ECOHEALTH MANUAL

EcoHealth-OneHealth Resource Centre - Chiang Mai University

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EcoHealth Manual

EcoHealth-OneHealth Resource Centre – Chiang Mai University

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Dean's Message

Warmest Welcome to EcoHealth-One Health Resource Centre (EHRC), Chiang Mai University!

On behalf of EHRC-Chiang Mai University, I am very glad to see the successfully completion of this first EcoHealth Manual in Thailand and I am highly appreciated for the hard work contributions of EHRC-CMU writer team for this manual. This manual is intended for all faculties, staffs, students, and everybody who are interested in EcoHealth, containing important practical information about EcoHealth systems. The manual was prepared as a handbook for teaching EcoHealth concepts and EcoHealth methodology to university students from diverse disciplines.

It is intended to introduce examples of important aspects of EcoHealth, providing real world examples of each aspect and suggesting how the EcoHealth approach to research can be applied to improve the quality of human health, animal health and the environment. The EcoHealth approach involves interdisciplinary efforts: experts from various academic fields working as a team, learning to speak each other's language, with the strengths of each discipline actively supporting each other. Moreover EcoHealth encourages researcher to consider the broadest context when looking at concrete problems. That transdisciplinary approach can be employed by users of this manual. I encourage you to take full advantage of this manual and enjoy applying EcoHealth approach in your daily work.

Warmly,

Lertrak Srikitjakarn, B.Sc., D.V.M., Dr.med.vet
Chairman of EHRC-Chiang Mai University
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Note from Editors

Feeding the growing population, while promoting better health, environment and sustainable livelihood opportunities is a global challenge that we all share. EcoHelath is an approach that addresses some of these challenges by assuring better health for people, animals and environment.

The IDRC supported program EcoZEID (Ecosystem Approaches to Better Management of Zoonotic Emerging Infectious Diseases) is being implemented by International Livestock Research Institute (ILRI) since 2009, in five countries in South East Asia. The project worked with a large number of regional stakeholders to capacitate them in understanding and incorporating/ practicing EcoHealth. Two EcoHealth resource centres have been setup at leading universities in Indonesia (Gadjah Mada University) and Thailand (Chiang Mai University) as part of the project.

This manual is prepared as a resource for building cognisance about EcoHealth to a cross section of stakeholders, especially the once attached to universities. A unique participatory approach has been followed to prepare this manual. Several 'write shops' were organised to design the content, format and methodology for preparing the manual. The write shops were facilitated by ILRI, integrating experiences and recommends from authors, all of whom have extensive experience working in the region. Such a participatory approach contributed to making the manual need based, pragmatic and demand driven.

We express our sincere thanks to the team of authors from EcoHealth/OneHealth Resource Centre at Chiang Mai University, especially Dr. Tongkorn Meeyam , and Dr. Robert and Chongchit Lamar. Our gratitude to the Chiang Mai University leaderships, including Assoc. Prof. Dr. Lertrak Srikitjakarn, Dean of the Faculty of Veterinary Medicine. Convergence of several faculties in particular veterinary medicine and nursing to write this manual strengthens the transdisciplinarity nature of this manual.

We are grateful to International Development Research Centre of Canada (IDRC) for their support and their continued endeavour to promote EcoHealth. Several ILRI colleagues and consultants were involved in reviewing the manual- many thanks to them.

Purvi Mehta-Bhatt, Fred Unger, Jeffry Gilbert, Delia Grace

Contents

Purpose of the EcoHealth Manual

This manual was prepared as a resource for teaching EcoHealth concepts to university students from diverse disciplines. It is intended to introduce examples of important aspects of EcoHealth, providing real world examples of each aspect and suggesting how the EcoHealth approach to research can be applied to improve the quality of human health, animal health and the environment. The EcoHealth approach involves interdisciplinary efforts: experts from various academic fields working as a team, learning to speak each other's language, with the strengths of each discipline actively supporting each other. Moreover EcoHealth encourages researches to consider the broadest context when looking at concrete problems.

That transdisciplinary approach can be employed by users of this manual. Individuals with a strong academic background in one area, e.g., the social sciences, can provide help to others who have had less experience in that discipline. By building an understanding of the concepts and research methods used by other fields, students can cooperatively develop their capacity to effectively apply the EcoHealth approach as members of interdisciplinary research teams.

CHAPTER 1
INTRODUCTION TO ECOHEALTH

1.1 The Emergence of the EcoHealth Approach

It is difficult to pinpoint an exact time and place when the concept of EcoHealth was first conceived. One of the individuals who saw the need to integrate health and the environment was John J. Hanlon, former president of the American Public Health Association. In his 1969 address to the Association, he told the group members, "The human ecologic approach, of necessity and by definition, calls for an interdisciplinary effort wherein the natural, physical, and social sciences, in company with engineering, combine to study the adaptive responses of man, and specially the effects of unsuccessful adaptation on his health." He went on with a call to action, stating that, "We must call forth men and women with the foresight and courage to accept the new and broader philosophic base of human ecology, as applied to human welfare, and, on accepting it, to act upon it. Only then may we as a profession make our true potential contribution to the development of a new society and a better world."[1] This manual is one effort to put the advice of Dr. Hanlon into practice.

Calvin Schwabe, DVM, in his 1984 book, *Veterinary Medicine and Human Health*, expressed a similar worldview saying that, "The critical needs of man include the combating of diseases, ensuring enough food, adequate environmental quality, and a society in which humane values prevail."[2] Dr. Schwabe was, himself, expanding on the observation of the 19th century German physician, Rudolf Virchow, who has been described as the father of cellular pathology, that, "Between animal and human medicine there are no dividing lines – nor should there be."[3] That is why it is said that it is not possible to specify one time or one individual as having been the initiator of the EcoHealth concept. Rather, the chain of thinking which led to the EcoHealth concept again validates Isaac Newton's famous comment made in 1676 when he was being praised for his many advances in scientific knowledge: "If I have seen further it is by standing on the shoulders of Giants."[4]

The term EcoHealth has been adopted by several organizations. One of the earliest major public events to use the term EcoHealth was the first biennial conference of the then newly formed International EcoHealth Association held at the University of Wisconsin-Madison, in the US in 2006. In October 2012, some 450 individuals representing 62 nations, including a delegation of eight representing the EcoHealth Resource Centre at Chiang Mai University, participated in the fourth conference in Kunming, China.

A similar term, "One Health," has been chosen by other important organizations including the American Medical Association and the American Veterinary Medicine Association which, in 2007, adopted the term "One Health" by joint resolution.[5] As defined in the AMA/AMVA resolution, the emphasis of one health is on promoting cooperation between human and veterinary medicine, but by no means does it negate the importance of an interdisciplinary approach or of the ecological focus of EcoHealth.

At present, the concepts of EcoHealth and one health are still evolving. There is no single universally accepted definition of either "One Health" or "EcoHealth." (Even the spelling of the terms is not yet standardized: some prefer to write EcoHealth without any capitalization.) That said, the following definitions are offered which seem to incorporate the essence of each of the terms.

- OneHealth: The collaborative effort of multiple disciplines — working locally, nationally, and globally — to attain optimal health for people, animals and the environment.
- EcoHealth: The study of changes in the biological, physical, social, and economic environments and of the relations of these changes to human health.

1.2 The Three Pillars and Six Principles of EcoHealth

One of the earliest promoters of the EcoHealth concept, according to Jean Lebel,[6] was the International Development Research Center (IDRC), a Canadian public corporation dedicated to supporting developing countries through the funding and advancement of their own researchers, which in 1994 decided to provide major support to the EcoHealth approach. This Ecohealth[7] Program Initiative was based on three methodological pillars:

transdisciplinarity, participation, and equity. Lebel defined the pillars as follows:[8]

- *Pillar 1: Transdisciplinarity*. Transdisciplinarity implies an inclusive vision of ecosystem-related health problems. This requires transdisciplinary communication – among researchers, community representatives, and decision-makers.

- *Pillar 2: Participation*. Participation refers to the aim of achieving consensus and cooperation, not only within the community, scientific, and decision-making groups, but also among them.

- *Pillar 3*: Equity. Equity involves analyzing the respective roles of men and women, and of various social groups.

More recently, Dominique Charron, currently the IDRC EcoHealth Program Leader, in the 2012 publication she edited, *Ecohealth Research in Practice: Innovative applications of an ecosystem approach to health*,[9] expanded on the three pillars of Lebel, introducing six Key Principles of EcoHealth. Three of Charron's principles are substantially similar to one of the pillars introduced by Lebel. The six principles, including an explanation of the newly introduced principles, is provided below.

- *Principle 1: Systems thinking*. Systems thinking holds that the component parts of a system can best be understood in the context of their relationships with each other and with other systems, rather than in isolation. Systems thinking focuses on cyclical rather than linear cause and effect. This type of thinking is in contrast with the scientific reductionism of Descartes. Whereas reductionism would try to understand a system by looking in detail at its parts, system thinking suggests that the way to understand a system is to examining the linkages and interactions between the elements that make up the system. [It should be noted that using systems thinking does not negate the need for studying the individual details of a system; both are needed to achieve fuller understanding.]

- *Principle 2: Transdisciplinary research*. (See Pillar 1)
- *Principle 3: Participation*. (See Pillar 2)
- *Principle 4: Sustainability*. The concept of sustainability means that EcoHealth research should aim to make ethical, positive, and lasting changes which are environmentally sound and socially acceptable. That last point is key: an ethical, positive, and environmentally sound change will not be sustainable if it is not socially acceptable to the target community which must live with that change.
- *Principle 5: Gender and social equality*. (See Pillar 3)
- *Principle 6: Knowledge to Action*. Knowledge to action refers to the idea that knowledge generated by research is then used to improve health and well-being through an improved environment.

The three pillars of Lebel and the six key principles of Charron all require not only willing cooperation across academic disciplines but also effective communication among researchers and stakeholders with widely diverse backgrounds. This manual provides practical guidance on how interdisciplinary cooperation plus interdisciplinary communication together can help put the three pillars and the six key principles of EcoHealth into practice.

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CHAPTER 2
HUMAN/ANIMAL HEALTH AND FOODBORNE DISEASE

2.1 Human and Animal Health

2.1.1 Everything is connected to everything else

All things in the world, both living and non-living, are interrelated. When something changes, it has an impact on other things. Those impacts, whether positive or negative, are unavoidable. Humans, too, have a relationship with everything around them. The health of people, which includes both physical and mental health, is connected to changes in the surrounding environment. For example, illness can be caused by exposure to infectious agents. Some infectious agents, such as some species of bacteria and viruses, can be transmitted from one person to another through the air or by contact with bodily fluids. Other infectious agents can be transmitted between humans and animals, either livestock raised by humans or wild animals.

2.1.2 Diseases and disease emergence

The three important groups of factors involved in the emergence of a disease are human or animal hosts, transmission agents, and the environment. When these three groups of factors are in balance, emergence or spread of disease will be minimal. However, changes in any of the three factors can cause an imbalance that can result in the emergence of a disease or even an epidemic.

Both living and non-living agents can result in disease. Those agents can be divided into groups: biological, chemical, physical, and psychosocial agents. Biological agents include disease causing organisms such as bacteria, viruses, fungus, and parasites. Chemical agents are chemical compounds which can promote the occurrence or the spread of disease. Some of those chemicals are used in the home as part of daily life, e.g., some cleansing agents, DDT and other insecticides. Other chemicals are used in agriculture and industry. Physical agents include heat, cold, light, sound, and radiation. Heat can cause health problems such as heat stroke and burns. Solar radiation can cause skin cancer. Sound at levels above 85

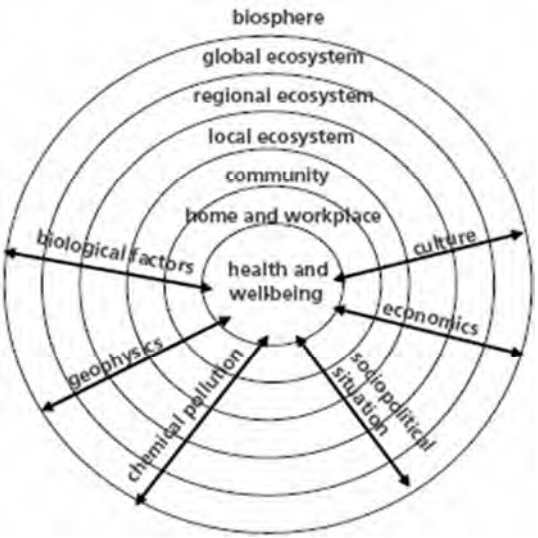
decibels which last more than an hour can result in deafness. Psychosocial agents include stress-inducing economic and social problems and interpersonal conflicts. Such stress-related problems can cause mood swings, anxiety, mental strain, and other mental illnesses as well as physical illnesses including high blood pressure, stomach ulcers, and asthma.

Some factors which can affect disease incidence are the result of conditions largely beyond the control of the individual, e.g., age, gender, ethnicity, marital status, education level, and vocation. For example, infants' immune systems are not sufficiently developed, so they have an increased risk of contracting various infectious diseases. The physical bodies of the elderly deteriorate with age, increasing the risk of disease, particularly chronic diseases such as diabetes, high blood pressure, cataracts, dementia, and cancer. Gender is also correlated with diseases, perhaps due to hormone levels and personality traits. Some diseases found frequently in males are correlated to typically male behavior such as regular consumption of alcohol which can result in alcoholism, cirrhosis of the liver, stomach ulcers, and accidents due to driving after drinking. Smoking can cause emphysema, lung cancer, and genetic diseases which can be passed along to offspring causing them to become ill, e.g., thalassemia, and diabetes. The prevalence of some diseases is correlated with marital status, e.g., single women are more likely to have cervical cancer and breast cancer than married women. In general, people with higher levels of education also have greater knowledge of health care. As education is also correlated with income, those with higher levels of education usually are better able to afford appropriate health care. Some people are at risk for illness due to contact with things related to their vocation, e.g., someone working in an industrial factory where there is much fine dust is at risk of respiratory diseases.

Events which occur all around us, whether or not they appear to be a problem, are complicated both for the individuals directly involved and for others who are impacted by the events. In applying the EcoHealth approach to a specific event or situation, especially problems related to health, it is necessary to remember that these events do not occur in one dimension only. According to the theory of disease emergence, there must be a balance between the disease, the host, and the environment. However,

each component of these factors has both internal and external elements. Solving a problem by focusing only on the disease, the host, and the environment might not achieve positive or sustainable results. It is necessary to apply systems thinking, which combines knowledge and abilities from various disciplines, to increase the capacity for effectively managing problems effectively. Figure 2-1 below illustrates some of the complex webs of interaction which must be considered.

Figure 2-1: Factors affecting health and wellbeing are connected in a multi-dimensional, complex web



2.1.3 Emerging infectious diseases

An emerging infectious disease is "An infectious disease that has newly appeared in a population or that has been known for some time but is rapidly increasing in incidence or geographic range."[1] In the past decade, there have been many new emerging infectious diseases in various geographic regions of the world which have had a major impact on the quality of life, the economy, and the social situation in many countries, e.g., Ebola, severe acute respiratory syndrome (SARS), avian influenza, (H5N1 and H7N9), and many types of drug-resistant microbes. Mounting an appropriate response to new emerging infectious diseases is one of the

major challenges where the EcoHealth approach can be effectively employed. The avian influenza situation in Thailand and the EcoHealth response to that situation is described in detail in subsequent sections of this manual.

2.1.4 Zoonotic diseases

Zoonotic diseases or zoonoses are defined by the World Health Organization as "Those diseases and infections which are naturally transmitted between vertebrate animals and man."[2] In short, zoonoses refer to diseases which are transmitted between humans and other vertebrates, both livestock and wild animals. The diseases can be transmitted from animals to humans or from humans to animals.

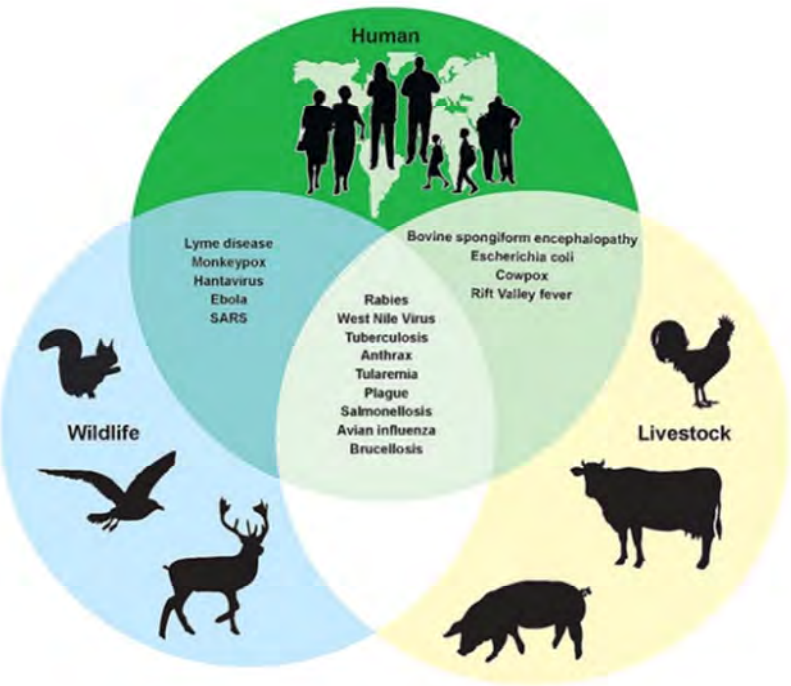
Any disease that is transmitted between animals and people is referred to as a zoonotic disease. In fact, in nearly all cases, the spread of disease can work both ways: humans infected with a zoonotic disease can infect susceptible animals. When a zoonotic disease infects livestock which are produced for human consumption, in addition to the human and animal health impact, the economic impact can be quite severe as was the case in Thailand in 2009 when a new zoonotic disease, influenza A virus subtype H1N1, caused a national pandemic. The economic effect of that zoonotic disease is described in Section 4.2 below.

Figure 2-2: The zoonotic disease virus known as Swine Flu spread from pigs to humans

There are many channels by which diseases can be transmitted from livestock to humans. Transmission can result from direct contact with a sick

animal, consumption of meat or other products from an infected animal. Examples include eating meat containing *Trichinosis* larvae, eating meat from an animal infected with Anthrax, or drinking raw milk from a cow that has tuberculosis. Infections can also come from breathing in the spores of a disease such as Anthrax, *Cryptococcosis*, or *Aspergillosis*. It could result from the bite of an insect disease vector such as the mosquito which causes Japanese encephalitis. Mouse ticks can be carriers of plague when they bite an infected animal. In the case of rabies, the disease organism is in the saliva of the rabid dog and is introduced into other animals through a bite by the rabid dog.

Figure 2-3: Examples of zoonotic diseases and their affected populations[3]



One of the zoonotic bacterial diseases that is encountered frequently in livestock in Thailand is Anthrax which is caused by the bacteria *Bacillus anthracis*. Most of the animals infected with this disease were infected by

breathing in the spores of the bacteria in the soil or on the grass or from drinking water and eating food which contains the bacteria. The bacteria can also get into the animal through a wound. When the bacteria enter the animal, it multiplies and spreads to various parts of the body where it produces toxic substances which make the animal ill. Cattle, buffaloes, and sheep with an acute Anthrax infection show similar symptoms: the blood is black or dark and seeps out of various orifices. Infected animals die quickly, and the carcass does not exhibit rigor mortis. Before the infected animal dies, the bacteria are excreted in its feces, urine, and milk. When the bacteria exit the body of the animal, they form a spore which is highly tolerant of heat and dryness and can live in the soil for 10 to 20 years, thus allowing the disease to reappear in the same location if environmental conditions are right for the bacteria to grow.

Figure 2-4: Anthrax, an infectious disease of livestock, is endemic in Thailand

Humans can become infected with Anthrax bacteria from animals through many avenues including direct contact with an infected animal or products from an infected animal, e.g., raising animals, butchering animals, from inspecting animals, or eating the meat of an infected animal as well as from inhaling Anthrax bacterial spores. In the case of infection through scratches, abrasions, or wounds on the skin, after two to five days a red blister forms. In two or three days more, the blister will swell, then break open and collapse at the center of the wound, forming a black scab. The surrounding area will become red and infected.

Figure 2-5: The Zoonotic Anthrax Cycle[4]

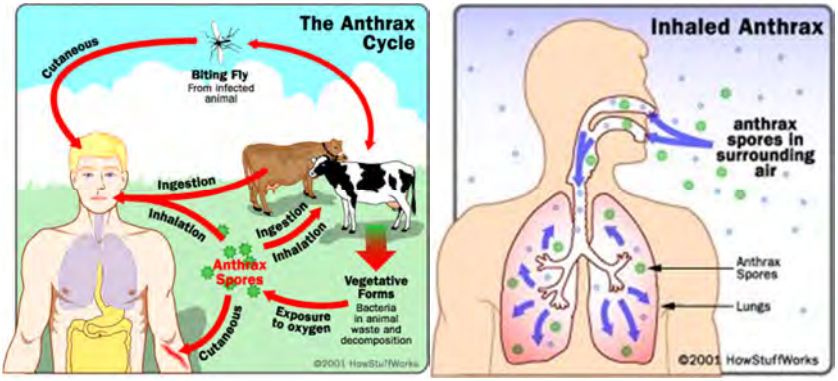


Figure 2-6: Characteristic features of a skin wound of someone infected with Anthrax[5]

2.1.5 Antimicrobial drug resistance in foodborne pathogens

The term "antimicrobial" is a broad term referring to substances that act against a variety of microorganisms, including bacteria, viruses, parasites and fungi. The term "antibiotic" is a narrower term referring to substances used to treat bacterial infections. Most of the concern with antimicrobial use in agriculture is with bacterial resistance, so "antibiotic" will be used to describe in this topic.[6]

Using antibiotic can cause an inevitable resistance. That means the more antibiotics are used, the more bacteria will develop resistance. In recent years, antibiotic resistance has begun to emerge more rapidly. This indicates a major threat to the continued effectiveness of antibiotics used to

treat human and veterinary illnesses. Many studies have documented direct transference of antibiotic-resistant bacteria from animals to humans through foods of animal origin. After antibiotics were administered to animals (for disease treatment, disease prevention, or growth promotion), the prevalence of antibiotic-resistant bacteria also increased in humans (such as *Escherichia coli* and *Campylobacter*).[7,8,9] The human health consequences of these resistant organisms include more serious infections and increased frequency of treatment failures. Patients may experience prolonged duration of illness, increased frequency of septicemia (bloodstream infections), increased hospitalization, and increased mortality.[10] When the drug of choice for treating their infection doesn't work, they require treatment with second- or third-choice drugs that may be less effective, more toxic with more serious side effects, and more expensive cost.[11]

2.2 Foodborne Disease

Foodborne disease is defined very simply as "a disease caused by consuming contaminated food or drink."[12] Pathogens, or what is often referred to as "germs," which can contaminate food or drink include bacteria, mold, viruses, protozoa, and prions among others. Preventing these pathogens from contaminating food is a part of EcoHealth concern.

The raw materials used to produce food for humans come from livestock, aquatic animals, and vegetables which are harvested and processed. Processing must be conducted to maximize the safety of the food in three aspects: biological, chemical, and physical. This section focuses on the biological aspects. The heart of protection against food-borne diseases is reducing and preventing contamination before and during the production process. That includes the prevention of the contamination of the bodies of the producers of the food, the processing equipment and supplies, and the provision of appropriate advice for the consumer. All of those factors can impact the safety of food for consumers.

Figure 2-7: Water in pond-raised fish and shrimp can become contaminated with pathogens. In addition, Pathogens grow particularly rapidly on seafood products which are not properly refrigerated

In addition to food processing, cultural factors can have a role in the incidence of food poisoning, e.g., eating raw or undercooked foods puts the individual at risk for infectious diseases such as *Streptococcus suis*, trichinosis, as well as various parasites.

Figure 2-8: Cultural factors such as eating raw or undercooked meat can affect the incidence of food borne disease

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CHAPTER 3
ENVIRONMENTAL HEALTH

3.1 Biodiversity

The Convention on Biological Diversity gives a formal definition of biodiversity in its article 2 as, "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". More simply stated, biodiversity, which combines shortened forms of the words "biological" and "diversity," refers to all the variety of life that can be found on Earth (plants, animals, fungi and micro-organisms) as well as to the communities that they form and the habitats in which they live.[1] A common unit of measure of biodiversity is the number of different species in a specified area. For example, the biodiversity of tree species in DoiSuthep-DoiPui National Park is about 90 species per hectare. Biodiversity measures can be used to compare areas, e.g., the total of over 2,000 species of flowering plants and ferns on the DoiSuthep and DoiSuthep mountains exceeds the total number of species on the entire British Isles, an area 1,000 times larger.[2]

Levels of biodiversity do not necessarily remain constant over time, however. For example, DoiSuthep-DoiPui National Park was formerly in habited by Lar gibbons (*Hylobateslar*). However, as the human population on the mountain increased, intensive hunting resulted in the extirpation of gibbons and all larger fauna from the park the several decades ago. The plant biodiversity in the park has been changing as well. Over the past few decades the headwaters of some streams have been slowly moving downhill, an indication of gradual drying of the local ecosystem due, at least in part, to the man-made fires which formerly burned large areas of the mountain each dry season. The fires were not hot enough to kill mature trees, but they did to kill many non-fire resistant seedlings. Over time, the prevalence of tree species which can withstand periodic burning increased while the prevalence of less fire-tolerant species declined. Gibbons, which formerly would have distributed tree seeds as they foraged for food, are no

longer there to perform that service. The full impact of the changes in the biodiversity of DoiSuthep-DoiPui National Park – and the health implications of those changes for the population of Chiang Mai city – have not yet been fully evaluated.

Not all changes in biodiversity are anthropogenic. During the Cambrian period some 540 million years ago, long before humans appeared on the Earth, there was a period of rapid expansion of new species. That expansion in biodiversity was followed by several periods of sudden decline in the number of species, with the greatest drop in biodiversity occurring about 250 million years ago.[3] Today, some people feel we are now in the midst of a new, man-made extinction event because of the recent decline in biodiversity world-wide.[4] Whether we are indeed heading for a new low point in biodiversity or not, it is indisputable that many species of plants and animals are declining in numbers and that some are in imminent danger of extinction due largely to the activities of humans. The full extent of the impact that declining biodiversity will have on human and animal health is still being evaluated.

3.2 Human Population Growth and Resource Limitations

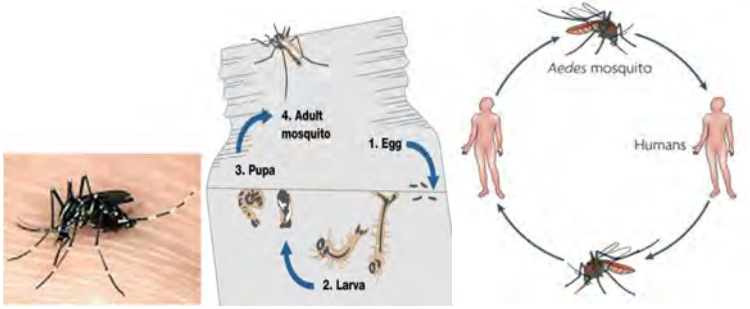
Rapid growth in the size of the human population is a relatively recent phenomenon. From the time that Homo sapiens emerged as a species, it took until 1800 to reach a population of one billion. Since 1987, only 11 years have been required to add an additional billion individuals, reaching a total of seven billion in 2011.[5] This rapid population growth has had a significant impact on many aspects of human health, animal health, and the environment. For example, interaction, voluntary or otherwise, between humans and wildlife has been rising. Demand for meat protein has grown both with the population size and with economic development. Both of those situations tend to increase the risk of the emergence and spread of zoonotic diseases.[6] Preparing to deal with the health and well-being aspects of the future's unprecedented population density is one of the major EcoHealth challenges facing the world.

3.3 Climate Change

Climate change can be defined as long-term shifts in weather patterns in a specific region or globally. Scientists have been aware for a century and more that climate in the world changes, but is has only been in the past decade or so that the concept of imminent and negative impacts from climate change have become widely accepted as fact. One major impetus for the wide-spread consideration of climate change was the 2006 documentary film by U.S. Vice President Al Gore, "An Inconvenient Truth." One important aspect of climate change is global warming. Over the past 100 years, the average temperature of the earth has increased by 0.74°C ± 0.18. Based on atmospheric models, it is estimated that during the period 2001-2100 the average world temperature will increase an additional 1.1 to 6.4°C,[7] although the change has not been uniform: some areas of the globe are getting colder while others are getting warmer. Patterns of rainfall and drought are also changing in many locations. At least some of the changing rainfall patterns can be attributed to changes in ocean water temperatures.[8] The degree to which climate change is anthropogenic is still being debated.[9]

Shifts in temperature and rainfall can directly lead to an increase in the incidence of disease. Two good examples are malaria and dengue. Malaria is caused by parasites in the genus *Plasmodium* and is spread by species of the *Anopheles* mosquito, while the virus that causes dengue fever is spread by mosquitoes in the genus *Aedes*. For both of those types, warmer temperatures allow the mosquitoes to extend their range into areas that were formerly too cold, while heavier than normal rains increase the amount of standing water where mosquitoes can breed, thus promoting increases in mosquito populations. Warmer water temperatures also increases the amount of carbon dioxide dissolved in water. The additional carbon dioxide allows mosquito larvae to mature more rapidly: the seven day maturation period for *Aedes* has been reduced to five days, resulting in a rapid increase in mosquito populations. In addition, *Aedes* mosquitoes, which normally feed during daylight hours, now feed at night as well due to warmer temperatures. Another example is the expansion of the range of the snail-borne disease schistosomiasis in China.[10] The WHO has concluded that the modest warming that has occurred since the 1970s was already causing over 140,000 excess deaths annually by the year 2004.[9]

Figure 3-1: Spread of dengue virus from infected individuals to *Aedes* mosquitoes and from *Aedes* mosquitoes to humans (Human to mosquito to human transmission).



Climate change also affects human and animal health by increasing the intensity of natural disasters such as storms and flooding, increasing the incidence of water-borne diseases. The upshot is that diseases which had disappeared from an area or that were able to be controlled begin to reappear. The climate change impacts are further exacerbated by increases in the number of people traveling around the world, potentially transporting diseases from one region to another.

Figure 3-2: Climate change is increasing the intensity of storms and flooding, increasing the incidence of water-borne diseases

In addition to affecting terrestrial weather, ocean temperature changes have had a particular health impact in shallow or coastal areas where marine animals such as oysters, clams, mussels, and shrimp are raised. Warmer ocean water promotes the growth of *Vibrio* spp., a type of hemophilic bacteria that infects marine animals. Bivalves become contaminated with *V. parahaemolyticus* due to their method of feeding: they filter water to obtain plant and animal plankton. If the ocean water contains *Vibrio* bacteria, it will get into the meat and internal organs of the bivalve. Similarly, shrimp ingest food through their mouth which is located on the underside of their bodies. They feed on the mud bottom of ponds which is where *Vibrio* can become concentrated.[11] Infected seafood which has not been cooked sufficiently can cause food poisoning in humans.[12] The problem is particularly acute in areas where there is a custom of eating raw seafood such as oysters, mussels, and shrimp soaked in fish sauce as some people believe, incorrectly, that soaking seafood in salty fish sauce kills all disease organisms. Symptoms of *Vibrio* infection include diarrhea, vomiting, and abdominal cramping.

From the examples described above, it is clear that climate change and its impacts on health and the environment involve a complex interaction of many physical, geographical, and socio-political factors.[13]

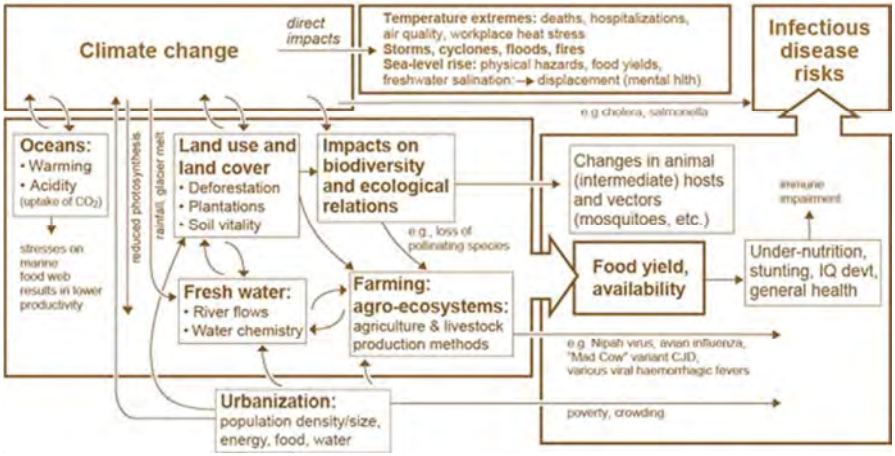
The diagram below by McMichael and Wilcox provides an overview of the major systems involved in climate change and their interactions. Transdisciplinary research using the EcoHealth approach can help unravel this complex web of interactions.

3.4 Land Use and Land Cover Change

3.4.1 Urbanization

Probably the most important geographic change in the distribution of the human population has been the increase in urbanization. In 1800, only about 2% of the world's population lived in urban areas.[15] By 2008, that fraction had grown to 50%.[16] The urban population in Thailand as of 2010 was 34%, with an annual growth rate of 1.8%.[17] If that rate of urban growth continues unchanged, the urban population of Thailand will double to 68% by 2048.

Figure 3-3: Interaction of systems involved in climate change[14]



The relatively high concentration of people in urban areas causes a variety of potential environmental and health problems including inadequate water and sanitation, lack of appropriate rubbish disposal, and industrial pollution. The World Health Organization cites other urban-related human health challenges including "violence and injury, non-communicable diseases (cardiovascular diseases, cancers, diabetes and chronic respiratory diseases), unhealthy diets and physical inactivity, harmful use of alcohol as well as the risks associated with disease outbreaks. City living and its increased pressures of mass marketing, availability of unhealthy food choices, and accessibility to automation and transport all have an effect on lifestyle that directly affect health."[18] The Washington, D.C. based Population Reference Bureau adds respiratory infections and parasitic diseases to this list of urban health issues.[15]

3.4.2 Intensive agriculture

The growing world population combined with higher average income levels has resulted in a rise in the demand for food. As the amount of arable land in the world is limited, food production increases have been accomplished through increasing intensification of agricultural production characterized by a low land fallow ratio, high inputs of capital and labor per unit area, and heavy use of pesticides and chemical fertilizers. Excessive

intensification of agriculture in some areas has resulted in degradation of soil quality, salinization of irrigated areas, over-extraction and pollution of groundwater, and increasing crop pest resistance to pesticides – outcomes that effectively reduce food production capacity. These impacts are exacerbated where farmers shift to a monoculture regimen rather than rotating their crops.

Figure 3-4: As pesticide use increases, crop pests become increasingly resistant

Livestock production is responsible for a significant proportion of agricultural intensification. As incomes rise around the world, the per capita demand for animal products, particularly meat and dairy, increases. This demand puts an increasing burden on the 68% of agricultural land which is in permanent pastures used in the production of livestock.[19] With more animals per unit area, the risk of infection, including zoonotic diseases, increases.

3.5 Air Quality

Air quality is defined as a measure of the condition of air relative to the requirements of one or more biotic species or to any human need or purpose.[20] Air quality usually refers to ambient outdoor air, although indoor air quality, the quality of air in enclosed spaces, such as homes, schools, or workplaces, is also important for good health. Air quality concern is not a new concept: In AD 61 the Roman philosopher Seneca was quoted as saying, "As soon as I had escaped the heavy air of Rome and the stench of its

smoky chimneys, which when stirred poured forth whatever pestilent vapors and soot they held enclosed, I felt a change in my disposition."[21]

The air pollution problem in Seneca's day was primarily the result of burning: wood for cooking and heating, oil for lighting, and manufacturing activities such as metal working and brick making. Although the fuels burned have changed since then, burning remains a major cause of air pollution, e.g., electricity generation, motor vehicles, and industrial processes. For example, in Lampang Province the Mae Moh electricity generating facility burns high sulfur content soft coal or lignite, releasing around 1.6 million tons of sulfur gas daily and some four million tons carbon dioxide into the atmosphere annually.[22] The sulfur, in the form of sulfur dioxide, has been linked to breathing problems such as asthma, wheezing, and shortness of breath. Sulfur dioxide is one of the major precursors of acid rain, which acidifies soils, lakes and streams.[23]

In rural areas of Thailand (and cities adjacent to rural areas such as Chiang Mai) air quality is adversely affected by the traditional burning of crop residues during the dry season. Some farmers feel that burning crop residue can help prevent insect damage to the following year's crop by destroying the eggs and larvae of insect pests. While it is true that some pests are destroyed by burning, there are many cultural practices which can help achieve that goal without the negative impact of burning.[24] Another reason for burning crop residues is the mistaken belief that the ash will improve the soil.[25]

The occurrence of accidents that have an impact on living things and the environment include the release of oil from a well in the Gulf of Mexico which spread oil around the area. That accident affected more than 60,000 pelicans living on Raccoon Island in the state of Louisiana in the U.S.A. That island was the largest pelican rookery; large numbers of birds died there. After that ecological disaster, it was almost impossible to see any pelicans on the island.

Figure 3-5: Factory and vehicle emissions contribute air pollution and global warming

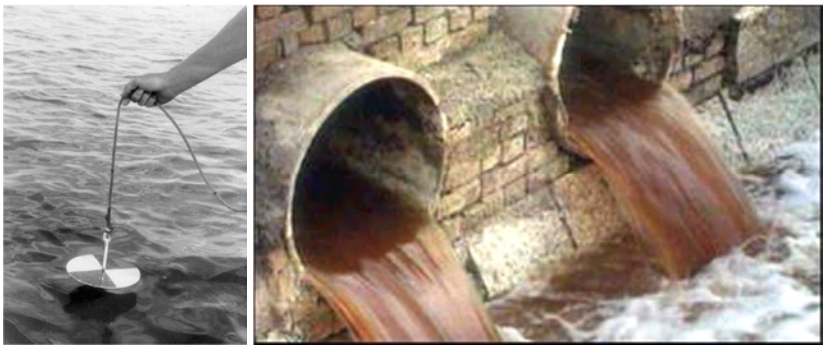
3.6 Water Quality

The definition of water quality closely parallels that of air quality: a measure of the condition of water relative to the requirements of one or more biotic species or to any human need or purpose. Some characteristics of water quality are easily measured. One of the easier metrics is water temperature which can be measured with a simple thermometer. Water temperature affects the biota living in the water: some organisms thrive in warmer water, others require cooler water. Changes in water temperature can affect those organisms adversely. Water clarity is another easily measured characteristic which can be measured with an instrument known as a Secchi disk.[26] The disk of known size is lowered into the water until the pattern is no longer visible. The depth is then recorded, and the water clarity can be measured from a clarity index. Some organisms thrive in clear water, while others require murky water to help them hide from predators. As with temperature, changes in water clarity can impact the organisms living there. Discharge of effluent from industrial operations into streams and rivers is one cause of reduced water clarity.

Measuring other aspects of water quality require special laboratory equipment, e.g., identifying the presence of disease causing organisms. One such organism is *Vibrio cholera* which causes cholera and severe diarrhea.[27] That disease is usually spread through food and drinking water which does not meet sanitary standards. In infected humans and animals, *V. cholerae* resides in the intestines and feces. Excreted feces can then infect natural

water sources or waste water, resulting in the spread of the disease. This disease usually occurs in communities where there are sick people and where the community uses a common water source, or in areas where basic infrastructure such as toilets is not available.

Figure 3-6: A Secchi disk is used to measure water clarity. Discharge of effluent into natural waterways can reduce water clarity.



One source of disease organism in water is runoff from farmers' fields which have been fertilized with animal manure. Even salt water can become contaminated with fecal bacteria, a particularly serious problem where raw sewage is pumped directly into the ocean.

Infections can also appear after a natural disasters such as the recent earthquake in Haiti. In that instance, cholera spread because after people's houses were destroyed, large numbers of people had to live together in emergency shelters which made disposal of waste and refuse difficult, including the bodies of humans and animals. The result was that the refugee centers became areas where diseases, including cholera, accumulated. In addition, the destruction of public water utilities forced people to obtain water from natural sources which had been contaminated with sewage and thus had become a reservoir of disease.

3.7 Waste Management

Aspects of the lifestyle of humans can have a direct impact on the environment which in turn affects human and animal health. Refuse generated by humans is a good example. The amount of waste generated

by humans is increasing rapidly, and most of that refuse is not biodegradable or biodegrades only very slowly over a period of decades. The accumulated refuse itself can result in a growth in the population of animals and insects which are vectors (carriers) for the spread of various diseases. If the refuse is burned, it creates emissions which pollute the atmosphere and negatively impact the quality of life of humans and animals. Changes in human behavior can help improve the health of humans and animals as well as helping keep the environment clean, e.g., using cloth bags rather than disposable (and non-biodegradable) plastic bags or putting food in reusable containers rather than Styrofoam boxes can reduce the amount of potentially disease-spreading refuse and can also help improve the quality of the atmosphere. (Environmental health is discussed in more detail in Chapter 3.)

Figure 3-7. Plastic bags and Styrofoam food boxes wind up in landfills where they can be breeding grounds for disease vectors. Burning refuse pollutes the atmosphere.

Human and animal health is also affected by natural disasters such as earthquakes, volcanic eruptions, severe storms, and flooding. In addition to the direct loss of life caused by the events, these situations also result in other health problems for humans and animals. The destruction of property leaves many people without access to clean water. Contact with polluted water can quickly spread disease. Those who are left homeless often congregate in crowed refugee camps where sanitation may be inadequate – another frequent source of the spread of disease including diarrhea, respiratory diseases, skin diseases, as well as mental health issues stemming from stress. Pets and livestock of the displaced humans often die in large

numbers, and diseases can spread among the survivors, and may even be transmitted to humans.

Municipal Solid Waste (MSW), commonly called "trash" or "garbage" is defined by the Center for Sustainable Systems as, "wastes such as durable goods, e.g., tires, furniture; nondurable goods, e.g., newspapers, plastic plates/cups; containers and packaging, e.g., milk cartons, plastic wrap; and other wastes, e.g., yard waste, food. This category of waste generally refers to common household waste, as well as office and retail wastes, but excludes industrial, hazardous, and construction wastes."[28]

MSW can create a serious potential risk to health and the environment as it can become a reservoir for diseases, particularly zoonotic diseases spread by rodents and insects. In general, the potential risk from MSW is closely correlated with the economic development cycle of a nation. A poor nation generates relatively little MSW per capita, so that disposal of that waste is not a major issue. As a nation develops economically, the amount of MSW per capita increases, but often efforts by municipal authorities to manage the growing quantities of waste are insufficient to effectively deal with the situation. Over time, if the economic prosperity of a nation continues to grow, funding becomes available to adopt appropriate methods of MSW disposal. Thus it is those countries with growing, but still relatively modest, economies that face the greatest health and environmental risk from MSW.

The Workshop on "Sustainability of Solid Waste Management in Thailand" held in Bangkok on 11 October 2010 summarized the situation for this part of the world, stating that, "Solid waste management has become a major environmental problem for many countries in Asia. Out of 12 billion tons of solid wastes produced globally and which includes 11 billion tons of industrial wastes and 1.6 billion tons of municipal solid wastes (MSW), approximately 4.4 billion tons are generated in Asia (out of which 790 million tons of MSW). About US$25 billion per year is spent on solid waste management activities in Asia," noting that "the situation is worsening particularly in fast developing economies such as Thailand where amount of waste generation is increasing at a fast rate."[29]

Recycling is one potentially effective method for reducing quantities of MSW, while providing an economic boost to the economy. The most common example is the recycling of plastic, glass, and aluminum containers. However, to be effective, recycling requires a change in cultural values and practices, which is often described as KAP or Knowledge, Attitudes, and Practices. The remnants of a less than totally effective effort to change KAP regarding recycling in Thailand is still visible. Some years ago, Thai government agencies provided funding to acquire trash receptacles of different colors. These receptacles were placed side by side in public locations around the country.

Five different colored waste bins were obtained for use in national parks.[30] Unfortunately, efforts to educate the general population about the concept of recycling and the appropriate types of refuse to deposit in each of the different colored trash receptacles was less effective than the efforts to procure the multi-colored trash bins. There were few public service announcements about the types of refuse to go into each bin or encouraging people with slogans like, "good citizens separate their refuse" similar to the earlier "Magic Eyes" campaign to eliminate littering. The end result was – and is – that trash is deposited in the different receptacles without regard to the type of material involved. Plastic bottles and food waste are deposited in the same receptacle. At the other end of the system, collection of waste, there are no separate collection schedules for different types of waste. Refuse from all types of receptacles is dumped into the back of the same truck.

What recycling of refuse that does occur is accomplished either by itinerant refuse pickers who sort through refuse bins for recyclable – and salable – materials, and by municipal refuse collection workers who pick through refuse after it is deposited in their truck, putting recyclables into separate plastic bags for later resale at recycling centers.

Figure 3-8. Recycling refuse bins on the road up to the temple in DoiSuthep National Park. Categories of refuse on the bins are almost completely obliterated: the original labels (left to right) were: Waste, Cans, Plastic, General Waste, and Glass

3.8 Agriculture-associated Problems

Many agriculture-associated problems affect people, animals, and the environment far from the farmers' fields. One example is the fertilizer used to increase crop production. Rain washes some of the fertilizer off the land into nearby streams or rivers. The fertilizers, which commonly contain phosphate, potassium, and nitrogen, chemicals which are normally in short supply in streams, rivers, and coastal areas. Increases in nitrogen and other nutrients in the water allow phytoplankton populations to expand dramatically, resulting in what are known as harmful algal blooms (HABs). The algae are then eaten by oxygen-consuming bacteria, resulting in a drop in dissolved oxygen in the water. Fish and other organisms which require oxygen to live are negatively impacted. Greenpeace reports that recent studies in Thai reservoirs have found frequent HABs in freshwater bodies, including the Bang Phra reservoir in Nakhon Pathom and the Mae Kuang Udomtara Dam in Chiang Mai.[31] Fertilizer runoff has also been blamed for the creation of "Dead Zones" in the Gulf of Mexico[32] and the Gulf of Thailand.[33]

Pesticides are another potential agriculture-related source of health problems. In many developing nations, the dangers of pesticides have often not been well publicized. In the 1980s in Thailand, salesmen promoting pesticides to farmers, particularly in highland areas where the use of pesticides was just beginning, were observed not to wear the recommended protective boots, gloves, and mask while demonstrating their product. When the salesmen were asked why they did not use the protective equipment, their answer was that their customers, the farmers, might be concerned that the chemicals are dangerous.

Consumers of food which has been treated with pesticides can suffer health problems due to those chemicals. Agricultural chemicals can contaminate food or remain in food from start of the food production process, that is, raw materials for animal feed that accumulate along the food chain, terminating in food for human consumption. Those chemicals can come from the agricultural production system and from industrial plants which are increasing in number to meet the demand for food. For example, insecticides can accumulate in the soil and in natural water sources, in human refuse which are near water sources, or sources of raw materials for human food. An example is marine animals that are consumed as food by humans which come from coastal areas. Near the coastal areas, rivers discharge their sediment load which has been washed off the land. That sediment can contain minerals which are beneficial for marine plants and animals, but it cannot be denied that in addition to the useful material, there are also some materials that have a negative impact on the environment and the food sources of humans. These materials come from agricultural chemicals and refuse from communities. The plants, the land animals and the marine animals are all raw materials for human food.

Even food production itself can be put directly at risk: non-lethal doses of neonicotinoid class pesticides have recently been found to reduce by 8 to 12 percent the size of colonies of bees (*Bombusterrestris*), but also to reduce the number of queens produced per colony from about 14 to two.[34] If the reproductive rate of these important pollinators were reduced, it could mean a significant drop in food production for humans.

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CHAPTER 4
SOCIAL AND ECONOMIC UNDERSTANDING OF ECOHEALTH

4.1 Social Understanding of EcoHealth

4.1.1 An overview of social and economic factors related to EcoHealth

EcoHealth is an innovative research approach that incorporates the social sciences and economics in addition to traditional health-related disciplines. However, there is still much work to be done in the area of socio-economics. As Charron noted in 2012, "to date, no publication has effectively captured the full range of outcomes of EcoHealth research, including the socio-economic and ecological context."[1] The author goes on to note that, "environmental change – climate change, globalization, urbanization, deforestation, and agricultural intensification – are affecting human health and are compounding social and economic disparities between rich and poor around the world."[2]

Both social science and economics look for the patterns in different aspects of human behavior, just as medical professionals look for patterns in the biological functioning of organisms. Social science focuses on human society and social relationships. Economics is the study of how people choose to use resources. Effective social science research, just like medical and environmental research, requires systems thinking. The EcoHealth approach provides a platform for combining knowledge of patterns of human social and economic behavior with knowledge of the operation of biological systems.

4.1.2 Social impacts of health problems

Many indicators show that the disparity between the rich and the poor around the world is increasing. That gap, according to some analysts, has been growing since 1967.[3] The wide gap between rich and poor means that the very poor may not benefit from economic development as much as others do. As Charron describes the situation, "the wide gap between rich and poor means that the very poor may not benefit from economic

development as much as others do. Development activities may change ecosystems in ways that threaten people's ability to obtain food, water, and fuel. Over-exploited ecosystems cannot sustain healthy livelihoods and are hazardous to human health. In many of the world's developing regions, people going about daily subsistence may have no alternative to activities that further degrade environments, and further endanger their health."[4]Difficult and complex situations such as these are often referred to as "wicked problems," that is, complex problems for which there are no simple uni-disciplinary solutions."[5]

In order to prepare an appropriate response to the health and well-being impacts of the economic gap between the rich and the poor it is necessary to first develop an understanding of the social context involved. Improving the social determinants of health requires understanding those determinants. This chapter provides an overview of what is involved in social and economic research, including a description of the concept of KAP – knowledge, attitudes, and practices – which is central to socio-economic research using the EcoHealth approach.

4.1.3 Social science methods for the EcoHealth approach

Applied social science research frequently focuses on understanding three aspects of the group being studied: their knowledge, attitudes, and practices related to the subject of the research. These three aspects are used together so frequently in the social sciences that they have come to be commonly abbreviated as KAP. The KAP survey tradition originated in the field of family planning and population studies in the 1950s, to help public health professionals develop appropriate family planning programs for different regions of the world.[6]It is generally assumed that those three concepts inform each other in a causal chain: knowledge underlies the creation of attitudes which, in turn, affect the practices of individuals, communities, and societies. Developing an understanding of the current KAP of the target group – including the context in which they exist – is the first step in planning how to change selected aspects of KAP in order to improve the quality of life of the target group.

In practice, research on KAP usually employs a number of different methods, including both quantitative and qualitative. The use of diverse

research methods in the same study is referred to as "mixed methods" research. Using more than one method of obtaining the same information helps in the triangulation of findings, that is, comparing results obtained from two or more independent data gathering exercises to help ensure the accuracy of the information and thus the findings of the study. The mixed method concept of integrating methodological procedures in a single study in a sense parallels the transdisciplinary nature of the EcoHealth approach.

A recent example of the use of KAP in a research project which used the EcoHealth approach is the 2005 project conducted by a transdisciplinary research team from the EcoHealth Resource Centre during an outbreak of Highly Pathogenic Avian Influenza (HPAI) or "bird flu" in Thailand. The target groups whose KAP were of interest included various groups of poultry raisers. Those groups covered a wide spectrum of size and economic clout. At one end of the spectrum were small, rural farmers who raised a few chickens for market, allowing the birds to roam freely around the farmer's home area. For most of these farmers, the sale of chickens to local markets was a relatively minor source of supplemental income. At the other end of the spectrum were the large commercial poultry producers who maintained flocks of a hundred thousand birds. The large commercial producers kept all their birds in large enclosures where interaction with the outside world could be controlled. Medium size producers were somewhere near the middle in terms of number of birds and in terms of controlling the environment in which the birds were raised.

Figure 4-1: Avian influenza is a serious emerging disease

Each of these groups had a different outlook on the potential risk of avian flu, so different approaches to developing an understanding of KAP related to poultry raising were developed for each group.[7] Among the main social science research methods used in that study were focus groups, in-depth interviews, and questionnaires. Each of those methods is described below.

Focus Groups: Focus groups are interviews conducted under the guidance of a facilitator or moderator. The groups usually possess certain characteristics in common, e.g., they raise chickens. The method of interviewing participants in focus groups originated in the field of marketing research, but is now widely applied in the social sciences[8] but who, ideally, are unfamiliar with each other because, as Kreuger notes, "familiarity tends to inhibit disclosure."[9] Among researchers, there is no consensus on the ideal size of a focus group, although the maximum number of participants is usually suggested to be twelve or fewer.

There are also no fixed rules regarding circumstances which would suggest the use of focus groups, although Cresswell suggests that, "Focus groups are advantageous when the interaction among interviewees will likely yield the best information, when interviewees are similar and cooperative with each other, when time to collect information is limited, and when individuals interviewed one-on-one may be hesitant to provide information."[10]

Similarly, there are no regulations regarding when in the course of a research efforts focus groups should be considered, although the use of focus groups both at the beginning and again at the end of a project can be highly beneficial.

At the beginning of a research effort, focus groups help generate information for inclusion in questionnaires. They also are a means of obtaining background information on the subject of interest.[11]"Pre-pilot focus groups may be used as an alternative to depth interviews in the initial phase of large survey study. Prior to the drafting and piloting of the survey instrument itself, focus groups may be used in the early days of the study for exploratory purposes, to inform the development of the later stages of the study."[12]

One common benefit of using a pre-project focus group is that the researcher can develop an understanding of the vocabulary used by the target group related to the topic of interest. As stated by Bloor, "Focus groups can be used to access the everyday language of research subject as a first step towards the compilation of a taxonomy of vernacular terms . . . or to insure that the terms chosen for a subsequent survey are ones that are consistently understood by the respondents."[13]

Learning the vocabulary of the target group – and the context in which that vocabulary is used – can be very helpful, as often respondents may be unfamiliar with or uncomfortable using standard scientific or medical terminology. A case in point could be a study of KAP related to the incidence of diarrhea. Villagers in a rural setting may well use less formal terms for diarrhea than would a medical professional. Even the categorization of degrees of diarrhea could be quite different, e.g., categorization of the consistency, wateriness, or color of the stool. Similarly, what is viewed as a serious case of diarrhea by a medical professional could be quite different from that of a rural resident. Focus groups can help the researcher learn to think and view the world as a villager would: the researcher can, through focus group interviews, learn to "speak the culture" of the target group.

End-of-study focus groups to discuss initial findings can help the quality of social science research in three ways. First, the end-of-study focus groups furnish additional data which can help qualify, deepen, and extend the initial analysis. Second, conducting focus groups with individuals who have been participants in the research can be a source of early feedback on the results. Third, the promise of such groups at the end of the project (and thus the opportunity to comment on the findings) may well facilitate access to information during the study.[14]

In the case of projects which are intended to change the KAP of the target group, focus group interviews can be one tool to evaluate the success of the project, that is, to determine the level of changes in the KAP of the target group.

Although there are no rules about when to use the focus group method, there are some definite guidelines which can help assure the success of the focus group interview. First, during the focus group session,

stick to the pre-determined questions. Second, tell the group in advance the approximate duration of the interview, then complete the interview within the time specified (if possible). Third, during the focus group interview, be respectful and courteous to all participants, and offer few questions and advice.[15] As Bloor succinctly states, "Successful focus groups are mainly a matter of forward planning."[16]

Interviews: Interviewing individuals is another way to obtain social science-related information regarding groups of interest to EcoHealth researchers. There are a number of texts that describe techniques for different types of interviews. Illustrations of a few interview methods are provided here.

Determining whom to interview is one question the researcher must answer. There are a number of different sampling methods available to choose from, each of which has its strong and weak points.[17] In social science interviewing, two methods for identifying people to interview are frequently used. The first is convenience sampling. With convenience sampling, the researcher selects individuals to interview from the general population who happen to be handy at the time. No specific criteria are used in making selections. This is one good way to begin the interview segment of a research effort. Very often, the random sampling is followed by the snowball or chain sampling method. With the snowball method, when the researcher interviews one individual about the topic of the study, they ask that individual to recommend others who would likely have information desired by the researcher. The researcher then seeks out those individuals, and can then ask each of them for additional recommendations for interviewees.

Some interviews are relatively short in duration, only a few minutes long. However, in some studies it is necessary to gain deeper insights into the topic than can be achieved in such a short time. In those cases, the extended interviews are known as In-depth interviews. An in-depth interview can last up to an hour or even a little more. Sometimes, the researcher will ask the subject to make an appointment for a second or even a third interview. Whereas random sampling interviews are frequently conducted with a relatively large number of individuals, in-depth interviews

are usually conducted with only a small group of informants who have significant levels of knowledge related to the subject being researched.

Sedimen provides a good summary of the objective of in-depth interviews. "The purpose of in-depth interviewing is not to get answers to questions, nor to test hypotheses, and not to 'evaluate' as the term is normally used . . . . At the root of in-depth interviewing is an interest in understanding the lived experience of other people and the meaning they make of that experience."[18] He also provides some good advice regarding interviewing in general, suggesting that the researcher should "listen more and talk less," noting that, "Listening is the most important skill in interviewing. The hardest work for many interviewers is to keep quiet and to listen actively."[19]

"Avoid interrupting participants when they are talking. Often an interviewer is more interested in something a participant says than the speaker seems to be. While the participant continues talking, the interviewer . . . can jot down the key word and follow up on it later."

Questionnaires: In conducting social science research, questionnaires are employed most frequently to obtain data primarily of a quantitative nature. Both focus groups and interviews are excellent tools for helping the researcher design an efficient and effective questionnaire. The results of the focus groups and interviews allow the researcher to phrase questions in such a way that they can be easily understood by the target group.

To help insure that a questionnaire will provide all the information needed by the researcher, it is a good idea to write out the key questions which the researcher desires to answer before preparing the questionnaire. That way the researcher can be sure that the questionnaire includes items related to each of the key research questions.

When quantitative information is being obtained, the completeness and efficiency of the questionnaire can be enhanced by first preparing "dummy tables." A dummy table is a table which includes all the parameters the researcher intends to include in the research report, e.g., the labels for the rows and columns (dependent and independent variables) for each table including the units of measurement to be used. The only thing missing

from the dummy tables is that there is no actual data – that comes from the questionnaire.

The final step, after preparing the dummy tables, is to write the questionnaire. Each question should provide specific information for inclusion in one or more of the dummy tables. With this method, the researcher can be sure that data will be obtained for each of the cells in each of the tables, and that no necessary information is left out. This method also makes sure that the questionnaire does not include any superfluous questions which are not really important to the data analysis.

4.2 Economic Understanding of EcoHealth

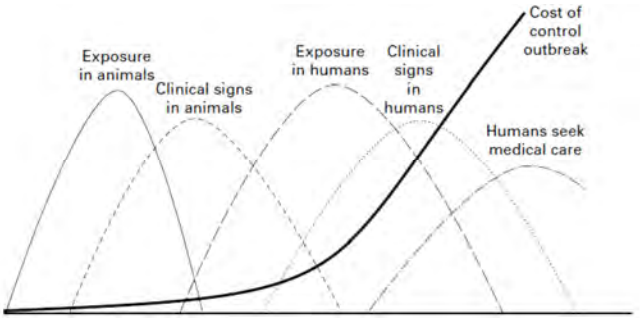
4.2.1 A view of the EcoHealth approach through an economic lens

The field of economics is frequently divided into two major branches: macroeconomics and microeconomics. The branch of economics that studies the behavior of the aggregate economy is macroeconomics. This branch examines economy-wide phenomena such as changes in unemployment, national income, rate of growth, gross domestic product, inflation and price levels. Macroeconomics is focused on the movement and trends in the economy as a whole. On the other end of the scale, microeconomics focuses on factors that affect the decisions made by firms and individuals. In practice, the factors that are studied by macro and micro will often influence each other, such as the current level of unemployment in the economy as a whole will affect the supply of workers which an oil company can hire from.[20]

The EcoHealth approach has a closely parallel structure, with both a macro and a micro component. For that reason, knowledge of the theories and practice both macro and microeconomics can help guidelines for EcoHealth activities. A recent World Bank publication, "Economics of One Health," describes the macro side of EcoHealth. As the executive summary states, "This report analyzes and assesses the benefits and the costs of control of an important group of contagious diseases. . . . . The case for control of zoonotic diseases (zoonoses) is compelling. The economic losses from six major outbreaks of highly fatal zoonoses between 1997 and 2009 amounted to at least US$80 billion."[21]Even the graph illustrating the cycle of

emerging zoonotic diseases emphasizes the economic benefits of early control in economic terms.

Figure 4-2: Economic and health benefits of early control of zoonotic disease.[22]



As the World Bank publication indicates, decisions regarding response to disease epidemics is are evaluated at the national or regional level, i.e., EcoHelath at a macro scale. An example from Thailand is the government's decision to take action to control the spread of Avian Flu which was discussed in detail elsewhere in this manual.

Once a nation has decided on a response to an epidemic threat, micro scale EcoHealth is brought into play. In the case of Avian Flu in Thailand, once the Ministry of Health had determined that control action was appropriate, micro scale efforts to reduce the incidence of the disease were designed and carried out at the local community level, including the research conducted by the Chiang Mai University EcoHealth Resource Center.[23]

4.2.2 Utility and the EcoHealth approach

Most people would like to avoid having diarrhea. That is, avoiding a bout of diarrhea is something that has value to them. But some people still eat foods such as undercooked or raw meat products which can cause diarrhea in part because they like the taste, and in part because it is part of their culture. To those people, the positive value of eating the food outweighs the negative value of the risk of diarrhea. That can be viewed as an economic decision: the utility value of avoiding possible diarrhea

balanced against the pleasure of eating that special food. This is an example of the economic concept of utility which is usually defined as the satisfaction that individuals gain from buying products (whether goods or services).[24] In this sense, utility cannot be measured directly in monetary terms: it is measured by the opinions of the individual consumer. To effectively have an impact on the KAP of a target population, there is a need to understand the perceived utility of alternative actions as viewed by that population. The social science research methods described in Section 4.1and in D.F. Charron's 2012 IDRC publication, "Ecohealth Research in Practice: Innovative applications of an ecosystem approach"[25] are also tools which can be employed to gain an understanding of perceived utility of members of the target population.

4.2.3 Economic inequality and the EcoHealth approach

Most agricultural-associated problems can be grouped together using the term "externalities." In micro-economics (and environmental economics) externalities is generally defined to exist "when a person makes a choice that affects other people that are not accounted for in the market price." The concept of externalities is described in more detail in Chapter 3.

4.2.4 Economic impacts of EcoHealth failures

In addition to the human and animal suffering, contaminated food products can have a significant economic cost as well. Investigating those costs is an important facet for research using the EcoHealth approach. A good example is aflatoxins, naturally occurring mycotoxins that are produced by many species of the fungus *Aspergillus*. Aflatoxins are toxic and among the most carcinogenic substances known.[26] They may be present in a wide range of food commodities, particularly cereals, oilseeds, spices and tree nuts, as well as in livestock.[27] The Food and Agriculture Organization has estimated that 25% of the world's crops are affected by mycotoxins each year, with annual losses of around 1 billion metric tons of foods and food products. Economic losses occur because of: 1) yield loss due to diseases induced by toxigenic fungi; 2) reduced crop value resulting from mycotoxin contamination; 3) losses in animal productivity from mycotoxin-related health problems; and 4) human health costs. These economic impacts are felt all along the food and feed supply chains: crop producers, animal

producers, grain handlers and distributors, processors, consumers, and society as a whole (due to health care impacts and productivity losses).[28] In Thailand, the highest aflatoxin infection rates have been found in peanuts and peanut products[29] and in corn.[30] In 1989, Tanboon-ek estimated that since Thailand exports more than 70% of the nation's corn production, a discount of 5% on FOB price because of aflatoxin contamination would cost more than US$ 25 million per annum in lost export revenue.[31]

Even rumors of health-related problems can have significant economic impact, particularly in a country like Thailand where the tourism industry represents a significant source of revenue and employment. In 2009, the CNN news network reported, "Two tourist deaths from suspected food poisoning at Phi Phi."[32] More recently, in December 2012 the online tourist news website provided news of the death of a recent economics master degree student from Chiang Mai University with the headline, "Barbecue death probed in Chiang Mai."[33] Whether or not these tragic deaths were in fact due to contaminated food, there is no doubt that such adverse publicity can have a serious negative influence on tourism in Thailand. Minimizing the actual occurrence of food-related illness could significantly such negative publicity and the accompanying economic impact.

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CHAPTER 5
ECOHEALTH CHALLENGES: FOCUS ON THAILAND

5.1 Introduction

This chapter is intended to integrate the information provided in chapters 1-4 and to comprehend how that material applies to actual situations in Thailand. Users of this manual should:

1. Understand and be aware of the importance and the connection of EcoHealth to problems all around us by learning from the present situation, including important problems at the national level.
2. Be prepared, using experience gained from Thai case studies, to employ the principles of EcoHealth to investigate the various components of problems and to develop and understanding of the inter-relationships of various stakeholders.

Included in this chapter are examples of real problems at the local and national level. The focus is on using systems thinking in the application of the EcoHealth approach to analyze problems as they arise, especially problems that impact the health of humans and animals, and to take appropriate action to mitigate those problems. The discussion issues provided below in three different situation categories include statistical data, daily news reports, and research results. Following the description of each situation, questions are presented which are designed to stimulate systems thinking and the application of the EcoHealth approach in responding to the situation. The emphasis is on the thinking process and the consideration of perspectives from various occupations.

5.2 Category 1 – Changes in Human and Animal Populations

A key objective in employing the EcoHealth approach is to look at problems related to health, especially human health, including maintaining a sustainable, friendly relationship with the environment. As noted in previous chapters, human demands on the Earth's resources are increasing

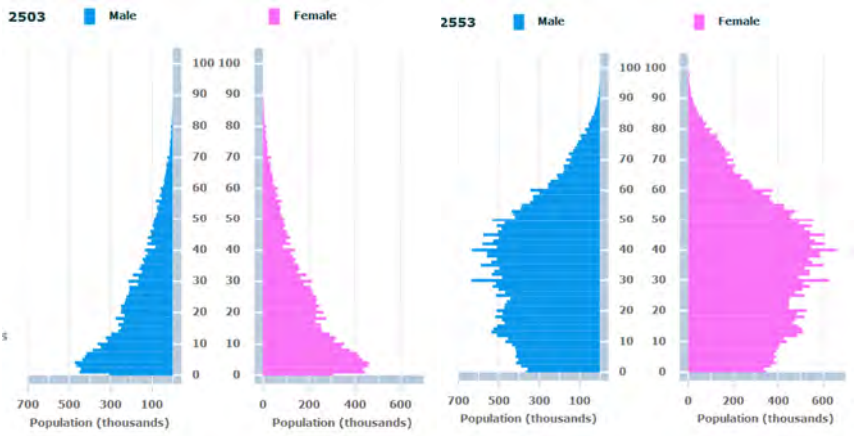
due to population growth. In Thailand, the population continues to increase, although the rate of growth has slowed in the past few decades. One result has been a shift in the age distribution of the population: the average age of the Thai population has been increasing.

Discussion Issue 1: Impacts of changes in age distribution

In 1960, the majority of the Thai population was in the age 1 to 10 cohort. By 2010, the largest cohort had shifted up to the age 40 to 50 age cohort. Over that 50 year period, the ratio of men to women has varied little. The trend is for the average age of the Thai population to continue to increase, with the majority of the population being elderly (age over 60).

Using the data provided here as well as information available from other sources, discuss the reasons for this demographic transition. Discuss potential future impacts on the economy, on society, on energy demands, and on health and health care needs. How could the EcoHealth approach help policy planners and local communities to prepare for the coming changes?

Figure 5.1: Population pyramids for Thailand in 1960 and 2010[1]



Discussion Issue 2: Population density in urban and rural societies

The following maps show the overall population density of Thailand, the percentage of the population in municipal areas, and the percentage in rural areas by province. The majority of the population in municipal areas is located in tourist cities or cities which are economically important. Those areas are only a small part of the population; in most provinces, the majority of people live outside municipal areas. Thus there are differences in the lifestyle of people in municipal areas and those living outside municipal areas.

Discuss the differences between urban and rural populations in the areas of health management, economic activity, overall lifestyle, and the ability to keep up/adapt to change. In addition, discuss factors influencing urban-rural population distribution differences in various provinces, trends in population density, and the impact of those trends.

Figure 5-2: Population density, percentage of population in urban and in rural areas of Thailand by province[2]

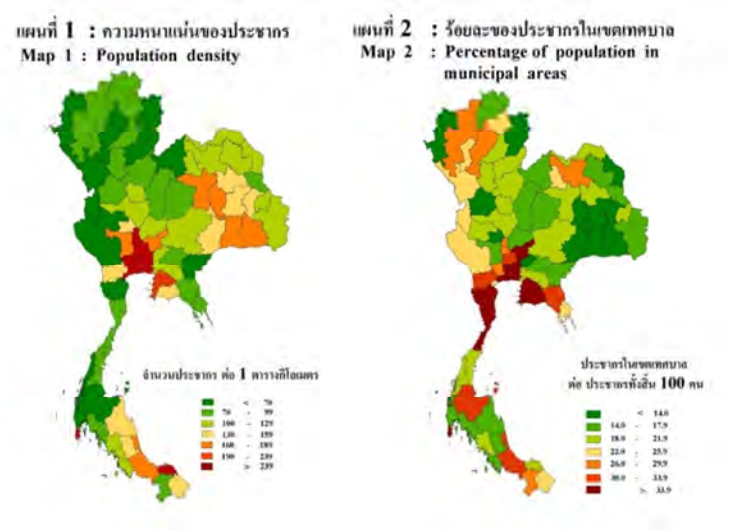
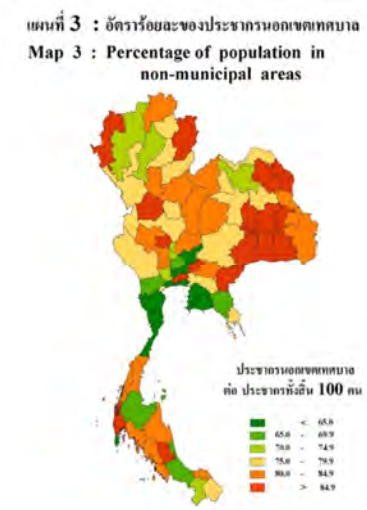


Figure 5-2: Population density, percentage of population in urban and in rural areas of Thailand by province[2] (cont.)

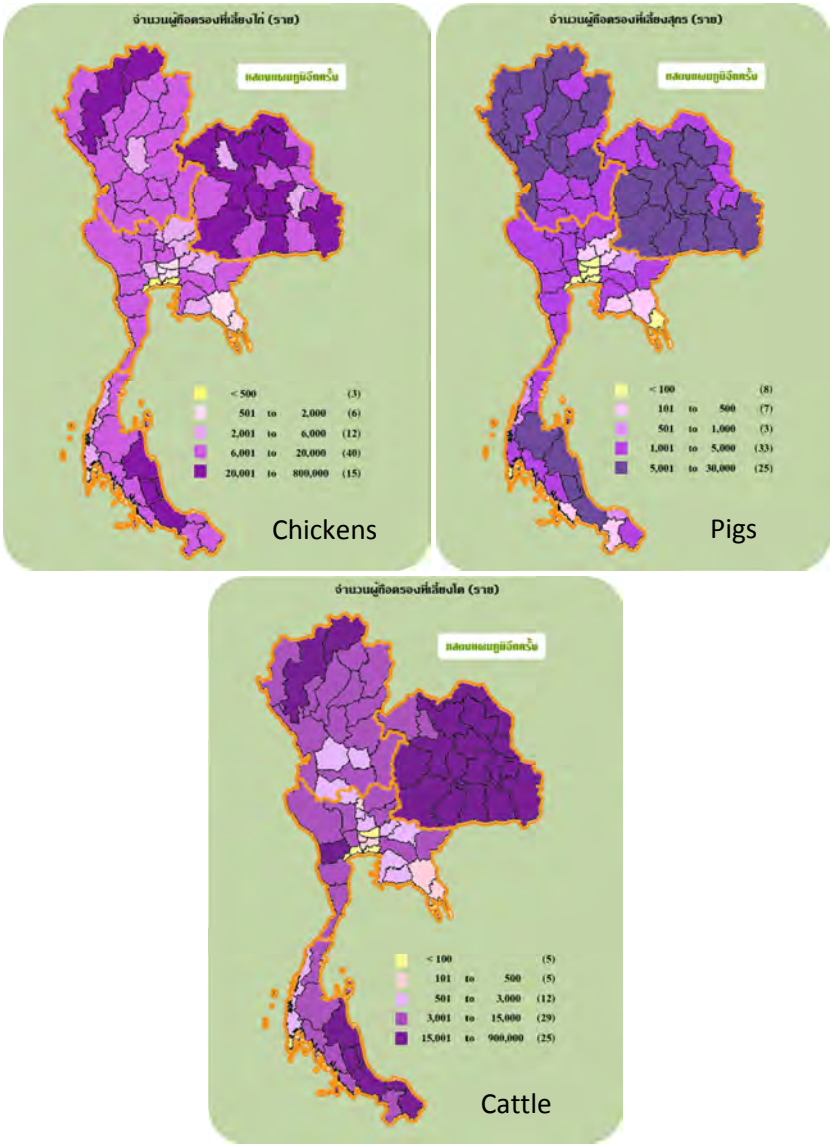


Discussion Issue 3: Density of livestock raising activities by size of farm

Large livestock raising operations are concentrated in certain areas and may be the main agricultural activity of that province. The location of livestock raising operations, especially large operations, is usually determined by accessibility considerations, particularly the transportation system for shipping products for processing or for export.

Discuss the impacts of livestock raising operations on the health of local communities. Compare and contrast the positive and negative aspects of small versus large livestock operations in terms of human health, animal health, economics, and society.

Figure 5-3: Numbers of livestock raisers by size of farm for chickens, pigs, and cattle[3]



5.3 Category 2 – Monitoring and Preventing the Spread of Disease during Emergencies

Discussion Issue 4: Disease situations during periods of flooding

On 7 October 2011, following a Department war room meeting Dr. Pornthep Siriwanarangsan, the Director General of the Department of Disease Control, stated that efforts to solve problems and protect against the spread of infectious diseases in areas affected by flooding would be accelerated. Using a VDO Conference to address Disease Control Offices throughout the nation, Dr. Pornthep ordered staff to go to the Disease Control Offices in flooded areas: Surveillance and Rapid Response Teams (SRRT) 1 Bangkok, SRRT 2 Saraburi, SRRT 8 Nakhonsawan, and SRRT 9 Pitsanuloke. Those government offices are responsible for flooded areas in the central and lower north regions including monitoring the spread of infectious diseases in areas where flood victims were sheltered. They were particularly concerned with seven priority diseases: influenza; pneumonia; hand, foot, and mouth syndrome; diarrhea; conjunctivitis; leptospirosis; and dengue. The offices are responsible for monitoring the incidence and preventing the spread of disease as well as providing support for provision of food and water, sanitation, and protection against insect disease vectors. Each of the Disease Control Offices was tasked with collecting data from their local area on the number of people affected by the flooding and the number evacuated.[4]

This news release from the period of severe flooding in Thailand in 2011 specified seven diseases for special monitoring: influenza; pneumonia; hand, foot, and mouth syndrome; diarrhea; conjunctivitis; leptospirosis; and dengue. Based on this information, discuss the cycle of each of the different diseases and the relationship between flooding and the cycle of emergence of the disease in an area.

Discussion Issue 5: Disease monitoring and investigation by Surveillance and Rapid Response Teams (SRRT)[4]

In 2011, the Disease Control Department established 58 mobile Surveillance and Rapid Response Teams (SRRT) at Disease Prevention and Control offices in flooded areas. The teams were deployed to all shelters for flooded victims as the shelters were crowded and sanitation was poor which could easily have resulted in the spread of various diseases. The Disease Control Department prepared additional quantities of equipment and medical supplies which were sent to the affected areas, e.g., 15,000 tubes of hand sanitizing alcohol gel, 6,000 pairs of boots, 20,000 packages of mosquito repellant, and a supply of rubber gloves. The Disease Control Offices were tasked with surveying local needs to allow rapid provision of needed supplies.

Discuss the roles of all those involved in this operation, either directly or indirectly, including individual team members and support units. Use diagrams if desired to illustrate the relationships of events and people involved, including possible ad hoc and long-term solutions for these types of health and economic problems.

5.4 Category 3: Environmental Impacts of Livestock Raising Operations

Situation 3: The impact of pollution from egg farms on the health of communities in the villages of Phae Mae Faek Mai and Chaedi Phattana in Mae Faek Mai Sub-district, Sansai District, Chiang Mai Province.[5]

This study of the impact of pollution from egg farms on the health of communities in the villages of Phae Mae Faek Mai and Chaedi Phattana in Mae Faek Mai Sub-district, Sansai District, Chiang Mai Province was conducted using questionnaires. Four dimensions of the impact were studied, physical, social, spiritual,

and psychological, with a sample of 196 households. One person was identified as the representative for each household. Selection of households was by simple random sampling. Of the 196 respondents, 146 individuals (74.49%) had lived in the community before the egg farm was established, and 50 individuals (25.51%) had moved to the community after the egg farm had been established.

It was found that the greatest impact of the egg farm was psychological. Those who had lived in the community before the farm was established cited being bothered most by flies (80.82%), followed by concerns over the risk of infectious diseases from fowl (63.01%). Respondents who had moved to the community after the farm was established were bothered most by flies (88%) and anxiety over infectious disease risk (58%). Regarding anxiety over the risk of infectious diseases from fowl, bad smells, and noise, the difference in psychological health between those who lived in the community before the farm and those who came after the establishment of the farm was statistically significant ($P < 0.05$). As to the impact on physical health, the study found that there was a statistically significant difference ($P<0.05$) in the areas of respiratory tract ailments, allergic rhinitis, and eczema. The egg farm impacted the health of individuals living in the area surrounding the farm in all four dimensions. For that reason, responsible agencies should establish pollution control guidelines or standards for the farm to prevent negative impacts on the health of the members of the community.

If you are a member of an organization which is responsible for these communities, please discuss the people who are involved and methods of solving the problems through cooperative action by all sectors.

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CHAPTER 6

MAKING THINGS BETTER: HOW CAN THE ECOHEALTH APPROACH CONTRIBUTE

6.1 Using the EcoHealth Approach to Solve Problems

Systems Thinking: Systems thinking involves analyzing the various components of a system including the relationships among sub-components. A good example is analyzing the operation of different systems and sub-systems which together make up the human body. There are a number of direct benefits which accrue to systems thinking:

- Systems thinking allows us to visualize something as a unit. We see the world around us as anointer related whole rather than viewing it as separate entities. This allows us to understand the unit of interest more clearly.
- Systems thinking allows us to observe the impacts of various perturbations. We observe and are aware of how a sub-section of the system functions. If that sub-section stops working or if it does not function properly, we can see the impact on the whole.
- Systems thinking helps us understand more clearly. We see the relationships among different sub-sections which are part of a system and their impact on patterns of behavior.
- We see that everything moves and changes. We gain understanding of the system of the operation of life which moves and changes all the time. Life does not remain constant in one location. Our thoughts follow a similar pattern.

Figure 6-1: An example of systems thinking related to society[1]

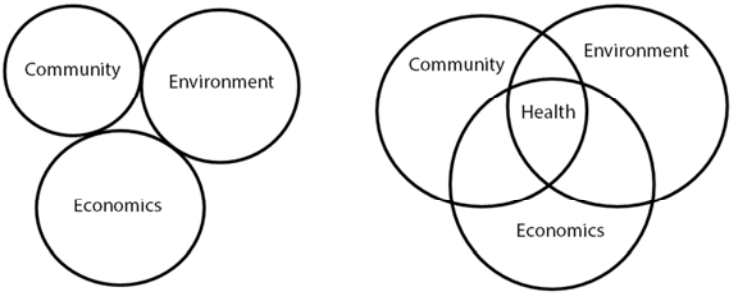
6.2 Transdisciplinary Research

6.2.1 Comparison of traditional research and transdisciplinary research

Most traditional research involves in-depth study within a single academic discipline. It is researcher-centered. The body of knowledge lies with the researcher. The research is conducted to understand the problems of another person. The results of the research, therefore, are not used to solve an overall problem.

Transdisciplinary research or interdisciplinary research is research that results in important changes in the research methods. It has an impact on the development of Thailand through the following principles. Results of transdisciplinary research must be able to be applied at once. Individuals and communities must have a role in the research process and must have a forward-looking or integrated vision, that is, the integration of more than three or four academic disciplines.[2]

Figure 6-2: A comparison of traditional thinking (left) and systems thinking (right)[3]



6.2.2 Types of research involving multiple disciplines

Research involving more than one academic discipline can be divided into three types: multidisciplinary, interdisciplinary, and transdisciplinary.

Multidisciplinary: With this method, researchers from many disciplines conduct joint research on a single topic. They divide the work explicitly according to the abilities of each individual. For example, an engineer or a scientist would study the technical impacts, an economist would study the economic impacts, social scientists would study the social impacts, and a lawyer would study the relevant legal aspects. The results of the research would be written up separately, in individual chapters. Those chapters would then be brought together as part of a single publication. The problem with this scenario is that the researchers from the different disciplines write up their results each in a different direction. A reader of the research report would not be able to identify an appropriate policy direction.

Interdisciplinary: Using this method, researchers from many disciplines conduct research together on one topic. During the first phase, individuals separate and conduct studies in their own academic area, then they present their preliminary research results to the group. But rather than just collecting the various chapters together into a book, there are joint meetings during the second stage (or potentially subsequent stages) to analyze the impact the results one discipline would have on the other disciplines. For example, if the impacts identified by the technical engineer would have negative economic and social impacts on some portions of

society, the social side would have to design a strategy and legal plan to help attenuate those economic and social impacts. That is, there have to be discussions among the members of the research team which strive to integrate the results of the study in each area. The results will not be individualized, with each person moving in his own direction. Following this iterative discussion process, the research results provide clear direction for use in identifying appropriate paths for development of policy.

Transdisciplinary: Using this method, researchers from many disciplines conduct research together on a single topic. Not only do they discuss the overall situation to be investigated, but at the outset they work together to establish the key questions for research. They then conduct the research together. That means when they take action, they do so together as a team; the group reviews the same data; and they continually exchange ideas. They act as if they were a single individual but with many bodies. They help each other think; they regularly challenge each other with new questions. They try to answer the questions which are in their own areas of expertise, then work to join all the answers together. Then they still have to surmount the barriers posed by the questions or concerns of co-researchers from other disciplines. When they reach a point where the entire team is satisfied, they will have a robust answer to the research questions, not just an arguments across the table as can happen with interdisciplinary research. This method is a distillation of many disciplines working closely together over the entire duration of the research effort.

6.3 The EcoHealth Approach in Practice

Transdisciplinary research is a key feature of the EcoHealth approach. It has features which are superior to other types of integrated research. That is, every discipline must work together from the outset, including analysis of the problem, exchanging ideas, and working as a team throughout the research process. That procedure means that every discipline truly has a role to play in solving the problem, and the methods for solving the problem will be accepted by all the participating disciplines. The challenge for actually applying this method of research in a given situation is that it requires highly skilled leadership which can attract experts from other disciplines to join the team and to motivate the team to merge their diverse bodies of knowledge.

Among the key characteristics of an effective transdisciplinary team are individuals from different disciplines who are open minded, willing to learn together, and willing to acquire and integrate knowledge from academic areas outside their own realm of expertise.

An example of integrated activities to control Avian Flu

Thailand first experienced an epidemic of avian flu during the first half of 2004. The Livestock Department, in their role as the lead government agency, made the decision to control the epidemic by following international guidelines. It was announced that all fowl within a five kilometer radius of an outbreak were to be killed, and that transport of fowl from within a fifty kilometer radius of the outbreak was prohibited. These restrictions had a negative impact on the willingness of fowl-raising farmers to comply. They felt the restrictions were not in line with the Thai way of raising fowl, and that communities had no role in the implementation of the restrictions. The result was that farmers surreptitiously moved their birds from within the restricted areas. Based on the experience with that reaction to the restrictions, the Livestock Discipline changed its method of controlling the spread of the disease, destroying birds only in the immediate area where the infection occurred and burying the carcasses nearby. The Livestock Department also publicized the program among farmers and communities so they would understand the disease situation and to encourage them to work together with Public Health officials. In addition, a provision was added to pay compensation to farmers whose birds were destroyed. The emphasis was on creating understanding among farmers and communities and making them aware of the danger of Avian Flu, including the capacity to infect humans. Following these modified efforts, the Livestock Department received increased cooperation from famers and communities. The successful result has been that Thailand has had no cases of Avian Flu since 2008.

Participation: With traditional research methods, the researcher is both the individual who identifies the problem and the person who seeks a solution to that problem. Sometimes the direction the researcher has identified for solving the problem is not implemented because stakeholders affected by the problem have not have a role in the process. With the EcoHealth approach, all stakeholders, especially those affected by the problem, e.g., members of a community, have a role in the conduct of the research including analysis of the problem, collection of data, analysis of results, and summarizing the results. That is, the stakeholders have a role and provide direction in every step of the research process. The end result is that the solution to problem will be not only technically correct but will also be appropriate to the context of those affected by the problem. Problem solving research in which all stakeholders play an active role is known as Participatory Action Research or PAR.

Traditional research is researcher centered. The body of knowledge belongs to the researcher, normally someone from outside the local community where the problem exists. In effect, the research is conducted to gain knowledge about the problems of others. Often the result is that the research findings are not used to solve the problem. Participatory action research, in contrast, is community centered. Researchers and members of the community work together to understand the problems of the community, problems which are identified and defined by the community. Similarly, solutions to the community's problems are developed collectively. All members of the community work together to solve the problem and all shares in the benefits of having solved the problem together. This method can be significantly more effective than traditional research methods.

There are five important principles of PAR: (1) Recognize the importance and respect the knowledge of individuals affected by the problem, particularly those in the local community. Accept the knowledge of members of the community, including the means of obtaining that knowledge and using knowledge in other areas that are different from that of the researcher. (2) Improve the ability and potential of members of the community through promoting the upgrading and development of their ability to analyze and synthesize the nature of their own problems. (3) Provide appropriate knowledge to individuals at the community level by

making it possible for them to receive the knowledge which emanated from within their own society, to understand the meaning of that knowledge and make appropriate use of it. (4) Take an interest in the criticisms of members of the community. Employing participatory applied research methods will help reveal questions relevant to the people's own problems. (5) Liberating thinking using participatory applied research will help members of the community of all levels be able to freely express their ideas.[4]

Sustainability: Conducting research using the EcoHealth approach anticipates that there will be change and that the change will be sustainable, especially the environmental, social, and economic aspects which are by nature continually changing. For that reason, problem solving requires an awareness of how things are interrelated and how they impact each other. For example, a program to reduce poverty in a remote area by promoting the raising of livestock such as chickens or pigs would have to consider the environmental impact of raising those types of animals, e.g., bad smells bothering the community or animal waste being deposited in the location of the community. The amount farmers would need to invest at the outset would have to be considered. In addition, it would be necessary to consider the location and size of potential markets where farmers could sell their animals. That is, it is necessary to evaluate all aspects related to livestock raising. If the farmers raise animals but cannot sell them, or if the selling price does not cover the cost of production, then promoting livestock raising would not sustainably reduce the problem of poverty.

Social and gender equity: In the process of conducting research using the EcoHealth approach members of the local community have a role in solving their problems. It should be borne in mind, however, that members of a community are diverse. For example, they differ in terms of vocation, social situation, and gender. This diversity must be addressed if solutions to problems are to be both successful and sustainable.

An example of a problem arising from inequalities in a society[5]

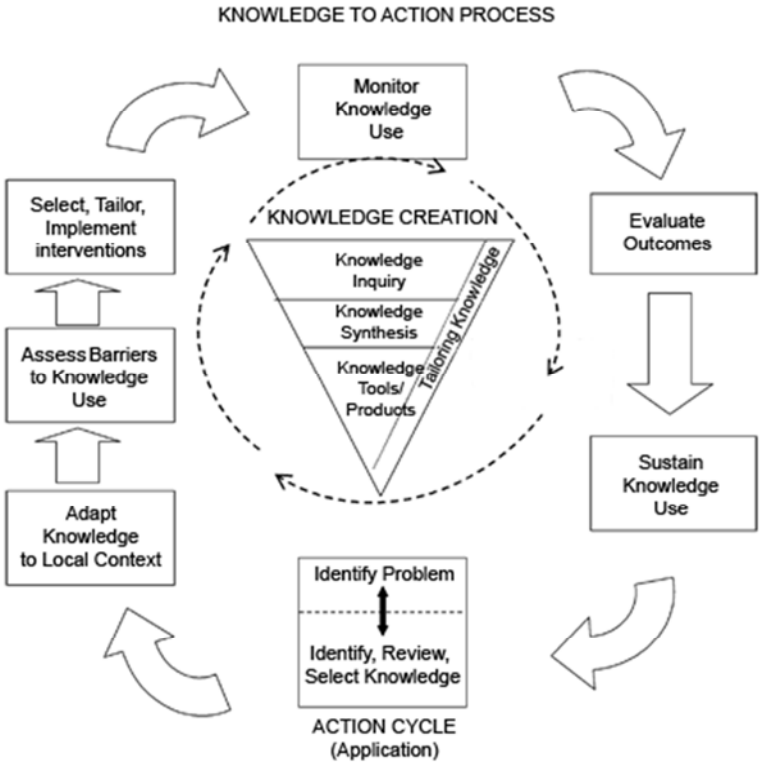
Health problems can result from differences in gender and social position. In the case of the Karen community in Khliti Lang Village, Thong Pha Phum District, Kanchanaburi Province, the village was impacted by a lead mine which was releasing polluted water into the Khliti stream, causing villagers who used water from the stream to become ill. In addition, livestock, including cattle and buffalo, were dying in a way that had never been seen before due to consumption of water from the polluted stream. That stream was found to be polluted with high levels of lead. It was not possible to use the water for agriculture, for watering livestock, or for human consumption. The Karen of Khliti Lang Village registered a complaint with a government agency and sued in court to have the mine cease operation and to have compensation paid to villagers for their losses. It took more than ten years for the villagers to win their court case. The mine finally ceased operation and had to pay compensation to the villagers. However, the lead pollution in the stream and the surrounding environment will have a continuing health impact. In addition, there is pressure to reopen the mine, without consideration of the impact on the villagers. This situation reflects the problems of people at the margins of society who may not receive appropriate attention from government agencies.

Knowledge to action: Implementing activities to improve the health and quality of life of members of a community by integrating the knowledge of different disciplines is the goal of the EcoHealth approach to research. Using the knowledge gained from research to promote change is known as Knowledge Translation (KT). That integration of knowledge should occur at all levels, from the policy level to the working level, and should involve members of the community. When that happens, it will result in change throughout the system.

Guidelines to knowledge translation (KT) include: (1) identify the area of a need or gap (or an opportunity), (2) identify the ultimate outcome

of interest, (3) assess the current state of knowledge in the area of interest, (4) describe the context within which the knowledge will be used, (5) identify possible mechanisms and opportunities that will enable movement toward the target outcome, (6) identify intermediate outcomes that will move knowledge system towards the target outcomes, (7) select and implement strategies to advance the use of research knowledge, and (8) assess progress and update approach as needed.[6]

Figure 6-3: Translating knowledge into action in the EcoHealth approach[7]



In summary, EcoHealth takes a different approach to research and traditional problem solving. It can be said that EcoHealth largely discards many traditional research methods. It represents a new approach to research which mobilizes various disciplines to work together from the outset of a project and gathers together relevant individuals both from

upper levels (e.g., policy makers) and the owners of the problem (e.g., people from a community where the problem exists). All work together on all facets of the research including evaluation of the problem, identification of the desired objective, specifying the method for solving the problem, and carrying out problem-solving activities. Throughout the process, there are periodic reviews to insure that the direction for solving the problem is feasible and sustainable.

The EcoHealth approach requires that the acquisition of knowledge must consider the overall picture; must employ systems thinking; must view problems from a collective perspective in order to see the connections between various components in the systems; must employ integrated work methods and work across disciplinary boundaries from the beginning; and must give relevant stakeholders a role, affording all equal importance. The research is not done exclusively to understand a problem. Rather, it is intended to lead to a solution of the problem through application of the newly acquired knowledge. The problem solution should focus on sustainability through effectively applying the important aspects of the EcoHealth approach.

An example of community problem solving using the EcoHealth approach

In 1994, when a government dam construction project for water storage began, the Rasisali Dam caused periodic flooding over a large area of forest land where a community resided and where they made their living raising cattle. Because of the flooding, families were gradually forced to sell off their cattle and buffaloes at low prices as there was no longer sufficient land to raise their traditionally large number of animals. That situation motivated the residents of Don Raed Sub-district, following a local community leader, Mr. Boonmee Sopang, to seek a solution to the problem. They used research of the local area as the vehicle to seek a solution. The research project was called, "Study of cattle and buffalo raising practices appropriate to the Pa Tham forest, Don Raed Sub-district, Ratanaburi District, Surin Province." The project received support from the National Research

Council, and implementation was led by Mr. Boonmee.

The research team and the residents of Don Raed Sub-district jointly sought an appropriate solution to the problem of raising cattle and buffaloes in the Pa Tham community forest. The research process used discussions as a forum for obtaining in-depth understanding of the situation from the target group, e.g., community leaders, village headmen, the Tambon [Sub-district] Administrative Office (TAO), and groups of cattle and buffalo raisers. Finally, a plan for raising cattle and buffaloes was developed. The plan included a pilot project involving 15 cattle and buffalo raisers test a system for obtaining food for animals when fodder was in short supply due to periodic flooding of the Pa Tham area. The solution was to establish fields for pasturing livestock, both on the private land of individuals and on community land. Traditional methods of preventing and treating diseases were tested by planting medicinal herbs from the Pa Tham forest in demonstration cattle-buffalo herbal medicine gardens in the area around the local school. Rice hulls were tried as a method to ameliorate the wet muddy conditions in cattle and buffalo corrals.

The results of the research helped the community to understand the event which had occurred in their community. The cause of the event was analyzed by reviewing data and learning to solve problems using the community's existing resources and abilities. In addition to searching for a community-based solution, government agencies and community organizations together helped provide extension services to the cattle and buffalo raising group. For example, the Livestock Development Office in Ratanaburi District, Surin Province, provided support in the form of animal feed and improved breed animals. The TAO of Don Raed provided 90,000 baht in financial support for the project to promote raising cattle and buffaloes in Don Raed Sub-district.

6.4 What can I do

It is well accepted that research which uses the EcoHealth approach is effective in successfully applying the results to solving problems because the research is comprehensive, including, e.g., socio-economics, public health, livestock, policy makers, and workers, which makes it possible to achieve sustainable solutions to problems. The EcoHealth approach offers challenges for both researchers and policy makers.

6.4.1 Challenges for researchers

With traditional research methods, the researcher identifies the problems and seeks solutions for those problems. The result is that sometimes the direction for solving a problem does not actually result in a solution when it is implemented due to a lack of participation on the part of the group affected by the problem. In using the EcoHealth approach, it is necessary to remove and discard the traditional methods of research. That is, individuals from many disciplines must work together. Stakeholders must have a role, especially those directly affected by the problem. Thus those who have a role in the activity must be open-minded about learning about academic areas which are different from their own area of expertise. They must be ready to learn together, to look at the same problem, and to work together with the community and government officials.

6.4.2 Challenges for policy makers

With the traditional research framework, policymakers are only recipients of research results. They do not have a role in the research from the outset, which means they often do not have a full understanding of the problem. The policy makers establish problem-solving policies by themselves. The actual stakeholders including people in the affected communities have no opportunity to express their ideas. They have no role in determining the directions for solving the problem or for insuring that the solution is sustainable. It is necessary for the policy makers to have a role from the beginning so they truly understand and are really aware of the problem. The individuals who can make that happen are the researchers who must encourage the involvement of the policy makers. That involvement could consist of providing periodic reports on the activities and

progress being made, including descriptions of how stakeholders are involved in the research process. In addition, policy makers can inform researchers of policy constraints, so those constraints can be factored in to the research process. The policy makers themselves should be encouraged to keep an open mind and to listen to the ideas and the research results so they can use that knowledge in establishing appropriate policies to respond to a problem.

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