COMPLEXITY

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CONNECTS WITH:
Participation and Research -- Gender

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MODULE INTRODUCTION

DESCRIPTION

This module covers material related to complexity and its importance for ecosystem approaches to health. What is complexity? Are there different kinds of complexity, such as mathematical, technical and social? Are they really different? Are there particular aspects of complexity that are relevant for ecosystem approaches to health? What are they? How are they relevant?

The world we live in is complex. The complexity we see in the world around us is a function of the nature of the world itself, we who observe the world, and the questions we ask. If we ask how to fix a broken watch, we can think of the watch in fairly simple mechanical terms, and we do not need to invoke notions of complexity; if we ask about the function of watches in society, or the social, political, economic and ecological relationships required to acquire the resources and pull together the materials and skills necessary to build a watch, we need to invoke complexity. Similarly, if we wish to save people dying of cholera, we have the relatively straightforward, albeit challenging tasks of providing them with the potable sources of fluid replacement. If we wish to prevent cholera epidemics, we are faced with complex, interacting political, social, economic, biomedical and ecological forces.

Issues we see as being complicated are only that way if we narrowly define the boundaries of the problem. This is particularly true in agricultural and food systems, for instance. Industrial economies of scale make efficient use of certain kinds of resources if one externalizes interactions with the social-ecological context. This industrial efficiency is dependent on stable external conditions, and is very **brittle** in the face of changes in external resources and economic structures. If everyone is growing corn, and the price of fossil fuels goes up, or the markets for corn collapse, the system cannot adapt; people might go hungry because all the corn is used for fuel, or, conversely, because they can't sell their crops. Large slaughterhouses that require high through-put of animals may have to shut down completely in the face of border closings (due to diseases such as (SA) BSE or Foot and Mouth Disease). This can have cascading, devastating effects as farmers cannot even service local markets. Small slaughterhouses that serve local markets can, in some cases, keep functioning when large slaughterhouses shut down because of closed borders. A similar argument holds for why a power grid that relies on many different kinds of power is much more **resilient** than one which is based on a few large power stations.

Every description of the world is a simplification, and systems descriptions are no different in that regard. Complex systems are descriptions of complexity, that is, they are attempts to describe the world as we live in it and experience it, that attempt to accommodate multiple dynamic interactions of as many variables as possible. By definition, there are many such descriptions (and hence many complex systems) possible; different observers will see different things in the world, and model them differently, either formally, or perhaps just in their heads. Although mathematical models are useful to explain certain events such as pandemics or climate variability, there is no single mathematical model that can explain the complexity of the world, and also predict the future. Managing a sustainable food system, or managing land use in a

watershed where industry, human settlement, wildlife and food production are vying for space are similarly complex.

DIRECTIONS

Ideally, this is a participatory module. However:

- **In one hour,** an instructor can take a single case study and walk through it, emphasizing the different aspects of complexity.

- **In a few hours,** use several instructors from different backgrounds (ecology, philosophy, participatory research, health) and have them lecture as part of the same session, dealing with a single (or several) case studies. Each instructor is required to ensure that a particular aspect of complexity is addressed (scale, perspective, feedbacks, and so on). The teaching is intended to elicit questions from the students, as well as between the instructors.

- **Over a day or so,** one can better engage the students in learning. Ideally, the instructor should have several stacks of flip-chart paper and many marker pens. There should be a room with sufficient round tables to assign about 6 students per table. Pictures of a case (usually selected by the instructor) are either looped through a powerpoint or other slideshow presentation, or tacked to the wall around the room. The case study pictures should include people who live in the case area, pictures of problems (piles of garbage, free-running dogs, dirty water, erosion, and so on), as well pictures of how people make a living. Then, have the students work in groups to work up the case.

    - **Issues map.** Ask students to list, map, and draw the issues that they see in the case study pictures. This can just be a list or scattered notes on the paper. There is no right answer; the aim is to get students talking to each other. (*15 minutes*)
    - **Talk about it.** What is Missing? How are they linked? (*10 minutes*)
    - **Stakeholder map.** Ask students to name the stakeholders they see in the slides. This can be a list or just names or categories. (*15 minutes*)
    - **Discussion.** Who is missing? How are they linked? (*10 minutes*)
    - **Making connections.** How are the issues and the stakeholders linked? In general, what does one do with this information? What else do we need to know? (*30 minutes*)
    - **More discussion.** This activity is then followed up by discussions of scale, perspective, and feedbacks. Ideally, these will be drawn on a blackboard or flipchart. It is important to allow as much freedom as possible, emphasizing that increased precision and rigour can be worked out later. The first step is always to identify all the issues, people, policies (official and unofficial) scales, and how they interact.

AIMS/GOALS:

The goal of this module is for students to:

- Understand what complexity is, how it is manifested in the kinds of situations tackled by ecohealth approaches, and what the consequences are for policy and action;
- Identify ways to act and manage realistically within contexts of incommensurability and uncertainty;
- Explore some of the tools that help us to work with complexity, including concepts and models as well as mixed methods, and by doing so, offer some optimism to participants when faced with the overwhelming task of tackling complex problems; *and*
- Identify the types of questions that will enable us to characterise complexity.

GUIDING QUESTIONS:

- What makes a system complex and not merely complicated?
- Who is a stakeholder? What does it mean to have different perspectives on a situation?
- How does one determine which perspectives are relevant?
- How does the purpose of our inquiry change which perspectives we deem to be relevant (i.e. the purpose of understanding a system, compared with the purpose of managing it)? Who should make this determination? How?
- What boundaries are relevant (e.g. spatial, temporal, governance, scales, and so on) and how do you identify and select them? How does boundary relate to scale?
- Is there ever too much uncertainty to make a decision? What does that mean?
- How does one deal with anticipated, undesirable consequences of decisions that are intended to (and expected to) have a short term good?

WORKING TERMS:

- Multiple perspectives and stakeholders
- Temporal and spatial scales/nested scales
- Nonlinearity, emergent properties, interconnectedness, interactions, time lags
- Resilience, feedback loops, self-organization, and unintended consequences
- Uncertainty, science, and decision making

CASE STUDY EXAMPLES

- The Kathmandu case study presented in *The Ecosystem Approach: Complexity, uncertainty, and managing for sustainability* (Waltner-Toews et al, 2008).
- The Cooum River case study in India presented in *An Adaptive Ecosystem Approach to Rehabilitation and Management of the Cooum River Environmental System in Chennai, India* (Bunch, 2000)

SECTION 1: FOUNDATIONS

DESCRIPTION

Basic scientific questions about a virus might be answerable using widely used, peer-accepted techniques, but questions related to complex socio-ecological health issues use multiple techniques and dramatically different paradigms to delve into complementary aspects of the situation. This section introduces several such complementary approaches and explores why we would use (and what we can learn from) such things as mathematical modeling, ecological modeling, participatory techniques, epidemiological techniques, systems theories, basic biology, anthropology, and environmental management. This section also provides an overview of some of the key thinkers and methodologies of complexity and systems thinking. It will introduce the key features of complex systems, in particular, issues of scale, feedback loops (self-organization), multiple perspectives, and uncertainty. Instructors can introduce the section by presenting the scholarly literature on complexity (i.e. a few key papers), and suggesting some important features of complexity for ecohealth. This discussion could be based on asking questions related to open or closed cases. [See Developing and Using a Case Study in your Teaching]

LEARNING OBJECTIVES

The goal of this section is to help students begin to understand the theoretical basis of ecohealth, including basic principles of complex systems theory, as well as the need for methodological pluralism and multiple stakeholder involvement.

KEY QUESTIONS

- What is a system? What is a complicated system? What is a complex system? What is a complex adaptive system?
- What is the difference between complex and complicated?
- Where does complexity arise from? Is everything complex?
- Consider a system (preferably from your own work) that you think of as being complex. What are the elements included in this complex system? How have you chosen them? Based on what knowledge?
- How do the elements interact and how are they organized/structured? Based on what knowledge did you decide?

KEY CONTENT

This section begins with an activity on "Incommensurability" to ensure that students become keenly aware of the need for tools for grappling with the complexity of ecohealth issues. The section should emphasize that it is not just that there are many different ideas on health and environment, but the knowledges which confront ecohealth issues do not match up neatly. This is the case both within the physical sciences, between the physical and the biological sciences, between the sciences and the social sciences, amongst the sciences and the humanities, between researchers and social workers, and amongst social workers and communities, families, friends,

and healers. The key content for this section includes post-normal science, systems thinking, complexity, resilience, non-linearity, uncertainty, scale, cross-scale interactions, panarchy/holons/nested scales, emergent properties, and self-organization.

Examples

Instructors can use on of the examples listed at the beginning of this module, or use their own case study examples which demonstrate concepts of post-normal science, systems thinking, complexity, resilience, non-linearity, uncertainty, scale, cross-scale interactions, panarchy/holons/nested scales, emergent properties, and self-organization.

Activities

Activity 1: Incommensurability

Learning Objectives

- Develop student's understanding that ecohealth issues cannot be reduced to simple problem-solving techniques because of the incommensurability of both the multiple perspectives involved in ecohealth issues, but and the different knowledges.
- Enable students to reflect on their dispositions towards multiple perspectives and knowledges.

Instructions

STEP 1: Introduce the Issue

Introduce students to a concrete ecohealth issue in a particular situation (e.g. Kathmandu case study). Choose a situation that will prompt them to think an issue in its complexity: tar sands, wind turbines, climate change, vector-borne-disease, and so on. You can begin the section by showing diverse images of the issue to the students.

STEP 2: Statements and Expressions

Provide students with a list of true statements and expressions of the case study that express and represent different standpoints, disciplines and ways of knowing. These statements or expressions could include a description, map or model of the position of the animals in the situation, a First Nations territory map, and/or a significant sound that relates to the issue. Try to place conflict up front and to include statements and expressions of the following kinds:

- Value
- Spiritual
- Economic
- Political
- Cultural
- An equation of some sort
- A statement in a language different from your students
- A policy statement written in legal lingo

Note: *Pay attention to other modalities that you bring in throughout the course, and add these to the statements and expressions. For instance, if you have a poet or an Indigenous person as a guest, add statements or expressions to reflect this.*

STEP 3: Rank Statements and Expressions
Ask students to privately rate the statements based upon their initial reactions in terms of the following dispositions towards the statements:

- Useful
- I would consult with
- Is true
- Interesting
- I would collaborate with
- I would like to learn more
- I have expertise in this
- I can't do this
- I don't know anything about this
- I should know this
- I'm curious
- I wonder
- I think this is irrelevant

STEP 4: Reflect
Based on their rankings, ask students to reflect upon and take notes on how they felt when they experienced the dispositions and some of the thoughts or questions which came to mind. For instance, if they selected "I wonder" for one of the statements or expressions, what did they wonder about?

STEP 5: Discuss
Facilitate a group discussion around the following questions:

- Who are the stakeholders?
- What are the issues?
- What's missing?
- How would you approach this problem?
- How do you begin to work with these multiple perspectives?
- How do your dispositions make you more or less capable of approaching this problem and working with multiple perspectives?

Note: *It can be useful to ask students to write down all the issues they think are important in a kind of scattered way on a big page, then connect the ones they think are connected (talk about evidence for this) and then identify the stakeholders who either influence or are directly influenced by those issues.*

STEP 6: Debrief
Throughout the course encourage students to continue to flag the truths that they take to be true, the one's they feel they have expertise in, and the ones they find whacky and which make them uncomfortable. They can use this to critique their frame of reference and their capacity to put together a participatory project, or to choose stakeholders. Advise students to place their discomforts about their work upfront and to use this to inform their choices about how to proceed.

STEP 7: Follow-up
Ask participants to write a short reflective piece on any discomforts that they encountered with this exercise, and facilitate a short discussion around their reflections the next day. [Can be linked with the "Reflective Journal" in Transversal Activities.]

Activity 2: Mind Grooves

Learning Objectives

- Demonstrate that humans have a tendency to think in linear patterns and have habits of thought which might disable us from noticing and thinking about something.
- Help students understand that complexity requires us to break out of some habits of thinking such as linear approaches to problem solving, and the belief that anything can be predictable.

Instructions

Step 1: Write
Write the following words on a flipchart or a blackboard:

- slumber
- dream
- bed
- quiet
- nap
- pillow
- night
- blanket
- pyjamas
- snooze

STEP 2: Reflect
Tell the students to read the words written on the flipchart, but not to write anything down.

STEP 3: Recall
Remove the words from sight and ask the students to individually write down as many words as they can remember from the flipchart.

STEP 4: Share
Ask students to share what words they recalled. For instance, ask them who wrote down words that were on the flipchart list (e.g. 'slumber' or 'night'), and then ask them who wrote down words that were not on the flipchart list (e.g. 'sleep').

STEP 5: Reveal
Re-post the list of words on the flipchart.

STEP 6: Debrief
Lead a discussion around the following questions:

- What caused them to think that they saw the word 'sleep' on the flipchart when it wasn't?
- How might this tendency of the mind to associate and to work within "mental grooves" impair our ability to conduct participatory research, or to deal with complex, non-linear problems?
- How can we develop capacities for catching ourselves when we fall into mental grooves?

STEP 7: Follow-up Activity
Ask participants to take note of the mind grooves that they encounter throughout the course. Throughout the course, at the end of each day ask students what mind grooves they encountered.

Specific Readings

Funtowicz S, Ravtez J (N.d.) Post-normal science - Environmental policy under conditions of complexity. Robust knowledge for Sustainability. Available: http://www.nusap.net [accessed January 3, 2012]

Funtowiczand S, Ravetz J (2008) Beyond complex systems: Emergent complexity and social solidarity. In: Ecosystem Sustainability and Health: A Practical Approach, Waltner-Toews D, Kay JJ, Lister P (editors), New York: Cambridge University Press, pp 309–321

Waltner-Toews D (2004) Ecosystem sustainability and health: A practical approach, New York: Cambridge University Press

SECTION 2: NON-LINEAR THINKING FOR COMPLEXITY

DESCRIPTION:

This section explores how our response to manifold complexity can change our ability to see what's there, to understand, to respond, to be affected, and to be effective. In this section students will work through, collectively and individually, mentally and physically, some examples of concrete methods or practices which support abstract, non-linear, non-reductive, thinking and being: bodily practices, mental practices, linguistic practices and visualization/imagination practices.

LEARNING OBJECTIVES

- Develop the ability to identify reductive, linear and binary thinking in and the problems associated with these.
- Develop capacities to think in complex, non-linear ways.

KEY QUESTIONS

- Are there ways that we could develop the skills and capacities to see, perceive, think, and act in non-reductive ways?
- How are we (or how can we become) able to be reductive but in ways which actually handle, integrate, or harmonize a greater degree of complexity?
- Can we learn to tolerate, handle, and maybe even enjoy the discomfort that accompanies complex (and abstract) thought and action?
- Can we appreciate how this is a crucial component of the research cycle, not something to remove from it, but integral to the ability to do post-normal ecohealth research?

WORKING TERMS

- reductive thinking
- binary thinking
- linearity and non-linearity
- post-normal science

KEY CONTENT

Non-linear thought or ways-of-being, and non-reductive, non-binary thinking, is often required in situations of high uncertainty and maximum urgency. However, when we don't know something we have a tendency to clamp down, close off, simplify, reduce, throw bits overboard, and/or run away. Are there other things we could do? Does our response to confusion or manifold complexity change our ability to see what's there, to understand, to respond, to be affected, to be effective? This line of inquiry thus has scientific relevance (connected to truth-value and good-knowing) and ethical relevance (connected to something within our capacity to pay attention to, and do a better or worse job with).

Examples

Instructors are encouraged to use one of the cases listed at the beginning of this module or to construct or use their own case study examples which demonstrate binary thinking in all its guises and problems, and strategies for developing the capacities to think in complex, non-linear ways.

Activities: Responses to Manifold Complexity

Learning Objectives

- Work through and understand, collectively and individually, mentally and physically, some examples of concrete methods or practices which support abstract, non-linear, non-reductive, thinking and being; bodily practices, mental practices, linguistic practices and visualization/imagination practices.
- Explore ways that we could develop the skills and capacities to see, perceive, think, and act in non-reductive ways, and develop an understanding of how this can affect research practices and results.
- Witness the effects and unintended consequences of our word choices and illustrate that words are not simply "givens" hovering above the things they name, but are signs always carrying many possible meanings.

Activity 1: What could your body do?

Instructions

- **Explore** one or more physical activities (yoga, karate, judo, dance, music, etc.). This activity would be a great opportunity to invite someone skilled in a particular activity to lead this part of the section. Or, one of your students might have such a skill and could lead the section.
- **Experiment** with bodies – arm movements, leg movements, extension and retraction, and capacity to grasp in order to explore how linearity and binaries are built into, as strong habits, our physical comportment.
- **Discuss:** Facilitate a group discussion about student's examples of their own bodies, their own somatic practices in the lab, in fieldwork. Questions for reflection and discussion:
    - How do different physical activities disrupt our ideas of purpose and function?
    - How does what we can do as somatic beings ratify or affect our work as mental beings, and vice versa?
    - What are some of the somatic practices of field work, research, and the lab?

Activity 2: What could your mind hold?

- **Activity:** Show students a couple of 'double aspect' drawings, for instance, the duck/rabbit illustration. (An internet search of: duck rabbit + double aspect + gestalt)
- **Discussion:** Ask students to reflect on and share some examples from their own research experience which are analogous to the 'double aspect' drawings.

Activity 3: What do your words do?

- **Read:** Jan Zwicky on metaphor
  - "I am interested in the phenomenon of 'seeing-as' because it encapsulates the mystery of meaning. The moment of recognition happens as if by magic; and yet, when we reflect on it, we see - its very name tells us this - that it is impossible without prior experience. What becomes puzzling then is the phenomenon of insight, the creation (apparently) of new meaning. Here, we forget that to re-cognize can mean to re-think, as in think through differently. It need not always signify mere repetition of a former cognition. We say in such cases not only that we recognize x (as Y), but that we realize x is y...

    'Recogniton' - even in the most straightforward cases of identification or recall - involves re-organization of experience - an act of contextualization, a sensing of connexions between aspects of immediate experience and other experiences. Thus the experiences of seeing how an assemblage of parts must go together, recognizing an old friend in an unfamiliar setting, and understanding a metaphor are species of the same phenomenon. They all involve insight, understood as re-cognition; a gestalt shift. And this is the origin of meaning." (Zwicky, 2003)

- **Experiment:** Try to consider metaphor as ***weight-bearing*** and ***shuttling between*** hetergeneous ***parts*** of the world. Letting what doesn't go together go together. Begin to see metaphor as an experiment with meaning-making. As a group, come up with a couple of metaphors for what is around the room or outside the window and think through Zwicky's description of metaphor (above) using yours as a working example.
- **Brainstorm:** Collectively brainstorm some health and ecology metaphors. Next, brainstorm the multiple meanings, concepts, and affects expressed by those metaphors.
- **Examples:** Present students with some examples of health and ecological metaphors from health and ecology literature. For instance, "contamination", "carrier," and "choking hazard."
  - **Discussion:** Discuss how our words or statements can silence or push one feature (aspect) of reality forward, leaving others out of focus. Admit that we cannot be overly poetic and and metaphorical in all of our work, but that there is a kind of action or accomplishment that goes along with how we speak, whatever idiom we use.

Activity 4: What could you see if you looked?

- **Read:** Jeanette Winterson excerpt on experiencing painting - http://www.randomhouse.ca/catalog/display.pperl?isbn=9780394281704&view=excerpt
    - "Long looking at paintings is equivalent to being dropped into a foreign city, where gradually, out of desire and despair, a few key words, then a little syntax make a clearing in the silence. Art... is a foreign city, and we deceive ourselves when we think it familiar... We have to recognize that the language of art, all art, is not our mother-tongue." (Winterson, 1996)

- **Discuss:**
    - How is our relationship with various art forms akin to our position as researchers grappling with the uncertainty of complex ecohealth issues?
    - What can our relationship with art can teach us about grappling with complexity and uncertainty?

Debrief: *Facilitate a group discussion around the following questions.*

1. Do we have a sense of what linear and non-linear thinking and processes are, or look like? What are good examples?
2. Do we know what binary thinking is, or feels like? What are good examples?
3. Do we have some working examples of reductivist thinking in science and/or living? What about non-reductivist thinking in science and/or living?
4. Do we know when it is, in fact, best to think non-reductively or in non-linear fashion, and do we have a sense of when reductive, linear, binary thinking(s) are actually more appropriate? What does that 'sense' consist in?
5. Are there ways that we could develop the skills and capacities to see, perceive, think, and act in non-reductive ways? Or, to be able to be reductive but in ways which actually handle, integrate, or harmonize a greater degree of complexity? Or, to be able to handle/tolerate (even enjoy) the discomfort that accompanies abstract complex thought and action? Can we appreciate how this is a crucial component of the research cycle, not something at remove from it, but integral to the ability to do post-normal ecohealth research?
6. Are there ways we could develop the skills and capacities to discern when it is better to open up, stay abstract, not collapse into binaries, or drive forward into efficiency and a solution versus when it is best to focus in, get concrete, lose degrees of abstraction and make decisions?

SPECIFIC READINGS:

Bunch MJ (2000) An adaptive ecosystem approach to rehabilitation and management of the Cooum River environmental system in Chennai, India. PhD Dissertation. Waterloo, Ontario, Canada: Department of Geography, Faculty of Environmental Studies, University of Waterloo.
Available: http://uwspace.uwaterloo.ca/bitstream/10012/597/1/NQ56673.pdf

Gislason MK (2010) Sounding a public health alarm: Producing West Nile virus as a newly emerging infectious disease epidemic. In: Understanding Emerging Epidemics: Social and Political Approaches, Advances in Medical Sociology, Volume 11, Mukherjea A (editor), Emerald Group Publishing Limited, pp.77–99

Winterson, J (1996) Art Objects: essays on ecstasy and effrontery. Vintage Books Canada.

Zwicky, J (2003) Wisdom & Metaphor. Gaspereau Press.

SECTION 3: MAPPING COMPLEXITY

DESCRIPTION

There is no objective 'correct' way to map complexity; the goal of complexity mapping is to communicate the interrelations and interactions between particular elements with regards to a particular topic, as perceived at a particular time in a particular space. One hundred maps of the same topic by the same person would all be different, and would all be correct. Complexity maps are used to understand systems as wholes. The goal of this section is to get students comfortable with different ways of mapping and exploring the conceptual interrelationships (complexity) in their work, research projects, theses, and so on. The section is designed to develop student understanding of complexity and systems via discussion and a hands-on exercise.

LEARNING OBJECTIVES

- Show students how to use a visual depiction to explore the complexity and interrelationships in different systems.
- Discuss the visual depiction of complexity not as a definition, but as the communication of perception.
- Compare and contrast different ways to represent complexity and interrelationships.

KEY QUESTIONS

- What is complexity mapping?
- How does complexity mapping relate to systems thinking?
- How is complexity mapping useful in research and writing?

KEY CONTENT

- Agent-based models
- Spaghetti diagrams
- Word clouds
- Holons & nested heirarchies
- Traditional brainstorms
- Feedback loops (including Hollings' infinity loop)
- Quadrants
- Venn diagrams

INSTRUCTIONS

STEP 1: Brainstorm (20 minutes):

- Facilitate a discussion around the following question: What is complexity mapping, how can it be used in research?
- Within this discussion, extract overarching themes as identified by the students and write these themes on flipcharts that will be used as touchstones for the rest of the session.
- Touch on how complexity can be assessed and mapped conceptually. Examples of complexity/conceptual maps can be posted or projected in order to stimulate thinking.
- Emphasize that these maps can be subjective, and that the point of complexity mapping is to elucidate connections, issues, and emergent themes, ***not*** to 'do it right' or achieve some goal of 'the perfect mapping of a complex issue.'

STEP 2: Visual complexity activity (35 minutes)

- **Brainstorm:** Ask students to consider the complexity in their own research, and then help them conceptualize how the fragments can be depicted visually (5 minutes).
- **Speed-mapping:** Ask students to map the complexity in their own work using flipchart paper and coloured markers (15 minutes).
- **Share and Discuss:** Divide the room and students into two groups. Ask one side of the room to visit the other side to look at maps and pose questions to their creators, and then switch (15 minutes).

SPECIFIC READINGS

Bateson R (1979) Every Schoolboy Knows. In: Mind & Nature: A necessary unity, New York: E.P. Dutton. Available: http://www.oikos.org/m&nschoolboy.htm

Berlow T, (2010) How Complexity Leads to Simplicity. TED Talks [video]. Available: http://www.ted.com/talks/lang/eng/eric_berlow_how_complexity_leads_to_simplicity.html

Resilience Alliance (2011) The Resilience Alliance Workbook for Practitioners, version 2. Available: http://www.resalliance.org/index.php/resilience_assessment

SECTION 4: TRANSDISCIPLINARY THEORETICAL APPROACH

DESCRIPTION

This section explores why grappling with complexity requires methodological pluralism and multiple stakeholder involvement, and how one might meet these requirements in a real-world research setting. It specifically addresses the issue of scale, and how it relates to accommodating multiple perspectives, different stakeholders, and feedback loops. It is important to relate the stakeholders to the scale of their interest and power, and to look at where feedback loops cross scales (for instance, national health concerns responded to by regulation which favours large scale), can undercut local resilience by uncoupling local feedbacks (such as agricultural production and environment).

LEARNING OBJECTIVES

- Discuss and illustrate the particular challenges that complex ecohealth problems pose to research, action/intervention and policy in general and within one's own research and the case study (i.e. projects are a part of a bigger system).
- Practice critical thinking and reflection with regard to one's view of the world, choice of conceptual frameworks, roles, methods and actions.
- Reflect upon elements of one's ethical practice such as respect, reciprocity, relevance, and responsibility.
- Understand the importance of the observer and the context in what is observed, and therefore the need for multiple perspectives.

KEY QUESTIONS

- What do different researchers mean by complexity and complex systems?
- Why do we use different approaches?
- How does one begin to synthesize the information from different approaches?

KEY CONTENT

- Scale
- Feedback loops (self-organization)
- Multiple perspectives
- Uncertainty

Activity 1: Multiple Perspectives and Complexity

INSTRUCTIONS

STEP 1: Background Presentations

Identify a situation or open case study case study for this activity. The "situation" could be defined initially by landscape (e.g. Hamilton Harbour), issue (e.g. environmental degradation), or illness (e.g. Avian Influenza). Invite knowledgeable people to address particular aspects of

complexity in the defined situation or open case study. There should be at least four brief presentations and the overall session should be facilitated by someone with skills in participatory methods.

STEP 2: Multiple Perspectives
After the four presentations, have student prepare for a mock town hall meeting ***or*** a debate on the open case study. The goal of the mock town hall meeting or debate is for students to be able to say or see how one would move toward making a decision.

- **Town Hall Meeting:** Have students prepare for a mock eeting where a policy or management proposal related to the case study is put forward. Divide the students into different groups and assign different stakeholder and/or academic perspectives to each group. Be sure to include different ages and genders in the perspectives you assign [see Module 5: Gender & Sex]. Then, ask the students to role play and debate the policy or management proposal from their assigned perspective.
- **Debate:** Have an open debate among the presenters and students about what this situation means in real life and what one does with this.

Scaling Down this Activity

- **Shorter version:** Invite two or more lecturers from different backgrounds to talk about complexity (e.g. social complexity versus mathematical complexity, and how this relates to policy and decision-making). The lectures should be followed by an open question period with students and (hopefully) some stakeholders from the case study situation.
- **Shortest version:** Present a lecture covering all the above topics, with one or more closed case studies illustrating the key points.

Specific Readings

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SECTION 5: CONCEPTUAL AND CONCRETE TOOLS FOR WORKING WITH COMPLEXITY

DESCRIPTION

This section further explores concepts of systems thinking and introduces various tools and methods to help structure ecohealth research and programs. The students will apply these tools and frameworks to their own research and examine the challenges and opportunities that each provides.

LEARNING OBJECTIVES

- To explore different approaches to structuring ecohealth research and programs;
- To implement one or more different approaches, such as:
    - Influence diagrams
    - AMESH diagram
    - Modelling scales
    - Mapping tools

KEY QUESTIONS

- How do you structure ecohealth research?
- Where are you going to get the history of the system?

KEY CONTENT

Systems thinking

- Interacting systems: political, infrastructural, social, ecological, human, animal, and so on
- Ways of accessing or reading the history of systems: Elders, tree rings, core ice samples, hair sampling, bird feathers, dead people, newspaper archives, and so on.
- Temporal trends and cycles
- How to think about timelines: possible futures, synchronic and diachronic
- Degrees of anticipation: ways to read a situation, signs of possible future events
- Phase shifts: non-linear change

Concrete tools that enable you to put these things together:

- Spaghetti diagrams
- AMESH diagram
- Modelling scales
- Mapping tools

AMESH Diagram

- **Present:** Present the example case or situation (e.g. Kathmandu case study) and describe the case in terms of the AMESH diagram
- **Activity:** Ask the students to create a AMESH diagram for their own research
- **Discuss:** In small groups, ask the students to discuss:
  - How the diagram works, or doesn't work
  - What was hard to fit in?
  - What's missing?
  - How might they adjust it?

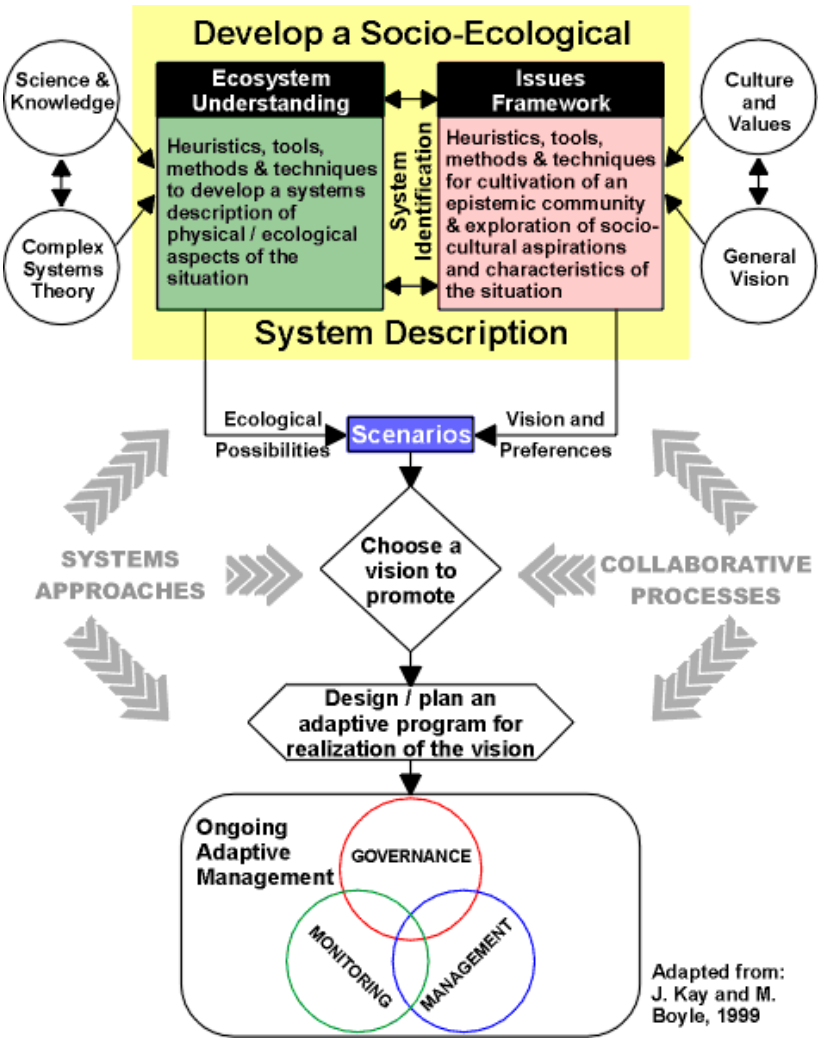

Figure 1: Adaptive Methodology for Ecosystem Sustainability and Health (AMESH) Diagram © Nesh 2003, reprinted with permission.

- **Present:** Present the example case or situation (e.g. Kathmandu case study) and describe the case in terms of the Spaghetti diagram.
- **Activity:** Ask the students to create a Spaghetti diagram for their own research
- **Discuss:** In small groups, ask the students to discuss:
    - How the diagram works, or doesn't work
    - What was hard to fit in?
    - What's missing?
    - How might they adjust it?

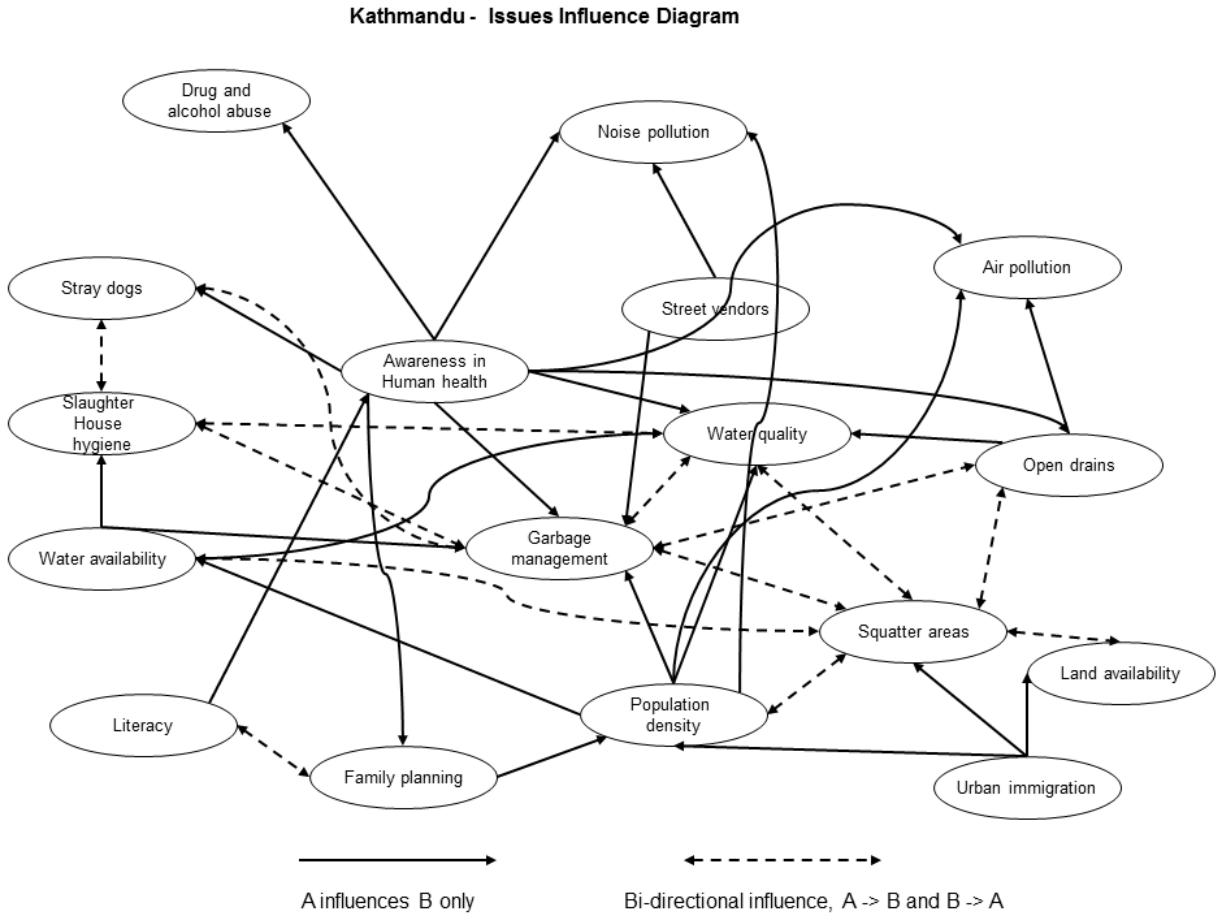

Figure 2: Influence Diagram © Nesh 2003, reprinted with permission. See Waltner-Toews D, Neudoerffer C (2010) Agro-urban ecosystem health assessment in Kathmandu, Nepal: A multi-scale, multi-perspective synthesis.

- **Present:** Present the example case or situation (e.g. Kathmandu case study) and describe the case in terms of a scale diagram
- **Activity:** Ask the students to create a scale diagram for their own research
- **Discuss:** In small groups, ask the students to discuss:
  - How the diagram works, or doesn't work
  - What was hard to fit in?
  - What's missing?
  - How might they adjust it?

Debrief

Facilitate a group discussion to explore each type framework and discuss re-occurring themes, observations, challenges, and opportunities.

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SECTION 6: INTERVENTIONS – EXAMPLES FROM RESEARCH AND POLICY

DESCRIPTION

In this section students will be introduced to examples of work where people have taken complex systems into account and made system adjustments or policy change.

LEARNING OBJECTIVES

- Develop skills to identify how scholarly research, intervention, and policy are related from the viewpoints of various stakeholders.
- Develop skills to identify links between policies across jurisdictional boundaries, bureaucratic mandates, and geographic scales.
- Develop skills to identify how policy and ecohealth research influence each other, and the dangers and opportunities afforded by these mutual influences.
- Develop effective language and communication skills that would be appropriate for policymakers at various scales and constrained by various bureaucratic mandates.

KEY QUESTIONS

- How (if at all) is an intervention or policy that takes complexity into account different from one that doesn't?
- What are the relationships between science, policy, and intervention in a complex ecosystems approach? What are the dangers as well as the benefits of these relationships?
- Consider some examples: How did the tools of complexity and/or ecohealth inform these interventions or policy?

EXAMPLES

There are a number of excellent examples to demonstrate the main topics of this section, including the following case studies:

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  Available: http://www.maweb.org/en/Responses.aspx
- Gale RJP (1997) Canada's Green Plan. In: Nationale Umweltpläne in Ausgewählten Industrieländern [a study of the development of a national environmental plan with expert submissions to the Enquete Commission "Protection of People and the Environment' for the Bundestag (German Parliament)]. Berlin: Springer-Verlag pp. 97–120.
  Available: http://www.ecological-economics.org/pages/greenplan.html
- Goy J, Waltner-Toews D (2005) Improving health in Ucayali, Peru: a multi-sector and multi-level analysis. Ecohealth 2:47–57

ACTIVITY

Bureaucrat Q&A

INSTRUCTIONS

STEP 1: Presentation
Invite a bureaucrat to give a short lecture about a policy change which was informed by complexity, followed by a Q&A session.

STEP 2: Activity
Ask students develop their posters [Transversal Activity] based on insights they gain during this session.

STEP 3: Debrief
Facilitate a group discussion guided by the *Key Questions* for this Section.

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