' they said. It'll be fun." Ellie mumbled under her breath as she knotted her bright red hair on top of her head, her blue eyes flashing in the sun. She recounted the last 14 days of her life. She had suffered through an overnight layover in Kuala Lumpur and then her flight touched down at Minangkabu International Airport and she had been swept up in a flurry of orientation slide shows, names and faces. Before she knew it, she was thrust into a tropical rainforest looking for the elusive orangutan. They had been tracking a mother named Siti and her offspring all over a section of the forest. Usually they would not be so dogged, but they believed Siti had given birth earlier in the week. They were honing in on the telemetry signal when they got the warning: fire had broken out just outside the border of the sustainable oil plantations. They would have to wait until the following day to make sure the orangutans were okay. On the way out of the forest she could not help but stare at the blazing sign that read "Future Home of JVM Incorporated" and a trickle of rage went up her spine. Another company to strip the forest clean.

The fire control efforts continued through the night and into the next afternoon. With every passing hour Ellie lost a little more hope that Siti and her babies would be okay. They had learned that the fire was set on purpose, part of a slash and burn campaign by a non-sustainable palm plantation. They had managed to destroy 1,200 acres of old growth peat forest in a matter of hours, with this fire alone. Ellie clenched her fists as they pushed through the brush, driven by the beeping of the telemetry tracker antenna. They came to the edge of the decimated area and were met with a gruesome site. Siti and her infant (a little girl) had not made it out of the forest. The site of her, charred beyond recognition, was almost too much for Ellie. Behind her she heard her bunkmate sob, grown men were sniffling. Nobody said a word. That's when the realization hit her—Siti had an older daughter as well. Ellie's heart stopped. Was there a chance for one of them? That's when they heard it, a small noise and movement in the mud. There, buried under a dense layer of wet foliage and mud, the tiny face of Siti's oldest daughter! The little survivor was freed from her little cave and rushed to the staff veterinarian. She suffered minor burns, mild hypothermia, and shock-but all in all, she was a fighter.

She was named Ubah which is Malay for change, before being relocated to the Bohorok Orangutan Center to grow up with her kind. Her mother and her baby sister Sayang were removed from the forest and buried under a durian tree on Bohorok's grounds. Their tree, and the legacy of Ubah, would serve as a reminder that change is necessary if we are to conserve biodiversity and save the orangutan, the man of the forest.

Background: The Fires of Malaysia and Indonesia

Slash and burn farming is defined as a method of agriculture in which existing vegetation is cut down and burned off before new seeds are sown, typically used as a method for clearing forest land for farming (EcoLogic 2014). The purpose of this type of land clearing is to imbue the land with nutrients, albeit short lived (Thomaz 2008). The fires burning in Indonesia cause devastation to prime orangutan habitat. Between 1997 and 1998 fires were estimated to have killed roughly 1/3 of the orangutan population. These fires alone released 1 billion tons of carbon dioxide into the atmosphere. The fires are typically worse during El Niño years because of the abnormally warm and dry seasons (World Bank 2015).

The burning of the fires also has far-reaching human health consequences. It is estimated that smog from the fires is responsible for 500,000 cases of severe respiratory disease, leading to 100,000 premature deaths each year. The debris from the fires affects people across Malaysia, Indonesia, and southern Thailand. The Indonesian government estimates the disease and loss of production cost the country \$47 billion USD in 2015 (World Bank).



The Plight of the Orangutan

Orangutan, translated from the Malay and Indonesian words meaning "man of the forest", is categorically a class of great ape. By 1996 their numbers had declined to the point that they were divided into two species—Bornean orangutan (Pongo pygmaeus) and Sumatran orangutan (Pongo abelii) (Payne 2008).

Orangutans are elusive creatures that spend the vast majority of their time in the dense canopy of the peat and tropical forests of Malaysian Borneo and Sumatra. They have long lifespan (35–45 years), do not reach maturity until around 15 years old, and can take up to eight years between offspring (Tisdell 2011). According to the World Wildlife Fund, in the last century orangutan numbers have plummeted fourfold to about 50,000 individuals remaining in the wild as of 2006. This drop occurred at the same time as the destruction of orangutans' suitable habitat through agriculturenecessitated deforestation and rampant forest fires. In the last two decades, roughly 5.5 million hectares of prime orangutan land have been lost (WWF). Deforestation is not solely to blame for the loss of thousands of orangutans. They are also greatly valued in the illegal pet and bush meat trades (WWF).

It is important to remember that orangutans act as an umbrella species in the Malay Archipelago (Tisdell 2011). Because they tend to be solitary. It can take a large area to sustain multiple animals (Nantha 2009). Conserving the land necessary for a sustainable population of orangutans will also protect valuable forest land for some of the area's other endangered species including the Sumatran rhinoceros, the Borneo pygmy elephant, and the Malayan tiger—all of which are on the IUCN red list as endangered or critically endangered (ICUN).

Biodiversity refers to the variety of life. In the context of the Malay Archipelago, it refers to ecological biodiversity or the myriad of ways animals/humans interact with the environment in which they live. A more difficult idea to conceptualize is the economic worth of biodiversity. The orangutan and the other endangered animals of Borneo and Sumatra do not carry inherent monetary value (Nantha 2008). They are not useful as work animals and cannot earn money for themselves—how then can their value be demonstrated to an impoverished population? According to Nantha and Tisdell (2008) the value of the orangutan, specifically, can be broken down into two categories—direct value and ecological values.



As discussed, the orangutan has qualities that make observing it in the wild difficult. The bulk of orangutan tourism dollars are spent on visits to orangutan sanctuaries and rehabilitation facilities (Nantha 2008). In spite of this, there are tourism companies that take visitors on expeditions to track and view orangutans in their natural habitat. One company, Red Ape Encounters in Sabah, earns roughly \$45,500 per year. They are able to funnel ~56% of this back into the community. Aside from tourism, there is no direct value of the orangutan that preserves its numbers in the wild. Hunting for meat and poaching for illegal trade bring revenue into the community but not to conserve the species (Nantha 2008). Ecological values are much more difficult to quantify. Orangutans' ecological value stems from their natural function in the ecosystem (Nantha 2008). The frugivorous diet of the orangutan makes them excellent seed dispersers. This directly maintains healthy forests which have innumerous benefits in the tropical ecosystem. What Nantha and Tisdell point out, though, is that the benefits of such ecological values are dispersed over the world population while the brunt of the cost is heaped on the local peoples. This makes it very difficult to explain the benefits of conserving even the most charismatic of species.

International non-profit organizations, companies, and governments are making attempts to mitigate the dire situation in Malaysia and the surrounding countries of Thailand and Indonesia. The United Nations has established a collaborative program on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries with the addition of sustainable management of forests (REDD and REDD+). They are working all over the world to reduce deforestation and build a sustainable future (REDD 2016).

In 2007 the World Wildlife Fund secured commitments from Indonesia, Malaysia and Brunei to establish protected and sustainably-managed forest habitat called The Heart of Borneo. This refuge is protected from both illegal logging and hunting. It may serve as a life raft for the endangered species in the area (WWF).

Finally, the Roundtable on Sustainable Palm Oil (RSPO) has set out to change the way palm oil is manufactured. They have gathered a variety of key stakeholders in the

palm oil conversation in an attempt to transform current unsustainable palm oil production (RSPO 2016). While far from perfect, the RSPO is a good first step toward a more sustainable future.

Policy Changes Ahead

The previously mentioned programs have established a framework for building conservation policy. What they lack is enforcement of the said policies. According to each of the key conservation groups, the governments in the impacted countries have been very cooperative in establishing protected areas and sustainable palm oil practices. The disconnect appears when it comes to enforcing the set policies. To assist in enforcement, it is proposed that the Local Government in the Malay Archipelago considers the following:

- i) Incarceration and fees for those caught hunting and poaching
- ii) Incarceration and fees for those caught in slash and burn deforestation





- iii) Steep taxes and fees for companies that do not adopt sustainable practices and who are not certified through the RSPO
- iv) Alternative employment in the form of park rangers or similar employment to provide income as well as police forested areas for poaching and burning
- v) Consider implementation of community-based forest management: give the people ownership and responsibility over portions of the forest with the goal of re-establishing habitable grounds
- vi) Mandatory labeling of palm oil in products
- vii) Indication of sustainable and non-sustainable sources

Palm Oil Still the World's Most Controversial Commodity

A report by a London-based NGO - the Environmental Investigation Agency released last month found <u>"dodgy assessments" of palm oil companies' operations</u> were the norm for auditors approved by the Roundtable on Sustainable Palm Oil (RSPO), the world's biggest sustainable palm oil organization.

The RSPO quickly <u>adopted a resolution acknowledging the problems</u> plaguing its certification process and committed to a number of reforms. But that was hardly the only controversy facing the global palm oil trade in 2015.

The production of palm oil led to a number of high-profile conflicts this year. In Indonesia, Dayak tribal villagers say <u>their borders were redrawn</u> to allow two companies to grow oil palm in their territory. In Peru, where more than <u>9,400 hectares</u> (more than 232,000 acres) of closed-canopy Amazonian rainforest have been removed for two oil palm plantations in the Ucayali region since 2011. Activists speaking out against deforestation have been <u>receiving death threats</u>.

There are even competing models for how to make palm oil without destroying the environment and violating human rights.

A group of major palm oil companies formed the Sustainable Palm Oil Manifesto and <u>released a study</u> that lays out a methodology for carbon neutral palm oil production. Critics of the new SPOM study say the carbon thresholds it proposes would allow "young rejuvenating forests" to be cleared for palm plantations.

They also point out that the study did not appear to be necessary in the first place since many of these palm oil companies have spent the past four years developing a similar methodology in partnership with civil society, with the main difference being that the new study was steered entirely by plantation, manufacturer and consumer companies.



The Price is Right: Possible Answers (Read Case Study at End of this Session First)

1. How much is 6.5 billion barrels of oil worth?

41 USD/barrel. Therefore 6.5 billion barrels of oil is 266.5 billion USD.

2. How much is a refinery?

Processing 60,000 barrels per day and producing over 4 million liters of gasoline and 2 million liters of diesel, a refinery can gain yearly revenue of 2.5 billion USD.

That yearly revenue is not profit, for it does not take into account the cost of operations and is based on current market prices of gas and diesel in Uganda today, which would

most likely decrease with the increase in supply. It also does not include the potential revenue from additional by-products of fractional distillation.

3. What is the value of Uganda's biodiversity?

Based on available data, the **quantifiable economic benefits of Uganda's biodiversity** have been calculated to have a value of at least Ush **1,112 billion a year (about** 330 million USD/year). It includes direct and indirect benefits.

- Direct benefits: use of forest, plant, wetland and water biodiversity as raw materials. The quantified value of these activities is about Ush 820 billion a year (241 million USD).
- Indirect benefits: terrestrial ecosystem services include watershed catchment protection, erosion control and carbon sequestration, while water-based ecosystems provide important water purification, storage and regulation functions. The quantified value of these services is Ush 300 billion a year (88.2million USD).

4. How much does biodiversity cost to Uganda?

The total quantifiable economic cost associated with Uganda's biodiversity is a minimum of Ush 506 billion a year (1.2 million USD/year) and it includes:

- Management expenditures associated with managing biodiversity. They are incurred to government agencies, non-governmental organizations, community members and external donors. For the Uganda government alone, the quantified value of these costs is over Ush 4 billion a year (\$1.2 million USD).
- Opportunity costs represent the income and other benefits predetermined from land use, investment and development opportunities excluded or reduced by the need to maintain biodiversity. The quantified value of the opportunity costs of biodiversity in terms of agricultural production predetermined in protected areas is over Ush 404 billion a year (119million USD).
- There are other losses to other economic activities, such as damage or human death and damage to crops and livestock from wild animals. The quantified value of wildlife damage to crops and livestock is more than Ush 97 million a year (28,500 USD).

5. What is the value of the schools, health clinics, and roads the oil companies built?

Infrastructure	Cost to Build	Amount Spent
School	770,000 USD	0
Health Clinic	700,000 USD	50,000 USD
Roads	2.3 million USD	162,000 USD
Total	3.77 million USD	212,000 USD

6. What is the value of the fishery industry to Uganda?

	National Income	Individual Income
Fisheries	140 million USD	3,796 USD

7. What is the value of a house in Uganda?

To build a home in Uganda may cost about \$290 (one million Ugandan shilling). However, compensations by oil companies was Ush 8,050, that is, \$2.37.

8. How much income agriculture may lose?

Over 51,600,000 USD, due to drop of 1.5% in funds. Oil is a non-renewable resource. At some point in time, oil and other mineral resources will be depleted. Without agriculture, the economy will then be left in a vacuum and be consigned to a net food importer status. This will have negative implications for the economy and national security. With growth in population, industries and services, the demand for food will grow higher and the country will lose by becoming a net importer instead of exporter of food.

i) Article: Loss of large predators has caused widespread disruption of ecosystems

ews.ucsc.edu/2011/07/apex-consumers.html

Scientists say decimation of top consumers may be "humankind's most pervasive influence on the natural world" due to cascading effects on ecosystems July 14, 2011 By Tim Stanhons

By <u>Tim Stephens</u>

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Sea otters maintain kelp forests (left) by preying on kelp-grazing sea urchins. In the absence of sea otters, the kelp forest is replaced by an "urchin barren" (right). Photos courtesy of J. Estes.



Restoration of wolves to Yellowstone National Park has allowed vegetation to recover from over-browsing by elk (left photo taken in 1997, right in 2001). Photos courtesy of W. Ripple.

The decline of large predators and other "apex consumers" at the top of the food chain has disrupted ecosystems all over the planet, according to a review of recent findings conducted by an international team of scientists and published in the July 15 issue of *Science.* The study looked at research on a wide range of terrestrial, freshwater, and marine ecosystems and concluded that "the loss of apex consumers is arguably humankind's most pervasive influence on the natural world."

According to first author, James Estes, a professor of ecology and evolutionary biology at the University of California, Santa Cruz, large animals were once ubiquitous across the globe, and they shaped the structure and dynamics of ecosystems. Their decline, largely caused by humans through hunting and habitat fragmentation, has had far-reaching and often surprising consequences, including changes in vegetation, wildfire frequency, infectious diseases, invasive species, water quality and nutrient cycles.

The decline of apex consumers has been most pronounced among the big predators, such as wolves and lions on land, whales and sharks in the oceans, and large fish in freshwater ecosystems. But there have also been dramatic declines in populations of many large herbivores, such as elephants and bison. The loss of apex consumers from an ecosystem triggers an ecological phenomenon known as "trophic cascade," a chain of effects moving down through lower levels of the food chain.

"The top-down effects of apex consumers in an ecosystem are fundamentally important, but it is a complicated phenomenon," Estes said. "They have diverse and powerful effects on the ways ecosystems work, and the loss of these large animals has widespread implications."

Estes and his co-authors cite a wide range of examples including the following:

i) The extirpation of wolves in Yellowstone National Park led to over-browsing of aspen and willows by elk, and restoration of wolves has allowed the vegetation to recover.

- ii) The reduction of lions and leopards in parts of Africa has led to population outbreaks and changes in behavior of olive baboons, increasing their contact with people and causing higher rates of intestinal parasites in both people and baboons.
- iii) A rinderpest epidemic decimated the populations of wildebeest and other ungulates in the Serengeti, resulting in more woody vegetation and increased extent and frequency of wildfires prior to rinderpest eradication in1960s.
- iv) Dramatic changes in coastal ecosystems have followed the collapse and recovery of sea otter populations: sea otters maintain coastal kelp forests by controlling populations of kelp-grazing sea urchins.
- v) The decimation of sharks in an estuarine ecosystem caused an outbreak of cownosed rays and the collapse of shellfish populations.

Despite these and other well-known examples, the extent to which ecosystems are shaped by such interactions has not been widely appreciated. "There's been a tendency to see it as idiosyncratic and specific to particular species and ecosystems," Estes said. One reason for this is that the top-down effects of apex predators are difficult to observe and study. "These interactions are invisible unless there is some perturbation that reveals them," Estes said. "With these large animals, it's impossible to do the kinds of experiments that would be needed to show their effects, so the evidence has been obtained as a result of natural changes and long-term records."

Estes has been studying coastal ecosystems in the North Pacific for several decades, doing pioneering work on the ecological roles of sea otters and killer whales. In 2008, he and co-author John Terborgh of Duke University organized a conference on trophic cascades, which brought together scientists studying a wide range of ecosystems. The recognition that similar top-down effects have been observed in many different systems was a catalyst for the new paper.

The study's findings have profound implications for conservation, "To the extent that conservation aims toward restoring functional ecosystems; the re-establishment of large animals and their ecological effects is fundamental," Estes pointed out. "This has huge implications for the scale at which conservation can be done. You can't restore large apex consumers on an acre of land. These animals roam over large areas, so it's going to require large-scale approaches."

The paper's co-authors included 24 scientists from various institutions in six countries. Support for the study was provided by the Institute for Ocean Conservation Science, Defenders of Wildlife, White Oak Plantation, U.S.; National Science Foundation, NSERC, Canada and NordForsk.

Case Study: On-shore Oil and Gas Exploration in African National Parks: The Gain and Loss to the Stakeholders Involved

By: Ally Wright, Conservation Medicine, Tufts University David Krucik, Conservation Medicine, Tufts University Irene Galan, Conservation Medicine, Tufts University Kathryn Rasp, Conservation Medicine, Tufts University

Learning Objectives

- i) To outline the basic history and background of oil and gas exploration in Africa, especially Uganda.
- ii) To identify key stakeholders and debate the negative and positive effects of oil exploration.
- iii) To demonstrate a grasp of the economics behind this issue by performing a very basic cost-benefit analysis of oil and gas exploration in the national park area of West-Uganda.
- iv) To explain the underlying conflicts and corruption behind the operations, and brainstorm and discuss ways to address the conflicts.

Background

In 2006 viable oil reserves were discovered in the Albertine Graben region of Uganda. This event, combined with the high international oil price, placed Uganda into the global petro club. Uganda's onshore oil was the largest discovery of the sub-Saharan Africa over the last 20 years, and international oil companies entered the country seduced by opportunities of high profits when international oil prices were still high (Patey L., 2016).

In 2009 the region's reserves were estimated at 6.5 billion barrels, enough to make Uganda a middle-income country within 25 years. However, oil extraction is a long-term business which takes years to be extracted, and for Uganda, the first oil exports are not expected until at least 2020. However, between 2014 and 2015, international oil prices fell from \$100 per barrel to averages of \$56 (Patey L., 2016).

In Uganda, many of these areas with potential for oil drilling overlap with areas rich in biodiversity such as national parks, forest reserves, water bodies, etc. (NGOP, 2014). Oil drilling not only has a direct impact on the environment and the biodiversity of Uganda, but also has a tremendous impact on the livelihoods of many of the villages surrounding Albertine region.

The disputes between Uganda Government and international oil companies have contributed to a delay in oil development and production. In the last few years, the Government of Uganda has acquired a debt that is one-third of its total GDP. Uganda has acquired loans from deals with state banks and other lenders from countries like China, France and England to fund ambitious projects. Uganda began to borrow beyond its means and now it may be following the path of other previous African countries where the oil resources have destabilized the countries and diminished development rather than powered it.

Seventeen international oil companies are interested in Uganda's oil blocks. The government has 6 blocks in total. The Ngaji block (895 km2) is the one that raises most concerns as it covers Lake Edward and part of Queen Elizabeth National Park. The other five blocks are: Ngassa block (410 km2) in Hoima district, Taitai & Karuka block (565 km2) in Buliisa district, Mvule block (344 km2) in Moyo and Yumbe districts as well as Turaco (425 km2) and Kanywantaba (344 km2) in Ntoroko district.

In addition, Uganda refuses to participate in the Extractive Industries Transparency Initiative (EITI) and to share with the public information from its oil contracts. Instead, the President of Uganda, Yoweri Museveni, manages the oil and gas and other major sectors of the economy (Patey L., 2016). International movements such as the Extractive Industries Transparency Initiative (EITI) have led towards transparency in other countries, but Uganda Government has not signed up yet. EITI Standard promotes open and accountable management of revenue and natural resources and governments sign up voluntarily to implement it. These standards follow the extractive value chain order and cover effective multi-stakeholder analysis, disclosure of information of how much money the countries obtain from oil and gas companies working in their country, the rules that the extractive sector has to follow and economic information about spending, exploration and production (EITI, 2016).



Figure 1: Political map of Uganda, showing the Albertine Graben region in circle (Source: UN Cartographic section. Available at: http://www.nationsonline.org/oneworld/map/uganda-map.htm)

Identifying the Conflict

The increasing need for oil and gas in developed nations is intensifying the search for oil in underdeveloped nations. The governments of these countries are promoting the exploration for this valuable resource in order to grow their economy. Many of the viable oil reserves are located in protected national parks (NGOP, 2014). However, because of the potential revenue the oil within these parks can create, governments are allowing international companies to explore and create refineries and pipelines that are environmentally damaging and create pollution (Fuda, 2015; Rwakakamba et al., 2014).

Uganda is one of many African nations facing this dilemma of possibly improving the economic status of their country at the expense of their national parks. The oil deposits are located within the Albertine Graben overlapping the Albertine Rift covering fourteen protected areas (Kityo, 2011).

Oil and gas development is a long process that can take decades before it is completed. The first step is to identify potential production areas. This is done by using remote sensing techniques (Borasin et al., 2002). Then, to obtain a better picture of the geological structures, they use seismic surveys which require large crews, vehicles, explosives, and clearing of vegetation along seismic lines (Borasin et al., 2002). After the seismic testing is done, the oil companies need to determine the commercial viability of the resource by drilling exploration wells (Borasin et al. 2002; PA Resources 2015). Four to ten years is what it takes from the discovery to the beginning of the production phase, which may involve drilling additional wells, building new pipelines, and refineries (Borasin et al., 2002; PA Resources, 2015). This development can be harmful to the environment and wildlife in these protected parks.

The process of drilling can cause a negative impact in the ecosystem, which impacts the communities and the wildlife population. Oil spills can also have devastating effects on the entire ecosystem (Rwakakamba et al., 2014). Albertine Graben is a region in Uganda covered by wetlands and with frequent rains. Therefore, there is a high risk of infiltration by oil spills. During oil drilling, local people and animals are exposed to aerosol pollutants of oil wastes and gas flares, waterborne diseases and other similar events. Construction of roads to access oil drilling blocks results in habitat loss and exacerbates fragmentation (McKenzie et al., 2012). Finally, it is also important to understand the noise impact that oil drilling has on wildlife (Patricelli and Blickley, 2006; Barber et al., 2011).

Whereas a spill or an explosion could cause permanent damage to the environment of Uganda, there is also a concern that tourism, agriculture, fisheries and human livelihood may be permanently affected as well. Uganda's natural parks are principal tourist destinations within the country. (Rwakakamba et al., 2014) showed that the number of visitors to national parks in Uganda increased from about 127,000 to about 210,000 between 2007 and 2011—an increase of over 65%.

Currently, there are several institutions like National Environment Management Authority, Uganda Wildlife Authority, Fisheries Resources Department, and Directorate of Water Resource Management in charge of close monitoring of the impact oil activities may have on the environment and biodiversity (NGOP, 2014).

Another concern many of the local villagers have is the possibility that the oil drilling activity will pollute Lake Albert. Many villages across the Albertine Graben depend on the fishing industry as an economic and livelihood source (International Alert, 2015). There has been a recent decline in the fish stock and many of the fishermen are blaming the oil drilling activities, claiming the large amount of noise the machines create is scaring the fish. There is evidence that the scarcity is due to overfishing, over-reliance on one economic source, and a failure of the authorities to manage the resource. However, because many of the oil companies have failed to have open communication with the villagers and fishermen, the anxiety of the latter group for their future and recent oil drilling activities has become overwhelming (International Alert, 2015). Lake Albertine is the breeding ground of many migratory birds as well as fish. Any oil spills could be devastating for both the environment and the fishing industry, and is a driver of conflict (International Alert, 2015). The villages near the lake and oil reserves are being constrained by the loss of land and property.

Oil development requires a great deal of land and there have been many concerns and disputes over the displacement of many villages for the activities of oil exploitation. Within the oil districts, villages are facing land-related problems like land grabbing, encroachment and fragmentation where oil is discovered within their village (International Alert, 2015). The problem of displacement and property destruction has been exacerbated by corruption characterized by unfair compensation for land and associated livelihood losses. Villagers are getting little to no compensation for the land they have surrendered to the oil companies. What little compensation some do receive is baseline, for the land only. They are not being compensated for crops lost, nor a fund to begin a new farm elsewhere (Balikuddembe, 2014). In a region of Uganda in which subsistence farming is so important, this unfair compensation can destroy a family life. The laws regarding property ownership technically outline correct property taken, compensation, and ability to argue property rights, but these mandates are not executed. The largely illiterate and poverty-stricken public does not have the resources to argue their case, or the ability to gain representation by someone that can (Tumusiimel, 2012).

The revenue from the oil produced is capable of improving the economic status of Uganda. The problem Uganda faces is that oil exploration will open opportunities of increased corruption, will place their national parks and wildlife at risk, and pollute the lakes currently supporting many of the disregarded villages within the oil districts. The lesson plan is meant to address these issues and have the participants determine whether oil exploration is worth the risk.

Stakeholder Analysis

Oil drilling exploration and protection of the national parks are two contrasting aspects. The management of these resources is generating conflicts between different stakeholders in the Albertine Rift in Uganda. In order to achieve a balance between increasing the oil drilling exploration, local community stability and environmental protection, an analysis of the different stakeholders is necessary. Figures 2 and 3 are the graphs where the stakeholders are categorized in order to determine the most

efficient way to address conflict and analyze the stakeholders undervalued.

International countries

There are several international nations related to the oil companies involved, interested in the development of oil within Uganda. Britain, France, China, Australia, India, Russia, South Africa, and Kenya are the major key players involved with oil exploitation in Uganda (Patey, 2015). These countries are interested in having a secure oil supply, especially because of their growing demand for oil. They also want to be considered a global player within the international oil market (Taylor, 2006). Making connections and forming bonds through oil can further assist to open up more trade avenues such as in valuable minerals (Taylor, 2006). Many of these international companies involved have strong diplomatic and economic power. They have a large political and global influence that could assist or hinder any projects Uganda devises (Taylor, 2006). Neighboring countries like South Africa and Kenya may not have the political and economic power the other countries do, however, their involvement can be driven by a similar desire to secure an oil supply and to be identified as key players within the oil market.

National government

The national government is mandated by the constitution to "ensure that all developmental efforts are directed at ensuring maximum social and cultural well-being of the people." Furthermore, according to their constitution, oil is a national resource protected by the federal government (Government of Uganda 1995). This combination makes the Government of Uganda an important stakeholder in the development of oil market and infrastructure. Because of the constitution, Uganda Government is ultimately responsible for generating profits from the oil resources and ensuring that these resources benefit the people. This includes, among other things, managing contracts with international oil companies (Directorate of Petroleum n.d.; Of et al. 2014). This gives them a magnificent amount of power over the entire situation. However, the government is still struggling with issues of corruption. In 2015 Uganda scored 25 on the Corruption Perception Index, ranking them 139th out of the 167 counties analyzed by Transparency International (CPI Report, 2015).

International companies

International oil companies are a major stakeholder in the development of Uganda's oil infrastructure and industry. Companies have already invested billions of dollars to aid in the development of the oil fields. These oil companies have signed contracts with the Government of Uganda to invest in infrastructure development in exchange for a majority share of the profits. The deals were struck in an attempt by the government to speed up development. These companies include CNOOC (China), Tullow Oil PLC (Britain), and Total SA Oil Company (France). Being foreign national based, their primary interests are recouping their investments in the regions and generating profits for their foreign shareholders.

Villagers

Oil development has brought alterations to many of the communities within the oil districts. Displacement is one concern that greatly affects villages, with the risk of receiving little to no compensation for their property. In August 2013, when the government first began planning the oil refinery to be built in the Albertine Rift, approximately 7.118 people from 13 villages were moved for possible construction needs (later unofficially estimated figure came to around 30,000 people that were displaced). In the same month, around 60,000 people were evicted from the Bukinda and Katikara villages in Hoima district (Albuja, 2014). However, the prospects of reliable jobs being created by the oil refineries can be advantageous to the villages. The unemployment rate in 2010 was 4.2% (Uganda Unemployment Rate, n.d.). It is expected that the oil companies will create 150,000 jobs (Jeong, 2015). The decisions made during oil exploration will greatly affect many of the surrounding villages. Oil companies have more contact with the villages than other stakeholders involving oil issues (Van Alstine, 2014). However, there is lack of information being communicated to the villages by the oil companies and the government (International Alert, 2015). The other stakeholders may not have any concern for the villagers and their community leaders due to their possible lack of knowledge and access to information, or other possible stigmas they suffer. A quarter of the population of Uganda is illiterate, with a greater portion living in rural villages (Schwarte, 2008). Many of the rural communities are also limited to information they receive with 5% of the population unable to access an electric grid or television, computers, radios, and even newspapers (Schwarte, 2008). Because of these limitations, many of the other stakeholders believe villagers lack the basic competence to make decisions for this possibly pivotal economic investment (Schwarte, 2008). Many of these expectations can hinder any attempts villagers make to have their concerns and opinions heard, yet if the villages unite and form a large group, together they can create greater pressure and power they need to stimulate change (Bategeka, 2008).

Farmers

Apart from losing their homes, these villagers might actually lose their entire income. The Uganda National Household Survey of 2005/2006 deemed that 84.6% of the Ugandan population is rural, and 31.1% lives in poverty. A large number of these poor rural populations depend on land for their livelihood as subsistence farming is one of the largest sources of income in the country (Veit et al, 2011). In a survey, specific to the Albertine region, four villages were sampled and among them 41% of land holdings were under 0.5 hectare and 60% under 1 hectare. These small plots of land were not being used for commercial agricultural profit, but for growing food and raising livestock for survival. For a region in which crop and livestock production corresponds to 50% of total income, these oil industries threaten to devastate the community. Environmental degradation from the oil exploitation as well as the associated socio-economic development, the government taking land owned by the villagers and the loss of farmhands to oil companies can result in the loss of livelihoods and even poverty. Protecting the integrity of natural resources in this region is essential in securing the well-being of the local community.

Fishermen

Subsistence farming and fishing are the two main ways of generating income for the communities in Lake Albert region. These livelihood activities have been disrupted since oil companies arrived, leading to a range of negative effects for affected groups.

There are two major sources of fish in Uganda: aquaculture and fishing in lakes and rivers. In Lake Edward, it is primarily tilapia, catfish and lungfish that are harvested. Since 2000, the fish stock in Lake Edward has declined due to overfishing and fishing malpractices. Oil exploration in Lake Edward brought expectations of bringing communities above the poverty line. Unfortunately, oil companies did not involve the fishery sector in the stakeholder analysis process. Now oil drilling raises concerns for local communities because even the smallest amount of oil spilled would have ecological consequences for the lake's biodiversity and for the fish stock. Furthermore, the lake represents an important source of natural resources and freshwater and more than 1,000,000 people depend on it (Benfield J., 2009).

Oil drilling has also had an impact on local economic growth, including a general rise in the cost of living for almost all the communities where oil drilling is taking place. Fish, firewood and transportation are much more expensive since oil companies arrived (Banfield J., 2009).

National Parks

Ecotourism is on the rise globally, and that trend is evident in Uganda national parks (Obua, 1997, Rwakakamba et al. 2014). This is a huge source of income that does not only fund maintenance and emergency response in the national park, but also supports the local and national economies (Obua, 1997). Yearly, ecotourism brings over \$7,704,191 to Uganda, with that number rising every year (Kasimbazi, 2012).

The Albertine Graben valley, in which most of the oil exploration is occurring, is one of the largest biodiversity hotspots in Africa. This area has over 20 forest reserves and 7/10 national parks including Queen Elizabeth National Park and Rwenzori Mountains National Park, both of which are World Heritage Sites (Kasimbazi, 2012). Oil exploration in this region poses a number of threats to these national parks. Discarded equipment, such as metal pipes and fuel pumps, pose a physical danger to both wildlife and humans. Introduction of roads and clearings allows poachers easier access to the protected wildlife within the parks. Poachers are also highly dangerous to the people that encounter them. The loss and fragmentation of land will ultimately threaten to reduce the wildlife populations that inhabit the parks, including the famous gorillas of Kibale National Park, and the ecotourism that stems from it.

Environmental groups

Last January, over 60 national and international NGOs, such as Global Witness and the Ugandan Civil Society Coalition on Oil and Gas, wrote a letter asking Uganda Government to stop issuing new drilling licenses, in particular, the Ngaji block.

According to the statement, these groups have also asked the international oil companies to withdraw from Ngaji block as oil activities in this area could have a tremendous negative impact on the environment. Oil spills, road construction, increased population and water pollution are just some examples. Any damage to the lake, the ecosystem or its biodiversity will have repercussions in all the local communities that live and depend on it. Moreover, NGOs are also concerned that oil exploration will decrease the number of visitors to Queen Elizabeth National Park, one of the biggest attractions for tourism in Uganda, contributing to around 8% of Uganda's GDP.

Cultural and Community Impact

Although the development of the oil sector may not be seen to affect a community directly, it is a challenge that will require engagement of community resources (Magis, 2010). To make proper evaluation, the participants (learners) need to understand the capacity of the community resilience to the impact of oil exploration.

Oil drilling can get a country out of poverty and into sustainable development. But if it is poorly managed, then it can create negative impact on the economy and region (NGOP, 2014). Local communities can suffer impact from oil drilling when local economies are distorted, hence raising the cost of living, lands and houses (Shepherd B., 2013).

In 2009, a peace-building charity organization called International Alert conducted interviews to the communities in Albertine region to identify some of the real conflict risks associated with the oil industry and its impact. Livelihood activities, such as fishing have been disrupted, leading to a range of negative impact for these communities; delayed compensations to landowners with land that has been affected by oil drilling infrastructure causes discontent; the lack of information from company activities and their closed relationship to the central government bring rumors, distrust and fear within and across this communities (Banfield J., 2009).

When oil companies came into Uganda, they promised to improve the community by creating schools, health clinics and roads. Ten years after the discovery of oil, the oil companies have failed to complete their promises even as they continue to explore oil, destroying crops, polluting the lakes and killing the fish (Jeong, 2015). These villages depend on those resources for their livelihoods. To compensate for all the troubles a household may have from the exploratory drilling, the communities were told they would be given a cash payout ranging from a few thousands to several hundreds of thousands by the oil companies and the Uganda Government. Of those that received the payout, many suffered from seeing their families torn apart and the social dynamic of many villages destroyed (Jeong, 2015). In Uganda, cultural practice allows men to own property such as land, and women are discouraged from doing so (Asiimwe, 2014). The men of a household or on a farm are the ones who received the payout and often spent it on beer, machinery and women — a cultural practice in Uganda to signify wealth (Jeong, 2015). It was also observed that the presence of oil companies with fences blocking access from oil drilling sites encouraged the villagers to also fence in their properties and claim ownership over lands. At the beginning, the villages trusted their neighbors and allowed the sharing of lands (Jeong, 2015). Not all villages were compensated in the

same manner however.

Whereas some families are getting massive payouts, some families are getting nothing. 29 square kilometers was marked off for one oil exploration mission near Hoima district in Uganda (Tumusiimel, 2012). Residents estimated at 7,118 from 13 villages in Hoima district were evacuated due to oil exploration, a majority of those people were smallscale subsistence farmers relying on their land for survival (Balikuddembe, 2014). Even before the drilling itself, residents were feeling the pressure. Residents of this district have voiced complaints about receiving little to no compensation after the destruction of their property by the reckless movements of the oil companies through the landscape for surveys alone (Balikuddembe, 2014). One resident, George Baisi, a butcher in Nyamasoga trading centre in the Hoima District, explains the situation, pointing at his roofed mud-house that is due to be demolished: "I spent approximately one million shillings to construct this house, but I was given 8,050 shillings as compensation for the house and part of my plot" (Tumusiime, 2012). In addition to getting nearly nothing from what the raw value of the home is, he is not being compensated for loss of lifestyle, cost of moving and starting business elsewhere, and other associated losses. Corruption can be blamed for this unfair compensation. Exposed in the summer of 2015, the Uganda National Roads Authority has admitted that part of \$3.5 million estimated to be over \$60,000 set aside to compensate for loss of land to roads, went to "ghost beneficiaries". They are currently facing a federal investigation by the Ugandan Government (Oil News Kenya, 2015). Uganda's 1995 Constitution guarantees a right to own property and prohibits "compulsory deprivation of property, except when such acquisition is necessary for public use or national security, public safety, public order, public morality or public health" (Tumusiime, 2012). This constitution demands prompt, fair and adequate payment for losses prior to the acquisition. However, it is clear that this is not the case. The corruption extends outside of the small scale government departments and oil companies. In fact, written into law is the justification for this unfair compensation. The Land Act states that when no mutual agreement is reached between the amount of compensation and/or take in general, the government can compulsorily acquire the land. However, the government must compensate the owner or occupier of the land for every day the land is encamped and for any inconveniences caused, or for any property taken from the land and any damage caused to the land. Not only does it state that the government can strong-arm the villagers and take their land, but the guidelines of the Land Act for determining compensation for customary owners' standing crops are vague, and do not account for pending crops on the land. The government might pay for the land, but not the seeds or plants on that land which give the owner their income or livelihood. The Land Acquisition Act, passed after the Land Act, states that acquisition must be by agreement between the government and the property owners, but most people are unaware of this provision and have weak bargaining capacity. The law states that a notice of intention to take possession of the land should be displayed near the land and all persons with interest in the land should be notified to appear on a specified day to state their concerns. It is only then that they may gain compensation. This seems legitimate, but since gazettes are not within easy reach and people may need to seek expert advice, the time allowance is insufficient.

Finally, the Petroleum (Exploration and Production) Act of 1985, one of the only laws regarding oil, states that oil belongs to the government, and so the property owner only enjoys surface rights. The owner of the land that the oil is found on, if they are not forced to move, does not get any margin of profit from the sale of oil drilled from their land (Tumusiime, 2012). The laws on paper seem to be for the people, but the execution is poor and allows the government and oil companies to take advantage of the public.

Agriculture is one of the country's top sources of income. A shift from agriculture and fishing to an oil-based economy which does not invest in agricultural development is risky. Oil is a non-renewable resource and if the country begins to import most of their food, and when the oil industry begins to decline, the country will be left in a very poor economic state. Even if revenue from the oil industry was not embezzled and large profits were being realized by the people, the population would grow and the demand for food would be higher. This would exponentially worsen the condition of the country when the oil industry crashes (Rwakakamba, 2013). The fishing industry is currently suffering from a decline in fish stock and could become worse if the oil extraction leads to pollution of the lakes.

Many of the villages and much of Uganda's economy depends on the fishing industry. Much of the village dynamics are already being altered from the current economic hardship. Within the fishing communities, the men would go out to the lake to fish on vessels and the women stayed by the shore to catch small amounts of fish using buckets (International Alert, 2015). But with a dwindling stock, the men stay out all night unable to support their families. Women are not allowed on fishing vessels, so many of them have resorted to spending their days drying out *mukene*, which is labor-intensive and pays barely enough to live on. Many women who have failed to get the support from their husbands have separated, taking the children with them (International Alert, 2015). Any oil spills that will damage the lakes will harm the fish stocks even the more, tearing more families and villages apart.

Overall, it seems on paper that the oil industry will bring jobs, bolster economy and increase the general livelihood for this poor and developing country. And while some regions and individuals are feeling the gain, most are not. Corruption and brute power and influence of these companies lead to exploitation of the undereducated and poorly resourced general public. The oil industry, as it is, is pushing communities past the point of resilience and into the state of harm.

Economic Evaluation

The discovery of oil promised to provide significant economic stimulus for Uganda. Unfortunately, the economics of oil production are not as straightforward as it is in calculating how much the country's oil reserves are worth. Oil prospecting and drilling is an expensive process and the cost of extraction sometimes exceeds the value of the oil. In Uganda's case, the economically viable oil reserves total 6.5 billion barrels worth of oil (Directorate of Petroleum n.d.). In order to develop this reserve, the Ministry of Energy and Mineral Development signed contracts with a number of different foreign oil companies, splitting the revenue from the oil extraction by 60:40, with oil companies retaining the majority revenue (Directorate of Petroleum n.d.; Of et al. 2014). Despite the total value of the reserves being over 200 US billion, the Ugandan Government will only see a little over 30 billion US dollars in revenue after profit sharing as well as prospecting and drilling costs, based on crude oil values on 2/24/2016 (NASDAQ 2016; US Energy Administration n.d., n.d.). (When presenting this material, these reported values should not be used. They should be recalculated based on updated market information, and updated infrastructure costs, which can be found by referring to the listed references above).

Additional costs will come from developing the infrastructure for refining and transporting the oil. Accurate estimates of these costs are difficult to develop because the development of the oil industry is in such early stages which makes it impossible to fully predict. Project costs are initial estimates and could change as the projects develop. The current plan is a pipeline to Kenya and a refinery so that Uganda can refine the oil and sell the products in order to reap associated increased profits. The refinery will cost approximately 5 billion US dollars, but could generate up to 2.5 billion US dollars a year, revenue, from gasoline and diesel production alone (Blair and Obulutsa 2013; Of et al., 2014). Similar to the above calculations, this is based on data from 2/24/2016 and should be recalculated when presented.) Uganda is still receiving bids to build the pipeline, but the cost should be expected to be in billions of dollars.

Ultimately, these costs are only a fraction of the low estimate for the revenue generated by sales of oil for the state. However, these calculations only take into account the very basic values and costs of oil; they do not account for the loss of revenue from negative impact on other industries. These calculations also do not account for potential issues that arise from corruption.

There has been an increase in corruption correlated to when oil companies began exploratory drilling. In 2001, Uganda was ranked 80 out of 180 according to the Transparency International's 2010 Corruption Perceptions Index (CPI), and in 2010, it rose to 127 out of 180. There have been many irregularities found in the education, energy, agriculture, police, and social security departments and other large scandals involving some high-profile organizations, costing Uganda several million dollars (Gelb & Majerowicz, 2011). The revenue from the resource can contribute to improving the

infrastructure of Uganda. However, because it lacks the government's ability to properly account for and allocate the wealth, this can increase the level of corruption involving the oil resource. Oil revenues can be misspent and misused to maintain government officials in power in underdeveloped countries like Uganda (Gelb & Majerowicz, 2011). According to the World Bank Assessment, corruption within the governmental system can cost a nation \$250 million annually. The amount of bribes, lack of supervision, and hiring up to 9,000 "ghost workers" can be an extensive loss of income, not just to the government, but to the people of the nation too (Gelb & Majerowicz, 2011).

Addressing the Conflict

Uganda's oil sector has come after several countries had taken the same risk and suffered from the consequences of oil extraction. Therefore, she can now try to emulate those that have been successful in mitigating the conflict with oil extraction, and also heed the warnings of failures labeled as "oil cursed states". Government officials and oil companies should involve all stakeholders in the consultative and inclusive meetings and address gender sensitive matters within their deliberations (Balikuddembe & Ardalan, 2014). Many of the communities within and nearby the oil districts have a great deal of mistrust of the government and the companies involved with the oil exploration. There will be a need for open communication between the communities and the officials of the oil sector in order to prevent conflicts and to enable fair compensation and factoring in any damages that can occur from the oil activities (International Alert, 2014). Many people's mistrust is rooted in the history of corruption they have seen. There is little benefit expected from the oil revenue which people believe will be swindled by state officials to keep them in power (Bategeka et al., 2009). In order to resolve the corruption involved with oil exploitation, the government will need to create a strong judiciary institute within the sector to ensure revenues are properly shared with the community and are used to help build infrastructures that will outlast the oil wells (Bategeka et al., 2009). There are efforts to create a system that will open communication and keep corruption at a minimum.

In Africa, on-shore oil drilling, whether in Mozambique, or in Kenya or in Democratic Republic of the Congo, has typically created conflicts among different stakeholders. In Uganda, political instability, government corruption and security issues have played a central role. Lack of transparency and Museveni's frequent priority for the oil sector will continue to increase discontent and unhappiness among the local communities and environmental groups. However, in Uganda, there is still a chance to improve management of natural resources. Oil extraction has potential to provide tremendous economic benefit for Uganda. It is imperative, therefore, that the government agrees to the much needed transparency policy and become an EITI candidate in order to avoid the experience of other developing countries. Access to abundant petroleum reserves is a blessing for nations. However, the inability to manage this sudden gift can drive a nation, and especially its inhabitants, to abject poverty. Uganda needs to prove that it is capable of managing its oil sector for the benefit of Ugandans, and show that they are committed to open management of the revenue that comes from oil drilling.

In Uganda, as in many other countries, there is also a battle between conservationists and oil companies. Virunga National Park in the Democratic Republic of Congo (DRC) shares

Lake Edward with Uganda. Therefore, allowing full-scale exploration and extraction of oil poses a threat to an area with UNESCO World Heritage Site status. Such culturally and sensitive sites are legally protected under the Geneva Convention together with other treaties including The Hague Convention for the Protection of Cultural Property in the Event of Armed Conflict. While oil exploration and extraction in national parks raises concern, oil drilling within World Heritage Sites is a violation of international law. Uganda is in a critical phase within the development stage of the oil sector and could be another example of a country that failed due to lack of communication, unfair policies, and destructive environmental costs. Alternatively, Uganda could become a country that successfully mitigated conflict and developed its economy while protecting the environment for the future generations.

As the participants in your class have learned, the task of mitigating conflicts is not as simple as it seems. Understanding the steps to identify the stakeholders and evaluate not just the economic cost, but also the cost of the communities' livelihood and the future, is a strong foundation to work towards mitigating this conflict.

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Article: 350 Africa Publication: 8 Ways Climate Change is Already Affecting Africa

http://350africa.org/8-ways-climate-change-is-already-affecting-africa/

Right now, the effects of climate change are being felt by people across Africa. Evidence shows that the change in temperature has affected the health, livelihoods, food productivity, water availability, and overall security of Africans. According to the <u>Climate Change Vulnerability Index for 2015</u>, seven of the ten countries most at risk from climate change are in Africa.

Africa has seen a decrease in rainfall over large parts of the Sahel and southern Africa, and an increase in parts of Central Africa. Over the past 25 years, the number of weather-related disasters, such as floods and droughts has doubled, resulting in Africa having a higher mortality rate from droughts than any other region.

1. Impact on Weather Patterns

Flooding

Flooding is the most prevalent disaster in North Africa, the second most common in East, South and Central Africa, and the third most common in West Africa (AWDR, 2006).

In North Africa, the 2001 disastrous flood in northern Algeria resulted in about 800 deaths and economic loss of about \$400 million. In Mozambique, the 2000 flood (worsened by two cyclones) caused 800 deaths, affected almost 2 million people, of which about 1 million needed food and 329,000 were displaced, and agricultural production land was destroyed (AWDR, 2006).

Drought

Between July 2011 and mid-2012, a severe drought affected the entire East African region and was said to be "the worst drought in 60 years".

2. Impact on Water Supply and Quality

Observable effects of climate change on water resources in Africa include: flooding, drought, change in distribution of rainfall, drying-up of rivers, melting of glaciers and the receding of water bodies.

West Africa

Entire economies suffer when the water levels of Africa's huge rivers drop. Ghana, for example, has become totally reliant on the hydro-electric output of the Akosombo dam on River Volta. Mali is dependent on the River Niger for food, water and transport. However, a great stretch of the river is now facing environmental devastation as a result of pollution. In Nigeria, <u>half the population</u> has no access to clean water.

Mount Kilimanjaro Glaciers

The gradual yet dramatic disappearance of the glaciers on Mount Kilimanjaro is a result of climate change (IPCC, 2001). The glaciers act as a water tower and several rivers are now drying up. It is estimated that 82% of the ice that capped the mountain when it was first recorded in 1912, is now gone. (IPCC, 2001)



Image © EarthKAM

3. Impact on Agriculture and Food

Across Africa, the landscape is changing. Droughts, heat stress and flooding have led to a reduction in crop yields and livestock productivity.

Eastern African countries are facing the worst food crisis in the 21st century. According to Oxfam, 12 million people in Ethiopia, Kenya and Somalia are in dire need of food. <u>Rainfall has been below average</u> with 2010/2011 being the driest year since 1950/1951, posing a serious problem for a continent almost entirely dependent on rain for its agriculture.



Image © wphna.org

4. Impact on Human Health

Climate-sensitive diseases and health impact can be high in poor countries that have minimal resources to treat and prevent illnesses. Examples of climate related health effects include:

- Frequent and severe heat stress linked to sustained increases in temperature.
- The reduction in air quality that often accompanies a heat wave can lead to breathing problems and worsen respiratory diseases.
- Impact of climate change on agriculture and other food systems increases rates of malnutrition and contributes to poverty *"With <u>one in four people</u> still undernourished in sub-Saharan Africa, climate change impact makes it even more difficult for governments across the region to improve food security and help reduce tensions."*
- The spread of malaria may increase in areas projected to receive more precipitation and flooding. Increase in rainfall and temperature can cause spread of dengue fever.

5. Impact on Shelter

Severe flooding and intense droughts have led to the destruction of many homes, shelters and villages across Africa. Conflicts over resources also exacerbate the impact and, in turn, contribute to the ongoing migration within and between countries in Africa.

Extreme events displace large amounts of people, especially those who are unable to respond and rebuild after disasters due to lack of resources.

"South Sudan refugees residing in a UN camp <u>are living</u> in knee-deep, sewagecontaminated floodwater, forcing some families to sleep standing up so they can hold their children out of the water."



Image © AlJazeera

6. Impact on Vulnerable Population

Women, children and the elderly are more vulnerable to climate change impact across Africa. Women laborers often experience additional duties as caregivers and from societal responses to climate change after extreme weather events (e.g., male migration).

The water scarcity places an additional burden on African women who walk hours and sometimes even days to fetch it (IPCC, 2014).

Children and the elderly face graver risks due to susceptibility to infectious diseases, such as malaria, and have limited mobility and reduced intake of food. The elderly face physical danger and even death due to droughts, heat stress and wildfires. Children often die from starvation, malnutrition, diarrheal diseases and flooding (IPCC, 2014).



Image © UNAMID

7. Impact on National Security

Climate change impact has the potential to exacerbate national security issues and increase the number of international conflicts. Conflicts often occur over the use of already limited natural resources, fertile ground and water. Access to consistent and dependable sources of water is greatly valued in many African regions. However, changes in the timing and intensity of rainfall have threatened water availability and are causing conflicts over this limited resource (IPCC, 2014). *"A United Nations report predicts that access to water may be the single biggest cause of conflict and war in Africa in the next <u>25 years</u>. Such wars are most likely to be in countries where rivers or lakes are shared by more than one country."*



A young man from the Nyangatom tribe patrols a water access point on the border between Ethiopia and Kenya. The site is one of ongoing conflict between the Nyangatom, the Kenyan border police, and the Turkana tribe (Image © vassar.edu).

The changes in precipitation and temperature are already affecting crop yields in sub-Saharan Africa. This has resulted in food shortages that have triggered crossborder migration and <u>intraregional conflicts</u> which have sparked political instability in Nigeria, for example.

8. Impact on Ecosystems





Climate change has already led to changes in freshwater and marine ecosystems in Eastern and Southern Africa, and terrestrial ecosystems in Southern and Western Africa. The extreme weather events have demonstrated the vulnerability of some of South Africa's ecosystems. The migration patterns, geographic range and seasonal activity of many terrestrial and marine species have shifted in response to climate change. The abundance and interaction among species have also changed (IPCC, 2014).

Despite the fact that the African continent has contributed the least to anthropogenic factors causing climate change, Africa is the worst hit.

1) Karatu Case study

What is a pest?


Karatu District Arusha Tanzania

Karatu district is located in Arusha region, Tanzania, and is known by its agricultural activities and irrigated farming practiced by the people. Among the major drawbacks that face the farmers are pests. As a means to overcome such problems, farmers indiscriminately use pesticides to protect their crops. This practice has been reported to be associated with many problems to the people, domestic and wild animals and the environment. Cases of abortions in humans and animals are quite high in the district, and are associated with pesticide poisoning. Skin diseases and infertility are also rampant especially to people working in horticultural farms. Incidences of fish and aquatic bird mortalities especially Lesser flamingoes (*Phoenicopterus minor*) are quite high and all are linked with pesticide poisoning. For example, in 2004, up to 45, 000 Lesser flamingoes died at Lake Manyara, which is being fed by rivers draining from the agricultural fields in Karatu district. Studies have shown high levels of pesticide residues in milk, beef and local chicken eggs. A case control study conducted in pregnant women who go to be delivered at Mount Meru Hospital in Arusha showed that they had very high levels of pesticide residues in breast milk and abdominal fats. The newly born babies had also high levels of pesticides in muconeum and umbilical blood. Studies further showed high levels of pesticides in water collected from Lake Manyara and different rivers around irrigated farms.

Efforts have been made by the government to overcome the problem. The Tanzania Ministry of Agriculture has been conducting seminars, extension work and restricting uses of pesticides including advocating for the integrated pest control systems, but the problem still exists and is getting worse.

Provide the participants with the case scenario of Karatu district in Arusha Tanzania:

- Have them read and analyze the case study and have a discussion on the following questions and record the answers on a flipchart:
 - 1. What is the problem? Who is affected? What are the challenges?
 - 2. What do you see as the social, economic and political angle to this?
 - 3. What key One Health issues can be identified?
 - 4. What sectors are involved?
 - 5. Are there any policy implications?
 - 6. What measures can be taken to protect the health of humans, animals and the environment?
 - 7. Can you give similar examples from your own background/work? How did you deal with it?

Useful Resources for Ecosystem Health and Climate Change

http://www.climate.gov/teaching/2014-national-climate-assessment-resourceseducators http://www.climate.gov/teaching http://esseacourses.strategies.org/module.nasa.html Rapport et al., 1998. Assessing Ecosystem Health. TREE, 13(10):397-402Borer et al., 2011. Bridging Taxonomic and Disciplinary Divides in InfectiousDisease. Ecohealth,D01:10.1

RESPOND SEAOHUN, 2014. One Health Modules:

https://seaohunonehealth.wordpress.com/ecosystem-health/

Margot. W. Parkes 2012. Diversity, Emergency, Resilience: Guides for a New Generation of Eco- Health Research and Practice. *Eco Health, Editorial*, 2012. Renaud De Plaen and Catherine Kilelu, 2004. From Multiple Voices to a Common Language: Ecosystem Approaches to Human Health as an Emerging Paradigm. *EcoHealth1* (suppl.2): 8-15

IDRC, 2012. Ecohealth Research in Practice: Innovative Applications of an Ecosystem Approach to Health. SBN: 978-1-4614-0516-0/288 pg. e-ISBN:978-1-55250-529-8

http://www.idrc.ca/EN/Resources/Publications/Pages/IDRCBookDetails.aspx? PublicationID=1051

Extra Notes on Ecosystem Health

Terminologies in Ecosystem Health

Ecosystem Health also known as Eco-Health recognizes the inherent interdependence of the health of humans, animals and ecosystems, and explores the perspectives, theories, methodologies emerging at the interface between ecological and health sciences (Wilcox 2004).

Ecosystem approaches to health focus on the interactions between the ecological and socio-economic dimensions of a given situation, and their influence on human health, as well as how people use or impact ecosystems, the implications for the quality of ecosystems, the provision of ecosystem services, and sustainability.

Ecosystems are dynamic and subject to both natural and human perturbations such as fire, flooding, drought, extinctions, invasive species, climate change, mining, fishing, farming, logging and oil spills. While there is no universally accepted benchmark for a healthy ecosystem, there are common signs indicative of the degradation of ecosystems.

One Health is the collaborative effort of multiple health science professions together with their related disciplines and institutions working locally, nationally and globally to attain optimal health of people, domestic animals, wildlife, plants and our environment (**One Health Commission definition**).

Other Terminologies

- **1. Ecosystem** is a <u>community</u> of living organisms in conjunction with the <u>non-living components</u> of their environment (things like air, water and mineral soil), interacting as a system to generate energy.
- **2. Abiotic** are the physical or non-living factors that shape an ecosystem. Examples include rocks, climate, pressure, soils, precipitation, sunlight, winds and humidity. These abiotic have a direct influence on living things.
- **3. Biotic** are living factors such as plants, animals, fungi, protist and bacteria. Biotic factors depend on abiotic factors to survive. The kind of biotic factors (living organisms) in a given area is often as a result of abiotic conditions of that area.
- **4. Habitat** is the area where an organism lives, including the biotic and abiotic factors that affect it.
- **5. Bio-diversity** includes the variety of all life on earth and the natural patterns it forms. Biodiversity has got 3 key elements:
 - Ecological diversity: biomes, provinces, ecoregions, ecosystem, habitat
 - Genetic diversity: populations, individuals, chromosomes, genes, nucleotides
 - Organismal diversity: phyla, families, genera, species, subspecies, population, individuals

- **6. Symbiosis** is the relationship in which two species live closely together, usually benefiting from each other. There are three types of this relationship:
 - Parasitism: parasite benefits, host is hurt
 - Commensalism: one species benefits, the other is neither hurt nor helped
 - Mutualism: both species benefit
- **7. Adaptation:** This is the ability of an organism to use suitable measures and mechanisms to survive in its environment. A good example is the polar bear. It helps it to camouflage, so its prey cannot see it. Its thick fur also provides the warmth to help it survive in its frozen environment.

What does an Ecosystem Entail?

An ecosystem consists of the biological community that occurs in some locale, and the physical and chemical factors that make up its non-living or abiotic environment. There are many examples of ecosystems: a pond, a forest, an estuary and grassland. The boundaries are not fixed in any objective way, although sometimes they seem obvious as with the shoreline of a small pond. Usually the boundaries of an ecosystem are chosen for practical reasons, having to do with the goals of a particular study.

The study of ecosystems mainly consists of the study of certain processes that link the living, or biotic components to the non-living or abiotic components. Energy transformations and biogeochemical cycling are the main processes that comprise the field of ecosystem ecology. As we learned earlier, ecology generally is defined as the interactions of organisms with one another and with the environment in which they occur. We can study ecology at the level of the individual, the population, the community and the ecosystem.

Studies of individuals are concerned mostly about physiology, reproduction, development or behavior; and studies of populations usually focus on the habitat and resource needs of individual species, their group behaviors, population growth, and what limits their abundance or causes extinction. Studies of communities examine how the population of many species interact with one another, such as predators and their prey, or competitors that share common needs or resources.

In ecosystem ecology we put all of this together and, insofar as we can, try to understand how the system operates as a whole. This means that, rather than worrying mainly about particular species, we try to focus on major functional aspects of the system. These functional aspects include such things as the amount of energy that is produced by photosynthesis, how energy or materials flow along the many steps in a food chain, or what controls the rate of decomposition of materials or the rate at which nutrients are recycled in the system.

Components of an Ecosystem

From this course and from general knowledge, you have a basic understanding of the diversity of plants and animals, and how plants and animals and microbes obtain

water, nutrients and food. We can clarify the parts of an ecosystem by listing them under the headings "abiotic" and "biotic".

Biotic Components
Primary producers
Herbivores
Carnivores
Omnivores

Usually, biological communities include the "functional groupings" shown above. A functional group is a biological category composed of organisms that perform mostly the same kind of function in the system; for example, all the photosynthetic plants or primary producers form a functional group. Membership in the functional group does not depend very much on who the actual players (species) are, but only on what function they perform in the ecosystem.

Processes of Ecosystems

The figure below with plants, zebra, lion, and so forth, illustrates the two main ideas about how ecosystems function: ecosystems have energy flows and ecosystems' cycle materials. These two processes are linked, but they are not quite the same (see Figure 1).



Figure 1: Energy flows and material cycles

Energy enters the biological system as light energy or photons, and is transformed into chemical energy in organic molecules by cellular processes including photosynthesis and respiration, and is ultimately converted to heat energy. This energy is dissipated, that is, lost to the system as heat. Once it is lost, it cannot be recycled. Without the continued input of solar energy, biological systems would quickly shut down. Thus, the earth is an open system with respect to energy. Elements such as carbon, nitrogen or phosphorus enter living organisms in a variety of ways. Plants obtain elements from the surrounding atmosphere, water or soils. Animals may also obtain elements directly from the physical environment, but usually they obtain these mainly as a consequence of consuming other organisms. These materials are transformed biochemically within the bodies of organisms, but sooner or later, due to excretion or decomposition, they are returned to an inorganic state. Often bacteria complete this process through decomposition or mineralization (see previous lecture on microbes).

During decomposition these materials are not destroyed or lost, so the earth is a closed system with respect to elements (with the exception of a meteorite entering the system now and then). The elements are cycled endlessly between their biotic and abiotic states within ecosystems. Those elements whose supply tends to limit biological activity are called nutrients.

The Transformation of Energy

The transformations of energy in an ecosystem begin first with the input of energy from the sun. Energy from the sun is captured by the process of photosynthesis. Carbon dioxide is combined with hydrogen (derived from the splitting of water molecules) to produce carbohydrates (CHO). Energy is stored in the high energy bonds of adenosine triphosphate, or ATP (see lecture on photosynthesis).

The Prophet Isaiah said "all flesh is grass", earning him the title of first ecologist, because virtually all energy available to organisms originates in plants. Because it is the first step in the production of energy for living things, it is called primary production (click here for a primer on photosynthesis). Herbivores obtain their energy by consuming plants or plant products, carnivores eat herbivores, and detritivores consume the droppings and carcasses of us all.

Commented [b3]: Quote scripture.



Figure 2 portrays a simple food chain in which energy from the sun is captured by plant photosynthesis and then flows from trophic level to trophic level via the food chain. A trophic level is composed of organisms that make a living in the same way, that is, they are all primary producers (plants), primary consumers (herbivores) or secondary consumers (carnivores). Dead tissue and waste products are produced at all levels. Scavengers, detritivores and decomposers collectively account for the use of all such "waste"—consumers of carcasses and fallen leaves maybe other animals, such as crows and beetles, but ultimately it is the microbes that finish the job of decomposition.

It is not surprising that the amount of primary production varies a great deal from place to place due to differences in the amount of solar radiation and the availability of nutrients and water. For reasons that we will explore more fully in subsequent lectures, energy transfer through the food chain is inefficient. This means that less energy is available at the herbivore level than at the primary producer level, less yet at the carnivore level, and so on. The result is a pyramid of energy with important implications for understanding the quantity of life that can be supported.

Usually when we think of food chains we visualize green plants, herbivores, and so on. These are referred to as grazer food chains, because living plants are directly consumed. In many circumstances the principal energy input is not green plants but dead organic matter. These are called detritus food chains. Examples include the forest floor or a woodland stream in a forested area, a salt marsh, and most obviously, the ocean floor in very deep areas where all sunlight is extinguished at 1000 meters above. In subsequent lectures we shall return to these important issues concerning energy flow.

Finally, although we have been talking about food chains, in reality the organization of biological systems is much more complicated than can be represented by a simple "chain". There are many food links and chains in an ecosystem, and we refer to all of these linkages as a food web. Food webs can be very complicated, where it appears that "everything is connected to everything else" and it is important to understand what the most important linkages are in any particular **food web**.

Biogeochemistry

How can we study these linkages in a food web? One obvious way is to study the flow of energy or the cycling of elements. For example, the cycling of elements is controlled in part by organisms which store or transform elements, and in part, by the chemistry and geology of the natural world. The term biogeochemistry is defined as the study of how living systems influence and are controlled by the geology and chemistry of the earth. Thus, biogeochemistry encompasses many aspects of the abiotic and biotic world that we live in.

There are several main principles and tools that biogeochemists use to study earth systems. Most of the major environmental problems that we face in our world today can be analyzed using biogeochemical principles and tools. These problems include global warming, acid rain, environmental pollution, and increasing greenhouse gases. The principles and tools that we use can be broken down into 3 major components: element ratios, mass balance and element cycling.

1. Element ratios: In biological systems, we refer to important elements as "conservative". These elements are often nutrients. By "conservative" we mean that an organism can only slightly change the amount of these elements in their tissues, if they are to remain in good health. It is easiest to think of these conservative elements in relation to other important elements in the organism. For example, in healthy algae, the elements C, N, P, and Fe have the following ratio called the Redfield ratio after the oceanographer who discovered it: C : N : P : Fe = 106 : 16 : 1 : 0.01. Once we know these ratios, we can compare them to the ratios that we measure in a sample of algae to determine if the algae are lacking in one of these limiting nutrients.

2. Mass Balance: Another important tool that biogeochemists use is a simple mass balance equation to describe the state of a system. The system could be a snake, a tree, a lake, or the entire globe. Using a mass balance approach, we can determine whether the system is changing and how fast it is changing. The equation is: **Net Change = Input + Output + Internal Change**

In this equation, the net change in the system from one period to another is determined by what the inputs are, what the outputs are, and what the internal change in the system was. The example given in class is of the acidification of a lake, considering the inputs and outputs and internal change of acid in the lake.

3. Element Cycling: This describes where and how fast elements move in a system. There are two general classes of systems that we can analyze as mentioned above: closed and open systems. A closed system refers to a system where the inputs and outputs are negligible compared to the internal changes. Examples of such systems would include a bottle, or our entire globe. There are two ways we can describe the cycling of materials within this closed system, either by looking at the rate of movement or at the pathways of movement.

Rate = number of cycles / time * as rate increases, productivity increases

Pathways are important because of different reactions that may occur.

In an open system, there are inputs and outputs as well as the internal cycling. Thus, we can describe the rates of movement and the pathways just as we did for the closed system; but we can also define a new concept called the residence time. The residence time indicates how long on average an element remains within the system before leaving the system.

Residence time (Rt) = total amount of matter/output rate of matter (*Note that the "units" in this calculation must cancel properly*)

Controls on Ecosystem Function

Now that we have learned something about how ecosystems are put together and how materials and energy flow through ecosystems, we can better address the question: "What controls ecosystem function?" There are two dominant theories of the control of ecosystems. The first, called **bottom-up control**, states that it is the nutrient supply to the primary producers that ultimately controls how ecosystems function. If the nutrient supply is increased, the resulting increase in production of autotrophs is propagated through the food web and all of the other trophic levels will respond to the increased availability of food (energy and materials will cycle faster).

The second theory, called **top-down control**, states that predation and grazing by higher trophic levels on lower trophic levels ultimately controls ecosystem function. For example, if you have an increase in predators, that increase will result in fewer grazers, and that decrease in grazers will result in more primary producers because fewer of them are being eaten by the grazers. Thus, the control of population numbers and overall productivity "cascades" from the top levels of the food chain down to the bottom trophic levels.

So, which theory is correct? Well, as is often the case when there is a clear dichotomy to choose from, the answer lies somewhere in the middle. There is evidence from many ecosystem studies that BOTH controls are operating to some degree, but that NEITHER control is complete. For example, the "top-down" effect is often very strong at trophic levels near to the top predators, but the control weakens as you move

further down the food chain. Similarly, the "bottom-up" effect of adding nutrients usually stimulates primary production, but the stimulation of secondary production further up the food chain is less strong or is absent.

Thus, we find that both of these controls are operating in any system at any time, and we must understand the relative importance of each control in order for us to predict how an ecosystem will behave or change under different circumstances, such as in the face of a changing climate.

Scales of Ecosystems

Ecosystems come in indefinite sizes. They can exist in a small area such as underneath a rock, a decaying tree trunk, or a pond in your village, or in large forms such as an entire rainforest. Technically, they can be classified as follows:

Ecosystem Micro: A small scale ecosystem such as a pond, puddle, tree trunk, under a rock etc.

Ecosystem Messo: A medium scale ecosystem such as a forest or a large lake.

Ecosystem Biome: A very large ecosystem or collection of ecosystems with similar biotic and abiotic factors, such as an entire rainforest with millions of animals and trees, with many different water bodies running through them.

Ecosystem boundaries are not marked (separated) by rigid lines. They are often separated by geographical barriers such as deserts, mountains, oceans, lakes and rivers. As these borders are never rigid, because ecosystems tend to blend into each other. This is why a lake can have many small ecosystems with their own unique characteristics. Scientists call this blending "ecotone".

Ecosystems can be put into 2 groups. If the ecosystem exists in a water body, like an ocean, freshwater or puddle, it is called **an aquatic ecosystem**. Those that exist outside of the water bodies are called **terrestrial ecosystems**.

Levels of Ecosystem

To understand the levels of belonging in an ecosystem, let us consider the diagram below.

Levels of organization in an Ecosystem



Individual, Species, Organism

An individual is any living thing or organism. Individuals do not breed with individuals from other groups. Animals, unlike plants, tend to be very definite with this term because some plants can cross-breed with other fertile plants.

In the diagram above, you will notice that Gill, the goldfish, is interacting with its environment, and will only crossbreed with other goldfishes just like her.

Population

This is a group of individuals of a given species that lives in a specific geographic area at a given time. (An example is Gill and his family and friends and other fishes of Gill's species). Note that populations include individuals of the same species, but may have different genetic makeup such as hair/eye/skin color and size between themselves and other populations.

Community

This includes all the populations in a specific area at a given time. A community includes populations of organisms of different species. In the diagram above, note how populations of gold fishes, salmons, crabs and herrings coexist in a defined location. A great community usually includes biodiversity.

Ecosystem

As explained earlier, ecosystems include more than a community of living organisms (biotic) interacting with the environment (abiotic). At this level note how they (biotic) depend on other abiotic factors such as rocks, water, air and temperature.

Biome

A biome simply means a set of ecosystems sharing similar characteristics with their abiotic factors adapted to their environments.

Biosphere

A biosphere is the sum of all the ecosystems established on Earth.

Food Chains

All living things need to feed to get energy to grow, move and reproduce. But what do these living things feed on? Smaller insects feed on green plants, and bigger animals feed on smaller ones and so on. This feeding relationship in an ecosystem is called a **food chain**. Food chains are usually in a sequence, with an arrow used to show the flow of energy. Below are some living things that can fit into a food chain. Can you build it?



A food chain is not the same as a food web.

A food web is a network of many food chains and is more complex.

See the food web illustration below—you can pick out a basic food chain from the web: Green plants > Grasshopper > Frog > Bird > Hawk



In the diagram above, the arrows show the directions of energy flow. They point to the animals doing the eating.

Energy Transfer

Energy is transferred along the food chains from one level to the next. Some of the energy is used up in growth, reproduction, repair, movement and other ways, and not made available to the next level. Shorter food chains retain more energy than longer chains. Used up energy is absorbed by the environment.

Food Web is the complex feeding network occurring within and between food chains in an ecosystem, whereby members of one food chain may belong to one or more other food chains.

Habitat is the place where a particular population (e.g., human, animal, plant, microorganism) lives, including its surroundings. For example, anaconda is the snake that lives in water and thrives very well there.

Plankton are microscopic plants and animals that live in water.

Human Behaviors and Systems that Impact Ecosystem Health

Different types of ecosystems

http://www.google.com/url?url=http://www.youtube.com/watch%3Fv%3DtQjbqgPxK c0&rct=j&q=&esrc=s&sa=U&ved=0CBsQtwIwAmoVChMI_7-

<u>Dqb61xwIVS9caCh19RwNY&usg=AFQjCNEX5tKObAaITPZncmR8SeANSOlLYg</u> *Terrestrial ecosystem*

http://www.google.com/url?url=http://study.com/academy/lesson/what-is-aterrestrial-ecosystem-definition-examplestypes.html&rct=j&q=&esrc=s&sa=U&ved=0CBUQtwIwAGoVChMI_7-Dqb61xwIVS9caCh19RwNY&usg=AFQjCNHcM-_F9GpBugblr5Zq6ses0_wjqA

Factors Influencing Human, Animal and Environmental Health

Case 1

During World War One, the destruction that took place had an impact on human, animal and environmental health. Lots of fumes from gunshots were released into the atmosphere coupled with many structures that were burnt. Lots of auto machines were used to transport the war machinery and lots of waste oils were poured into the ocean and lakes for disposal. Vegetation and trees were cut and many wetlands destroyed in search for shelter and fuel for food preparation. As a result of insecurity, many families lost their children and parents, jobs and businesses were also destroyed. Cultural heritage and places of worship were destroyed, leading to changes in the ways of life.

As a result of the war, food production reduced, malnutrition was dominant and death due to hunger and disease set in. Floods and long spells of drought, extinction of both plant and animal species and change in weather patterns were witnessed. After the war, rehabilitation involved an increase in population, industrialization, new habitats, poor waste disposal, low food productivity, an improved socio-economic status but which was very competitive.

Case 2

Ecosystem Health in the Central Rio Grande Valley and the Great Lakes Basin

The Central Rio Grande Valley in New Mexico represents a practical application of measuring indicators of ecosystem health at different spatial scales. The region is targeted for ecosystem health assessment because of rapid changes resulting from the high level of human activity concentrated in the river valley. The irrigated valley produces many of the cash crops valuable to the USA's economy, and an estimated two million people depend directly on the basin, which is considered to be North America's largest intensively engineered flood-plain landscape.

Important indicators of ecosystem health in this landscape include biodiversity and water quality. Symptoms of degrading ecosystem conditions include the prevalence of exotic species and disease, water contamination and loss of riparian forests. The spread of exotic species affects the productivity of farm fields by reducing the production potential of the native grass strips between the river levees. Increased disease prevalence is the indirect result of reduced biodiversity, marked by the loss of gallery forests (which have been replaced by cottonwoods). These trees become focal points for roosting birds, which are vectors of the parasitic plant, mistletoe (Phoradendron tomentosm). Reduced water quality is the result of the leaching of nitrates and coliform bacteria from manure, which are discharged through runoff.

The contaminated water, together with the loss of riparian forests and their inherent alteration capacity, has resulted in contaminated runoff reaching the water system

unabated. Another contributing factor to reduced water quality is the occurrence of unregulated human settlements (ëcoloniasí), which discharge raw sewage directly to irrigation ditches. All of these anthropogenic stresses are causing extreme ecological degradation to the Central Rio Grande ecosystem.

A somewhat different pattern of pressures has impacted the Laurentian Lower Great Lakes Basin (Lake Ontario and Lake Erie, North America). Before the early European settlement in the early 19th century, the region was characterized by a high abundance and diversity of forests, fish and mammals with the establishment of intensive agriculture, commercial fishery and forestry operations, and building of canals, which drastically changed the biophysical character of the basin. The three primary attributes of ecosystem health were adversely affected:

Reduced productivity was evident from the decline in fish abundance and infertility of agricultural soils; lowered resilience became apparent after many decades and other stresses (such as the introduction of exotic species, leading to the extinction of native fish species); changes in organization (community structure) became evident with a shift in dominance from highly organized near shore to the relatively less organized offshore pelagic associations.

The loss of resilience resulted in widespread extinctions of native fish species and a flip to eutrophic conditions, characterized by periodic anoxia over large areas of bottom waters of the central basin of Lake Erie, and radical shifts in the structure of fish communities from once dominant littoral and demersal terminal-predators and benthic feeders (consisting of more specialized stocks and high species diversity) to offshore pelagic associations composed of exotic species. Additional indicators of decline in the health of the Laurentian Lower Great Lakes Basin include an associated loss of ecosystem services, such as the decline in water quality, the loss of edible fish (owing to the accumulation of toxic substances, which have resulted in health advisories suggesting limits to consumption), loss of the once thriving commercial fishery, and virtual depletion of the commercial timber resources of the basin.

- 1. What do you understand from this case?
- 2. Identify and explain bio-physical, cultural, gender, socio-economic and ecological factors and their influence on human, animal and environmental health.
- 3. Identify the risks of ecosystem disruption to human and animal health.
- 4. Describe what would happen if any of the links in this web broke down.

Video on disruption of ecosystem through use of pesticides

 $\label{eq:http://study.com/academy/lesson/use-of-pesticides-benefits-and-problems-associated-with-pesticides.html$

Describe mitigation measures to counteract ecosystem health disruption.

http://www.google.com/url?url=http://issuu.com/westcountryriverstrust/docs/2013-07-

08 cm evidence review wq_v2&rct=j&q=&esrc=s&sa=U&ved=0CDMQtwIwCGoVC

$\label{eq:hMIsMKogeW1xwIVCbwaCh0a8wLL&usg=AFQjCNEoolZgMHGebew6zp-NGM40ig4qmQ} MGM40ig4qmQ$

Methods of Ecosystem Health Assessment

Ecosystem health assessment mainly has two methods: one is **indicator species assessment**, and the other is **structure and function index assessment**.

Indicator Species Assessment

This involves ecosystem health assessment using measures of resilience, vigor and organization.

Vigor is measured in terms of activity, metabolism or primary productivity. An example of reduced vigor from a study of the Great Lakes Basin (North America) is the decline in the abundance of fish and infertility of agricultural soils within the basin.

Organization can be assessed as the diversity and number of interactions between system components. An example also from the Great Lakes is reduced morphological and functional diversity of fish associations that occurs under multiple stresses.

Resilience (counteractive capacity) is measured in terms of a system's capacity to maintain structure and function in the presence of stress. When resilience is exceeded, the system can flip to an alternate state. A prime example is the shift from benthic to pelagic dominated fish associations in the Laurentian Lower Great Lakes Basin.

Structure and Function Index Assessment

This includes single index assessment, complex index assessment and index system assessment which includes natural index system assessment and social-economic natural index system assessment.

Climate Change and Drivers

Changes in the atmospheric abundance of greenhouse gases and aerosols in solar radiation and in land surface properties alter the energy balance of the climate system. These changes are expressed in terms of radiative forces which are used to compare how a range of human and natural factors drive warming or cooling influences on global climate. Since the TAR, new observations and related modelling of greenhouse gases, solar activity, land surface properties and some aspects of aerosols have led to improvements in the quantitative estimates of radiative forcing.

There are at least 22 climate change causes (drivers)

The sheer number of drivers speaks of the complexity of climate change. The principal influence of each of the drivers and their impact is shown in the table below. Some drivers exert a more immediate influence while others contribute over much longer time scales. CO2 (carbon dioxide) is one of the drivers; and while everyone agrees that CO2 does contribute to climate change as a greenhouse gas, the magnitude of CO2 influence has not been settled within the overall scientific

community, the political systems, the media or the population in general. We have determined that the influence of CO2, though significant at low concentrations in the atmosphere, is of minor impact as more and more is added to the atmosphere, a view that we address in the following Critical Facts List.

More Than One Climate Driver!

DRIVER	PRINCIPAL INFLUENCE	IMPACT	COMMENTS
Sun's heat and magnetic variations	Amount of sun's heat and solar shielding variations over time.	Strongest	Amount retained modified by other drivers.
Orbital eccentricity	Determines distance from the sun at any given time.	Very Strong	Distance variations mean heat variation.
Earth's tilt	Determines Earth's seasons and heat received at high latitudes.	Strong	Additional tilt can affect polar ice melting.
Earth's wobble (precession)	Determines season closest to or farthest from the sun.	Strong	Can be a positive or negative feedback.
GHG water vapor	Strongest GHG. Affects cloudiness, albedo, vegetation, and precipitation volumes.	Strongest of GHGs	Net effect the least understood (predictable) of the GHGs.
GHG carbon dioxide (CO ₂)	Captures infrared heat radiated from Earth's surface, reradiates some heat.	Strong only at low	Greenhouse effect non-linear. Usually follows temperature changes.
GHG methane CH4	Captures infrared heat radiated from Earth's surface, reradiates some heat.	Moderate (low volume in atmosphere)	Generated in wetlands, by industries and some animals.
Ocean currents	Distributes heat around Earth. Can change patterns quickly or very slowly.	Strong	Largest reservoir of surface heat. Affects precipitation.

More Than One Climate Driver! (Continued)

Plate tectonics (seafloor spreading)	Causes volcanism, CO2 and sulfate particle input, subuction and mountain building.	Strong long-term	Affects ocean currents, sea level, and polar
Location of continents	Affects major ocean currents and heat and moisture to poles.	Strong to weak	continents. Land over poles promotes more glaciation.
Elevation of land massses	High elevations increase chemical weathering (CO2 removal).	Weak	Also affects regional climates, monsoons and locations of deserts.
Chemical weathering	Affects CO ₂ removal and carbon sequestration.	Weak	Little short-term effect on climate.
Volcanism	Constant source of CO2, sulphate particles, and short-term soot.	Moderate to strong short-term	Provides great lava and ash layers for age dating.
Extraterrestrial impacts	Immediate fires, then cold for 1 to 5 years.	Strong very short-term	Can create ocean and atmospheric toxicity.
Albedo	Determines how much solar heat is reflected or retained.	Moderate to	Affected by many drivers, constantly changing.
Fauna & flora (animal life and vegetation)	Affects albedo, oxygen, CO2 and methane content of atmosphere.	Moderate	Abundance and type of flora track temperature, CO2, and moisture changes.
Atmospheric circulation	Distributes heat and moisture and affects upper ocean current patterns.	Moderate	Distributes nutrients to oceans, affecting sea life abundance and carbon sequestration.
Cosmic rays	Suggested they create particulates that seed low level clouds (cooling).	To be determined	More research needed to verify impact magnitude.

H. Leighton Steward, 2007

Documentary or video clip to show drivers of climate change

http://www.google.com/url?url=http://www.youtube.com/watch%3Fv%3DwSJgkG99 4yg&rct=j&q=&esrc=s&sa=U&ved=0CC0QtwIwCGoVChMIvPeDwr23xwIVBlwaCh 3xIg9c&usg=AFQjCNF7o9UawLbO7DP45nMBNRpggLI4Lw

http://www.google.com/url?url=http://www.youtube.com/watch%3Fv%3Df1SqeatPeL s&rct=j&q=&esrc=s&sa=U&ved=0CBgQtwIwAWoVChMIvPeDwr23xwIVBlwaCh3x Ig9c&usg=AFQjCNEuk93YEIXQbdvODNEIBgVTZdMkyA

http://www.google.com/url?url=http://www.youtube.com/watch%3Fv%3DkKh8Uw6_wrM&rct=j&q=&esrc=s&sa=U&ved=0CBUQtwIwAGoVChMIvPeDwr23xwIVBlwaCh3xIg9c&usg=AFQjCNEyQnRxCCjhWMOYC-jyxrlb7cdBJg

Impact of climate change on ecosystem

http://www.slideshare.net/ghaiath/climate-change-and-its-impact-onhealth#14400681856821&fbinitialized

Climate change and mitigation strategies

http://www.google.com/url?url=http://www.youtube.com/watch%3Fv%3DjSDCU4Gy _2U&rct=j&q=&esrc=s&sa=U&ved=0CBgQtwIwAWoVChMI967Y2MC3xwIVyIYaC h0twgY9&usg=AFQjCNHIJbmwpdCoTW1gk5zK0906Iybdow

http://www.google.com/url?url=http://study.com/academy/lesson/global-climatechange-effects-and-mitigationstrategies.html&rct=j&q=&esrc=s&sa=U&ved=0CBUQtwIwAGoVChMI967Y2MC3 xwIVylYaCh0twgY9&usg=AFQjCNGYfoSTjH-4GisWit16P-N5FcNdWw

OHCEA EVENT EVALUATION – ECOSYSTEM HEALTH SHORT COURSE

Facilitators:

Dates:

OHCEA supported you to attend the **Culture and Ethics Short Course**_event. Please take a few minutes to fill out the following confidential questionnaire. Your responses will help us better understand the value of this event and improve future programs. Thank you!

Please circle your response to each of the following:

- 1. This event met my expectations.
 - a) Strongly disagree
 - b) Disagree
 - c) Agree
 - d) Strongly agree
 - e) Don't know
- 2. This event was relevant to my personal interests.
 - a) Strongly disagree
 - b) Disagree
 - c) Agree
 - d) Strongly agree
 - e) Don't know
- 3. This event was relevant to my professional interests.
 - a) Strongly disagree
 - b) Disagree
 - c) Agree
 - d) Strongly agree
 - e) Don't know

- 4. The information presented was new to me.
 - a) Strongly disagree
 - b) Disagree
 - c) Agree
 - d) Strongly agree
 - e) Don't know
- 5. The amount of information provided was:
 - a) Not enough
 - b) About right
 - c) Too much

6. This event helped clarify my understanding of "One Health."

- a) Strongly disagree
- b) Disagree
- c) Agree
- d) Strongly agree
- e) Don't know
- 7. The pre-event logistics were well organized.
 - a) Strongly disagree
 - b) Disagree
 - c) Agree
 - d) Strongly agree
 - e) Don't know

8. The event itself was well organized.

- a) Strongly disagree
- b) Disagree
- c) Agree
- d) Strongly agree
- e) Don't know

9. Overall, I found this event to be worthwhile.

- a) Strongly disagree
- b) Disagree
- c) Agree
- d) Strongly agree
- e) Don't know

10. I intend to take actions in my work as a result of what I learned at this event.

- a) Strongly disagree
- b) Disagree
- c) Agree
- d) Strongly agree
- e) Don't know

11. Describe what, if any, actions you will take in your work as a result of this event.

12. What were the strengths of this event?

13. What can be done to improve this event?

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14. What single most important lesson did you learn from this event?

15. Please write any additional comments you may have about this event.

16. Did you present at this event?

a) Yes

b) No

16a. If yes, what was the topic of your presentation?

17. What is your *primary* area of work?

- a) Nursing
- b) Human Medicine
- c) Veterinary medicine
- d) Wildlife Medicine
- e) Public Human Health
- f) Public Veterinary Health
- g) Other (please specify):

18. Which sector do you represent?

- a) Government
- b) Private sector
- c) Education
- d) Non-governmental organization (NGO)
- e) Research
- f) Other (please specify):

19. What is your sex?

- a) Male
- b) Female

20. Nationality: