CHALLENGES AND STRATEGIES FOR IMPLEMENTING THE ECOSYSTEM APPROACH TO HUMAN HEALTH IN DEVELOPING COUNTRIES

Reflections from Regional Consultations

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Challenges and Strategies for Implementing the Ecosystem Approach to Human Health in Developing Countries

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Introduction

Canada's International Development Research Centre (IDRC) and the United Nations Environment Programme (UNEP) are working together to improve human health through better stewardship and management of the earth's ecosystems and our natural resources. While IDRC's Program Initiative Ecosystem Approaches to Human Health (Ecohealth) constitutes a bridge between a strategy for integrated management of the environment (healthy ecosystems) and a global, ecological approach to promoting human health, UNEP's mission is to provide leadership and encourage partnerships in caring for the environment by inspiring, informing and enabling nations and people to improve their quality of life without compromising that of future generations.

The ecosystem approach to human health offers an unequaled opportunity to promote human health through an enlightened approach to management of the ecosystem. Ecosystem management relates to natural and environmental resources, of course, but it must also take account of all the many anthropogenic components, by integrating the social, economic and cultural factors pertaining to the living environment. In this publication, the Ecohealth framework is used to analyse the links between ecosystem and human health vis-á-vis three stressor situations: intensive agriculture, mining and cities. While different, these settings do have some commonalities: they present potential environmental risks as well as benefits to communities. At the same time, finding sustainable solutions requires community involvement.

This publication is devoted to promote the Ecosystem Approaches to Human Health concept and to disseminate the main conclusions of three international consultations held in 1999 and 2000 and sponsored by multiple international agencies and regional institutions. In the first three chapters, the authors introduced complementary perspectives, discussing the main conceptual and methodological challenges that are essential to the Ecohealth paradigm. While the first two papers refer to global issues, the third paper is devoted to the use of the Ecohealth approach to promote a better understanding of the ecological and social patterns of communicable and tropical diseases. Chapter 4 includes selected abstracts presented at one of the meetings. While Chapter 5 summarizes the discussions of the working groups of the three meetings, Chapter 6 focuses on the main conclusions and final reflections emerging from these consultations.

The meetings brought together participants from academic institutions, non-governmental organizations, international institutions and national governments to discuss the key challenges for implementing an Ecosystem Approach to Human Health concept.

In Rio de Janeiro, Brazil, the meeting was sponsored by the IDRC, UNEP, the Pan American Health Organization (PAHO) in Brazil, and the National School of Public Health of the Oswaldo Cruz Foundation (ENSP-FIOCRUZ), the host institution. Participants discussed the implications of using an ecosystem approach to human health in order to understand and prevent communicable diseases. A series of Panels and Working Groups analysed the multiple associations between the disruption of agro and urban ecosystems throughout the Americas and increases in the occurrence of tropical diseases such as malaria, dengue, Chagas and leishmaniasis. Sessions were devoted to the analysis of social, demographic and ecological dimensions at various scales, and the implications for ecosystem health of development projects. A second round of case studies analysed the interrelationships between ecosystem disruption and emerging and re-emerging diseases. A final session discussed appropriate to study integrated policy options for prevention.

Participants agreed on the urgent need for collaborative efforts to support systemic and interdisciplinary research, as well as participatory and intersectorial strategies to foster better management of stressed ecosystems. Specific ecosystem methodologies were proposed to deal with the expansion of several tropical and emerging diseases in developing countries. The ecosystem approach was seen to be central to our ability to move beyond the management of specific diseases and to promote sustainable human health.

In Hull, Canada, IDRC and UNEP co-hosted a consultation that took place during the Canadian Conference of International Health and was devoted to explore the Ecosystem Approaches to Human Health concept and the application of this concept in agricultural, urban and coastal environments. Participants agreed that an Ecosystem Approach to Human Health requires:

- acknowledgement of the complex and often unpredictable relationships between the living and non-living components of our ecosystems;
- transdisciplinarity among diverse academic and applied professions;
- an emphasis upon the local community's understanding and knowledge of health and ecosystem management;
- an understanding of the differing roles of women and men in achieving and preserving health; and,
- a promotion of a holistic view of human health and environmental sustainability*.

The working groups identified four key challenges for an Ecosystem Approach to Human Health (a brief synthesis of these challenges is included in chapter 5.2.):

- finding a shared vision;
- assuring community access;
- gaining credibility; and,
- measuring success.

In Caracas, Venezuela, IDRC and the Association of Amazonian Universities (UNAMAZ) co-hosted a Regional Workshop in which participants from Latin America discussed the strategies to respond to the main challenges that were identified at the International Consultation that took place during the Canadian Conference on International Health in Hull, Canada.

The working groups discussed the regional thematic priorities and most relevant research

issues with regards to the following "stressors":

- Urbanisation processes;
- Mining; and,
- Intensive agriculture

Participants called for stronger institutional links to develop, disseminate and implement an ecosystem approach to human health in Latin America and the Caribbean.

The models used for illustrating and conceptualizing the relationship between the environment and human health have advanced considerably over the past century. By sharing the reflections that took place in these meetings, the aim of this publication is to contribute to move forward in the development of this new approach.

In a sense, an ecosystem approach to human health is simple. It follows the connection between people's activities and their impact on the environment, and between the state of the ecosystems and people's health. In another sense, an ecosystem approach to human health is complex. It draws on science and technology as well as traditional knowledge to grasp a web of causes and effects linking ecosystems and human health.*

Roberto Bazzani
Gabriella Feola

* From "Ecosystem Disruption and Human Health". A Joint IDRC/UNEP Consultation at the Canadian Conference of International Health. November 1999.

CHAPTER 1

Ecosystem Approaches to Human Health*

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Introduction

In the course of history the human social system has become so influential and so entangled in the natural or ecological system that society can no longer act without more regard for nature. Human social systems have both local and global impacts that can impair the quality of life, predispose to disease and even threaten life support systems. It has become essential to try understand our world as a complex socio-ecological ecosystem and take such steps necessary to manage human affairs in ways that promote not only the health of people but also the planet. Reductionist science by itself can not deal with the complexity of this task. The ecosystem approach is one means to this end since it recognizes the interconnectedness of biotic and abiotic elements of the environment and effectively derives from a management perspective. Simply stated, managing for human health must be embedded in the wider pursuit of ecosystem health.

The Operative Meaning of Health

Health is a logical and indeed universal goal for the ecosystem approach to managing human affairs. The wider application of the idea of health to ecosystems is consistent with contemporary views of what constitutes human health as articulated by the WHO; health is not only the absence of disease but also *the extent to which an individual or group is able to on the one hand to realize aspirations and satisfy needs and on the other to change or cope with the environment.* It is instructive to note that the notion of capacity is at the core of understanding health in this definition. An attractive simple definition of human health is the capacity for living.

Health embodies the two critical elements which are at play and need to be balanced in the present environmental crisis. Specifically they are preserving the ecosystem's capacity for self-reorganization and renewal on the one hand and achieving reasonable human goals on the other. While informed by science, health is not a science *per se*, in distinction to medicine. Health is normative in character because it deals with human goals. As such it can adapt to changing circumstances.

The capacity for self-organization and renewal in the context of ecosystems has been termed "integrity". To some this term describes

* This paper was originally published in *Reports in Public Health*, V. 17 (supplement), pp. 69-75, 2001.

ecosystem function in the pristine state. Given that such conditions are extraordinarily rare or absent from our present world, in practice it is an ideal or benchmark against which to judge the effect of human activity or natural disturbance. Karr (1996) has defined "biological integrity" as – the biological context and condition that is the product of evolutionary and biogeographic processes at a place where human influence is minimal.

Some believe that ecological integrity incorporates health as a feature. In this context the notion of health seems to denote largely freedom from degradation (disease), a limited view of health that is passé. Therefore it seems preferable to subsume integrity within the concept of health rather than *vice versa*.

The term integrity can also be used to describe the ability of social and economic structures to maintain their organization

Some scientists, policy makers and natural resource managers are finding the concept of ecosystem health a useful overarching goal for ecosystem management. They recognize that the pursuit of health accommodates the need for the integration of natural and social sciences with human values and extends in its application from individuals and populations to multiple populations of species, namely ecosystems. Health is also useful in that it is widely understood among the public. Health speaks to citizens.

The Ecosystem Approach

Ecosystems can be conceptualized as a nested spacial hierarchy (holarchy) of geographic units (holons) all embedded within the biosphere. Ecosystems have structure and function. Each level of the ecosystem hierarchy displays emergent properties. Their geography is sufficiently homogeneous to be ecologically consistent, e.g. a watershed. Ecosystem function reflects the complex interactions of physical and biological components that maintain ecosystem organization. Because of their complexity, which is unknowable in the final analysis, ecosystems are models or abstractions of reality chosen or defined to serve human purposes.

Ecosystems evolve over time, albeit they may have several relatively stable preferred states. They are to a degree unpredictable and can undergo catastrophic change under appropriate conditions. The system may be transformed into one with new characteristic features (attractors). Because of this unpredictability ecosystem health management has to be adaptive (Kay, 1999, Murray et al., 1999). Nonetheless the determinants of ecosystem health are amenable to scientific study and management for preferred outcomes a desirable process.

Ecosystem based health management recognizes and takes account of the connectivity among different components within and among ecosystems. In some cases the connections are important to ecosystem function and stability (e.g. keystone species). In many cases the connections are much less determinative and hence of less importance to management decisions.

Because ecosystems have structure they can be mapped, so it is not surprising that Geographic Information Systems (GIS) is an important technology in environmental management. Maps have extraordinary power to screen out unnecessary information and help untangle messy reality and facilitate a focus on key features of an ecosystem.

Modeling ecosystem function is more difficult but information and computing technology has provided powerful tools to tackle this task. The use of "frameworks" to simplify and identify key

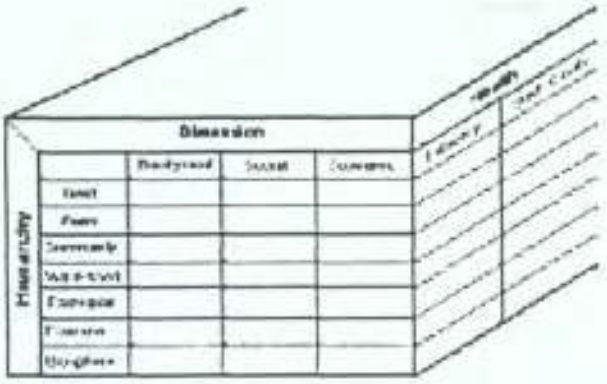

Figure 1. A conceptual framework, in this case an agroecosystem, illustrating a typical ecosystem hierarchy, its biophysical, social and economic dimensions and the essential parameters of health, namely, integrity and sustainable goal achievement. The temporal dimension can imagined by replicating the diagram in time. Such a framework serves to simplify the complex relationships that must be considered in management for ecosystem health (vanLeeuwen et al., 1998).

relationships within and between ecosystems is helpful in understanding ecosystem functional relationships in pursuing management goals (Figs. 1 and 2). However modeling ecosystem function would seem a particularly challenging task in the quest to identify those circumstances in the ecosystem which are the principal determinants of human and ecosystem health.

The "pressure-state-response" framework is another means to focus research, analysis and management on ecosystem problems (Pieri et al., 1995). In this methodology a "stressor" is selected have conflicting views, and 4) the high stakes in environmental decision making.

Participation can be a very difficult process! Some reasons are: conflicting priorities and or cultures within or between communities; undesirable impacts occurring at other levels in contiguous or other levels of the ecosystem hierarchy; social structures may be inadequate to facilitate consultation with stakeholders; governance structures that are not congruent with geographical ecosystems (e.g. a watershed.); and, possible difficulty with legal and political legitimacy. In ecosystem management there are winners and losers and success may depend on reasonable compensation for the losers. Also participation would seem to drive development projects towards general community development which may not be congruent with the objectives of specifically funded projects. Bureaucratic barriers between agencies is another obstacle to the kind of integrated action that is necessary in managing for ecosystem health. Given these obstacles it is not surprising that IDRC scientists believe that "ecosystem health proponents have identified community participation as a requirement to the approach but have yet to identify explicitly the theories and methods they will use to achieve this goal" (IDRC, 1997).

Research and management for ecosystem and human health is basically about helping communities achieve reasonable and sustainable goals. The long term success of managing for the health of ecosystems and improving human health ultimately depends on "empowering communities enlightened by knowledge" (Forget, 1999).

Social capital and overcoming poverty

Participation helps build social capital, an essential ingredient in overcoming poverty and enhancing development (World Bank, 1999). While agencies like the World Bank are still struggling to determine ways of measuring social capital it has made some attempt at its definition. It has been defined as "the norms and societal relations imbedded in the social structure of society that enable tenable people to coordinate action to achieve goals". Institutional structures that build social capital tend to be horizontal rather than vertical and is in keeping with the kind of community involvement associated with the ecosystem approach to health management. The building of trust among the players is another

important ingredient in this process. A civic community is not only the precursor and guarantor of good governance but also the key to sustained socioeconomic development (Serageldin, 1996) and the achievement of health goals.

Ecosystem Links to Human Health

In the period when IDRC was laying the intellectual groundwork for its Ecosystem Approaches to Human Health Program Initiative, de Sauvigny (1995) postulated "the hypothesis underpinning the ecosystem approach to human health is that improved appreciation of the linkages between human activity, ecosystem conditions (e.g. natural or anthropogenic ecological degradation), human health and public policy will provide a better understanding of the working of a system and the points of most effective intervention, be they health or other interventions". The IDRC Program is a test of this hypothesis.

Disease and health have been considered classically as dependent on the interaction of host, etiologic agent and the environment. This classic triad does not go far enough. All three elements in any particular situation are linked to the biological physical, social and economic dimensions of the ecosystem hierarchy in which they are embedded (Fig. 2). Human health interventions may be compromised if ecosystem linked determinants of health are not understood and managed.

There are many links between human health and ecosystem state and function which can serve to focus research and management. Biophysical links may occur in the immediate environment, e.g. mosquito vector breeding habitat or source for harmful pollution, or to events in the remote biosphere, e.g. ozone depletion leading to local effects from harmful UV radiation. Socio-

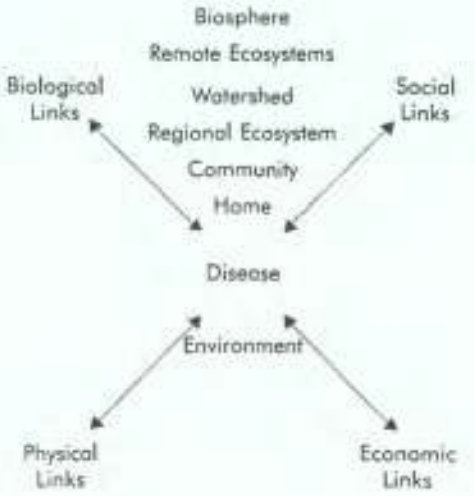

Figure 2. An "onion skin" illustration of a conceptual ecosystem nested hierarchy which provides a framework for applying an ecosystems approach to a problem. In this example the framework guides the analysis of ecosystem relationships and links to the classic triad of host, agent and environment, which is the point of departure in understanding disease causation and control. Also environmental stressors such as mining and agriculture can be analyzed by in this framework, in which case the activity in question is illustrated in the core of the diagram rather than disease (modified from Mergler, 1999).

economic links can vary from things like personal income, sexual behavior and crime at the local level to factors like trade policies and the economics of pharmaceutical production at the global level.

Ecosystem links to human health can be approached in many ways. IDRC has focused its research program on the links associated with landscape disturbance in agriculture, mining, and urbanization. General examples of other links are any impairment to ecosystem function that affects water or air quality; and activities that impact vector borne-disease. Poverty is another major and often confounding factor in many ecosystem approaches to human health.

When landscape disturbances cause ecosystems to lose their integrity, i.e. the capacity for renewal, society loses numerous "nature's services" that are essential for human welfare, or in the extreme,

human existence. While the value of natural products like food and lumber have been incorporated into our economy, most ecosystem services have not. Recently the value of these services world-wide have been estimated to be 33 trillion dollars or nearly twice the world's annual GDP (Costanza R, et al., 1997). Some of the most important are regulation of atmospheric composition, climate, and hydrological flows. Others are biological control of populations, nutrient cycling, soil formation and erosion control and sediment retention, waste treatment, purification of water, and a diverse gene pool for medicine and agriculture. These services can no longer be taken for granted and the development of public policies and resource economics must take them into account. If custodians of land the world over are to forfeit economic advantage to conserve ecosystem services for our global society, as they inevitably must, it will be essential to provide equitable compensation.

The Ecosystem Health Management Process

Strictly speaking it is impossible to manage ecosystems in the full sense of the word because of their unknowable complexity and because of their sometimes unpredictability. However, in practice, management can attempt to direct human activity for preferred ecosystem states but it needs to be *adaptive* in order to adjust to unexpected change and new knowledge. The scientist's role in this management process is to inform the stakeholders about possibilities and options in an ongoing dialogue (Kay, 1999, Murray et al., 1999) that can respond to change and new circumstances be they biophysical or socioeconomic. This base of information provides for resilience or adaptability.

The principal features of an adaptive management process for healthful management of ecosystems are: ecosystem assessment; ongoing participation of stakeholders; identification of indicators; development of a management plan; and implementation, monitoring and adjustment (Gaudet et al., 1997; VanLeeuwen et al., 1998; Murray et al., 1999).

Assessment

Scientific assessment of the ecosystem in question involves defining, describing and evaluating the ecosystem (both ecologically and scoioeconmically), preparing the conceptual model and establishing a data-base. Scientists operate in a *trandisciplinary* mode and consult in a meaningful way with the community. Description focuses on defining relationships that connect the ecosystem with higher level systems in which it is nested and lower order systems or communities of which it is comprised.

Participation of stakeholders

The assessment exercise is performed in the context of the stakeholder goals that are to be pursued. It must select those factors that are most germane to the goals of the enterprise and incorporate perspectives from different disciplines. It must integrate links in a socio-ecological framework.

These goals must re reasonable if they are to be sustainable in the long term. Stakeholders need to be adequately informed by scientists and based on trust in both scientists and the social structure in which they operate (live). Issues need to be resolved.

Selection or development of indicators

Once goals and operating objectives are established appropriate *indicators* need to be selected or developed and methods for their measurement established. Management must be

guided by the appropriate indicators to achieve goals. Two old aphorisms are worth keeping in mind: "you can't manage if you can't measure" and "when you measure performance, performance improves". The selection and development of indicators is one of the important research domains. Different performance indicators may need to be tailored to the specific needs of stakeholders, policy makers and scientists..

Preparation of health management plan

A management plan will address areas like policy interventions, indicator development, measurement, assignment of responsibilities, accountability. governance and communication strategies.

Implementation, monitoring and adjusting

Finally, the implementation of the management plan involves monitoring priorities in relation to objectives and continuing the interaction between management governance agencies and stakeholders, so as to facilitate adjustment to evolving circumstances. Management will include an ongoing research component.

Adapting Education to the Ecosystem Approach

Unfortunately our universities and science in general have been largely reductionist in their approaches to pedagogy heretofore. University graduates, including those in the health sciences, are inadequately prepared to wrestle with the inherent complexity of environmental and ecosystem health issues and problems. The pedagogy involved in teaching system's thinking is not served by current reductionist approaches of the traditional disciplines. Perhaps the only feasible approach to transdisciplinary education is to adopt a much more problem or case oriented curriculum in which students grapple with real ecosystem health problems, an approach familiar to many medical educators. Students must learn how to wrestle with complexity and integrate the relevant disciplines of the sciences and humanities that are involved in coming up with solutions or coping strategies. It would also be useful if students learned to interact with those from other disciplines that will have a stake in managing for ecosystem health, for example with students planning careers in public health. One can anticipate that courses with a more conventional format could provide training in useful techniques such as GIS and modeling and essential disciplinal knowledge such as ecology.

Conclusion

The ecosystem approach is a highly desirable, if not essential, context in which to promote human health at a time when environmental degradation has become inextricably linked to the long-term well-being of humankind.

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CHAPTER 2

An assessment of risks and threats to human health due to the collapse/degradation of the ecosystem

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"A healthy population and a healthy environment are social and economic good. We cannot think of a healthy population without a healthy environment and ecosystems."

KLAUS TOEPHER
Executive Director
United Nations Environment Programme
From the Statement at the Third World Health Organization
The Ministerial Conference on Environment and Health, London 16-18 June, 1999

Human dependence on the natural environment is evident as the ecological systems provide humans with the goods and services essential for survival and good health. Consequently, changes in the environment pose serious threats to human health.

In recent years, there has been a growing concern among the scientific community, business and public sector about the potential links between the collapse/degradation of the ecosystem and impacts on human health. This study was conducted to assess the status of scientific knowledge in this field It also attempts to provide a scientific explanation of the consequences of environmental change and deterioration of the ecosystems, in particular, on human health. Health problems resulting from ecosystem degradation vary dramatically from region to region, reflecting geography, climate, and region's level of economic growth and policy preferences. The study analyzes global, regional, and national trends, which may provide a scientific basis for decision-making in the formulation and implementation of environmental policy. There is also an intention of this study to show the importance of raising public awareness about the critical need for a more holistic understanding of the links between ecosystem well being and human health.

The analysis indicates that most of the health impacts due to degradation of the ecosystem occur as a result of the combination of environmental processes that create the conditions conductive to diseases. There are invariably intermediaries connecting the change in the ecosystem and human health.

The study does not judge any individual country, nor attempts to provide direction on how to

resolve human health problems. However, it is becoming clear that there is a need and an opportunity to combat global and regional health concerns due to environmental degradation.

There are no separate realms in nature. The health and very existence of humans cannot be seen separately from the natural environment, which provides both sustenance and hazards. However, not all risks and threats to the health of the population arising from the degradation of the environment are the result of human activities, as many of the hazards are an intrinsic part of the ecosystem. Thus, the challenge lies in maintaining people's health while simultaneously improving the health of the ecosystem as a whole.

The environmental threats to human health can be divided into two main categories: (1) lack of development – inability to cope with natural hazards and/or lack of access to essential environmental resources, and (2) unsustainable development – ecosystem collapse/degradation (WRI, 1998). So, major causes of environmental changes, as well as characterization of environmental hazards – biological and chemical – are critical items to be analyzed.

The goal of this study is to establish whether there are strong and direct links between ecosystem collapse/degradation and human health. Therefore, the main objectives are the following: (1) to review key emerging and re-emerging threats to human health on global and regional/local levels due to the ecosystem collapse/degradation, (2) and to analyze the efforts undertaken by others to establish causal linkages between ecosystem degradation and human health.

This study also intends to show the importance of raising public awareness about the critical need for a more holistic understanding of the links between ecosystem well being and human health. It is the intention of this study to assist in increasing people's understanding of the linkages between the degradation of the ecosystem and human health.

Environmental health refers to conditions and characteristics of the environment, which affects the quality of population health. It is becoming obvious that ecosystem ills are increasingly the root cause of many of the sufferings within the human community (Rapport, 1998). The impoverishment of human health due to the degradation of the ecosystem may be described as an "illness resulting from disrupted internal balances due to external stresses" (Odum, 1995). The consequences of ecosystem collapse are often human breakdown in terms of biological, physical, social, and economic dimensions (Rapport, 1998). Discovering original and improved ways to assess ill health and dysfunction in the ecosystem, which represent the basic functional unit of the natural environment, are the emerging goals of the environmental-health interface. Because human activity sometimes results in unpredictable outcomes, a significant element of health is to promote flexibility, or adaptability, in the face of unexpected transformations and uncertainty.

The status of human health is a reflection of a whole variety of complex interactions between the internal biological system and the total external environmental system. However, certain population groups, either because of their lifestyle, occupation, location or consumption patterns, are differentially vulnerable to specific health risks and threats. This, in combination with differential hazard exposure, may put the group at increased risk (TERI, 1998). Thus, health effects of one particular change in the environment should be assessed within the context of other coexisting environmental effects and occurrences, such as rapid urbanization, human population density and increasing

mobility, increasing movement of produce, resources exhaustion, desertification and pollution.

As a possible result of environmental change during the past 20 years, about 30 new diseases (e.g., Legionella, HIV/AIDS, ebola, hantavirus pulmonary syndrome, a new strain of cholera, and a host of antibiotic-resistant pathogens) have emerged (TERI, 1998).

The sustainability of human health is the primary importance when the concept of the impact of global environmental change is applied to health issues. Indices of the sustainability of health status may be focused on the integrity and stability of the global environment's ecological systems that maintain the life and health of the population. These indices may not directly measure human biology but may assess the degree to which human biophysical needs are being satisfied by the sustainable use of ecosystem services. The indicators may include bioindices predictive of human disease risk, such as vegetation cover and groundwater levels in relation to infectious disease vectors, or the degree of the balance between population size and available resources (McMichael, 1997).

The key research issue today is the fundamental infrastructural significance to human health of the biosphere's natural systems. Thus, the potential threats and risks from the global environmental change differ from well-recognized, locally found environmental risks to health from directly acting harmful agents. Disruption of natural ecological systems endangers the health of the population by a variety of direct and indirect ways, immediate and delayed mechanisms (McMichael, 1997).

Present State of the Environments and Causes of Ecosystem Collapse/ Degradation

From a global perspective the environment has continued to degrade during the past decade (UNEP, 1997). Humans have modified approximately 50 percent of the land surface, account for more than 20 percent of the atmospheric carbon dioxide concentration, utilize over 50 percent of the accessible surface fresh water, responsible for about 60 percent of all nitrogen fixation, and the list of such impacts on the environment may continue (Rapport, 1998). The total impact of this is a significant danger to the favorable functioning of the natural life support systems, which are the major part of the ecological systems, and to the sustainability of the population health. The combination of environmental changes that creates the conditions leading to disease occurrence is also of a significant concern here.

Human activities are directly responsible for creating agroecosystems and cultural landscapes at the expense of many natural communities and the reduction in ecosystem services. Serious loss of forest quality and old-growth habitat in many temperate and boreal forests due to pollution and other injurious agents and tropical deforestation with current rates averaging about 0.7 percent per year are problems of a significant concern. Desertification and drought are problems of a global dimension that affect more than 900 million people in 100 countries, some of them are among the least developed in the world. Twenty five per cent of the Earth's land area are being affected by land degradation. Desertification is occurring on 30 percent of irrigated areas, 47 percent of rainfed agricultural lands and 73 percent of rangelands. Hydrological and ecological functions of over one-half of all wetlands have been altered due to encroachment.

Global freshwater biodiversity is declining significantly. Today about one-third of the world's population is living under moderate to severe water stress, most notably in Middle Asia and North Africa. Coastal waters are being contaminated by land-based sources, particularly by municipal wastes and cause eutrophication. Many fishery resources are classified as overexploited. Red tides have increased in distribution and frequency. Stratospheric ozone has decreased since 1979 by about 5.4 percent at northern mid-latitudes in winter and spring, and about 2.8 percent in summer and fall. The amount of spatial and temporal patterns of precipitation are changing (Watson *et al.*, 1998). These changes are beginning to have adverse consequences for human population.

There are some fundamental mechanisms and forms of ecosystem degradation that affect human health. According to Karr (1997), there are three major multidimensional mechanisms of environmental and human systems alteration:

1. Indirect depletion of ecological systems (soil degradation, water supplies degradation, biogeochemical cycles alterations, climate changes, ozone layer depletion, and water, air and soil pollution);
2. Direct depletion of non-human living systems (loss of biodiversity, renewable resources exhaustion, pest outbreaks, spread of alien species);
3. Direct depletion of human systems (epidemics, emerging and re-emerging diseases, reduced quality of life, failure to thrive in infants and children).

Environmental change and ecosystem degradation in particular are the result of many different occurrences in natural and/or man-made systems. The causes of the ecosystem collapse/ degradation can be divided into two major categories: natural and human-induced.

Naturally provoked changes in ecosystems are the following, but may be not limited to:

- Changes in climate (e.g., ocean functioning, cosmic radiation).
  Sea level rise due to the climate change may lead to increased erosion in coastal zones and loss of natural protective features such as dunes and mangroves. Potential health impacts are considered to be cumulative and interact synergistically (WHO, 1996).
  Changes in climatic conditions are enabling mosquitoes and other disease carrying insects to survive and breed at more northern latitudes and higher altitudes. The distribution of species in an ecosystem may vary due to such changes.

- Natural Disasters (e.g., floods, cyclones, droughts, volcano eruptions and earthquakes).
  Natural disasters may lead to devastating consequences to both natural and man-managed ecosystems. Flooding and severe raining may cause inundation of a river flood plain and low lands as well as impair top soil layers and wash out nutrients and microelements, volcano eruptions can lead to a collapse of an ecosystem by polluting the air and covering the land surface with lava and ash and by these means destroying vegetation cover, earthquakes may lead to land degradation, and droughts may lead to the loss of biodiversity and species migration.

Human-made causes of changes in ecosystems include, but may be not limited to:

- Development and intensification of agriculture (WRI, 1998).
  The direct result of agricultural practices is the conversion of forest and grassland ecosystem into agroecosystems, which are poorer in biodiversity and consequently less stable and resistant to other interventions. Other effects include soil and water contamination with

chemicals and pesticides, land degradation, and salinization.

- Industrialization, increasing energy use and urbanization (WRI, 1998).
  Industrial development and rising energy use lead to direct changes and very often destroys the ecosystem by simply occupying the space and converting natural environments into industrial sites and urban areas. Habitat fragmentation and loss in biodiversity, alteration and destruction of vegetation cover, removal and disproportional distribution of species, air, water (fish kills and eutrophication) and soil degradation, pollution, and contribution to the climate change (greenhouse gases) are the results. Stratospheric ozone depletion is also considered to be the result of industrial development (WRI, 1998).

- Other activities (e.g., construction, forestry, hunting, fishing, recreation, etc.).
  Such activities may lead to the loss of biodiversity, habitat fragmentation, river/stream regime alteration, resources extraction, vegetation cover destruction, disproportional distribution of species, and pollution of the environments.

Impacts of the Ecosystem Collapse/ Degradation on Human Health

Human health can be a casualty of environmental degradation and change. Ecosystems that are sufficiently stable and biologically diverse tend to maintain the quality of human health. Degraded or collapsed ecosystems – aquatic and terrestrial environments – seem to have a significant impact on human health.

- *Degradation of Aquatic Ecosystem and Human Health*

  Water pollution continues to degrade freshwater and marine ecosystems, what in its turn causes millions of preventable deaths every year, especially among children (UNEP, 1998). Water affects disease in many ways, such as drinking contaminated water, contact with aquatic invertebrate, lack of water or infection through vectors (Fig 1). Greater incidence of illness due to consumption of contaminated fish and shellfish is an increasing concern. Harmful algal blooms in many coastal regions in the world cause a number of diseases, including poisoning, neurological disorders, gastroenteritis and others (UNEP, 1998, HEED, 1999). Eutrophication – a process of water quality degradation caused by excessive nutrients – is depriving lakeside residents of good water quality in many densely populated areas of the world (UNEP, 1994).
  Aquatic ecosystems such as ponds and wells, which are affected by climate change, provide breeding grounds for certain parasites and disease vectors and changes in water flow in these systems could influence the incidence of a number of diseases. Natural networks of rivers, lakes, marshes play a role in the transmission of water-related and vector-born diseases as well.

- *Degradation of Terrestrial Ecosystems and Human Health Impacts*

  Expanding agriculture, clearing of forests, mining activity, or the building of dams, irrigation schemes and unplanned urban development – activities which change the structure and functioning of terrestrial as well as aquatic ecosystems – pose a number of health concerns. These concerns may include increased exposure to toxic substances, such as pesticides, and increased exposure to infectious agents because mosquitoes would be provided with new breeding grounds, while at the same time more people would be brought into contact with them (TERI, 1998).

The loss of species and ecosystem diversity erodes genetic diversity. In addition, approximately many of the 20 000 plant species used as traditional medicines around the world are under threat of overexploitation (UNEP, 1993).

According to the National Institute of Environmental Health Sciences (USA), deforestation changes natural habitats and creates several human health concerns such as an increase in infectious diseases, depression, and alcohol abuse. These can result from deforestation and the disruption of habitats and cultures. Forest fires have profound impacts on the physical environment including: land cover, biodiversity, climate change and forest ecosystems. Health impacts are often serious. Estimates suggest that 20 million people were in danger of respiratory problems from fires in Southeast Asia (Levine et al., 1999). Deforestation may continue at high rates until more of us see the value of forests for biodiversity, potential medicines, improved environmental quality, and climate mitigation (NIEHS, 1999).

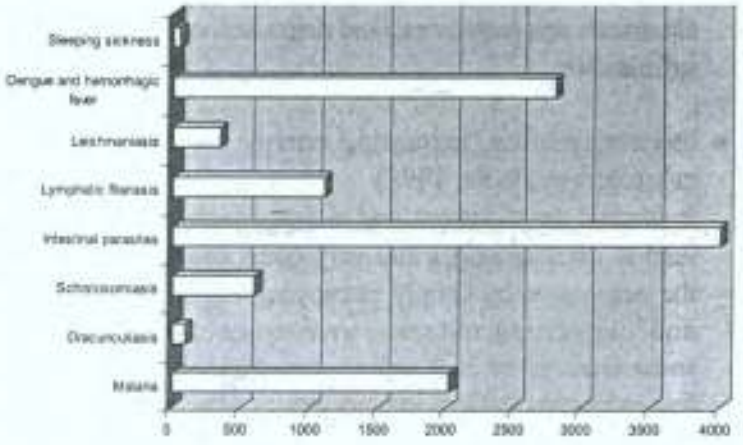

Figure 1. Estimates of population at risk due to water related diseases

Consequences of Climate Change in Human Health

Almost all climate scientists accept the notion that the likely increase in, and spread of, many diseases is likely to be the single most dangerous threat that climate change poses to human health (Kingsnorth, 1999).

Temperature and weather changes through different mediating processes may have direct and indirect health outcomes. Exposure to thermal extremes and altered frequency of weather events may result in altered rates of heat- and cold-related illnesses, psychological disorders, and deaths. Indirect results from the effects on range and activity of vectors, altered food productivity, sea level rise, impacts of air pollution and others may include changed incidence of diarrheal and vector-borne diseases, malnutrition, impairment of child growth and development, asthma, allergic and respiratory disorders, and deaths (WHO, 1996).

Global climate changes may create favorable conditions for disease carrying insects to proliferate at more northern latitudes and higher altitudes. Malaria, dengue, yellow fever and some

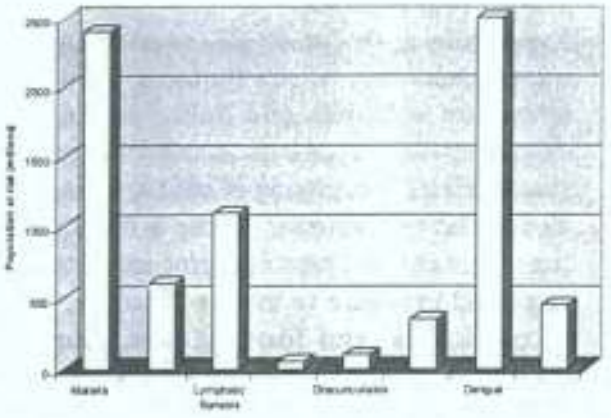

Figure 2. Major tropical vector-borne diseases as a result of climate change

other types of viral encephalitis are likely to increase. According to the World Health Report WHO (1996), approximately half of the world population are at risk of insect-born diseases (TERI, 1998). Malaria gives an important example, because it presently accounts for approximately 350 million cases annually, including about 2 million deaths (McMichael, 1997) (Fig 2). The combination of stresses contributed to appearances of several rodent-borne diseases, such as leptospirosis and viral hemorrhagic fevers (Epstein, 1997).

Consequences of Ecosystem Degradation and Human Health at a Regional/Local Level

The extent of environmental threats to human health is distributed unevenly in developed and developing countries. In some countries the effects of a degraded ecosystem or transformed environment is exacerbated by inadequate sanitation and nutrition, cultural peculiarities and demographic features. In areas where environmental threats coincide with poor social and economic conditions risks and threats to the population health are higher. In general, countries in Africa and parts of Asia seem to face the highest health threats from the collapse/ degradation of the ecosystem.

Table 1 demonstrates basic data on the linkages between ecosystems, impact on human health, regional/local examples and consequences and/ or possible occurrences of the threat and risk to human health.

It is worthwhile mentioning that there is no lack of warnings, pronouncements and declarations on the issue of the human health in connection to the degraded ecosystem from scientists, politicians, humanists, business society, and interested agencies (Rapport, 1998). UNEP, WRI, WHO and other organizations' reports and publications, WWW sources, research articles in scientific journals and books provide the necessary material on the environmental health subject. The problem is how this information is presented, where the emphasis is placed, and how and to whom the information is disseminated and, then, used. A proper understanding of the threats from the degraded ecosystem to human health is necessary. The strengthening of collaborative agreements between agencies may help to enhance scientific quality and extend data resources (U.S. DHHS, 1984). Therefore, government agencies, which are responsible for health assessment, policy-making, regulations and health quality assurance require an ongoing production, collection, and analysis of information about the impacts of the changed ecosystems on population health (PAHO, 1999).

A basic obstacle to the assessment of the human health status in relationship to the ecosystem degradation and establishment of direct links between ecosystem collapse and human disease lies in the coping with absence of direct, strong, connective mechanisms and scientific uncertainty. For instance, the recognition of the fact that ozone layer depletion, loss in biodiversity or pesticides accumulation affects human population health is based on the understanding that the influence is going through the energy or food chain, often through various indirect pathways. There always seems to be intermediaries connecting the change in the ecosystem and human health. For example, such environmental changes as climate change, land degradation, pesticides and fertilizers use, and aquifer depletion seriously affect agricultural production. Agricultural production is a major determinant of nutritional status and population health. Hence, human health is affected via processing or consumption of agricultural production and not directly by land degradation or aquifer depletion.

Table 1: **Ecosystem Degradation and Human Health Consequences on a Regional/Local Level**

Ecosystems	Driving Forces and Changing Ecological Patterns	Influence on Human Health and Additional Possible Consequences	Regional/Local Example
Atmosphere	Climate change Extremes in temperature: excessive heat. Increased rainfall, frequency and severity of droughts (Chen, et. al., 1997). Changes in temperature and humidity (WHO, 1996) Extension of drought areas. Deficiency in micronutrients. Variations in temperature, precipitation, and humidity (WHO, 1996)	Malaria, Meningococcal disease epidemics, Starvation Malnutrition related diseases Dengue Arboviral infections Excess in the rate of heat-related deaths in summer Physiological disturbance, Hantavirus, Respiratory diseases are the fourth leading cause of death Further global mean temperature increase may create ecological conditions conductive to malaria in 60% of the world's land area, compared with current 45%. Similar outcomes are possible with schistosomiasis. Health consequences may include diseases from a breakdown in sanitation.	Rwanda, Ethiopia, East African highlands, Madagascar, Benin, Burkina Faso, Chad, Mali, Niger, Nigeria, North-east Africa, Australia, Oceania, China, USA, Mexico, Argentina
Pollution	Pollution from power plants, metallurgy, the coal industry, the chemical industry, and vehicular emissions, burning of bio- and fossil fuels.	Respiratory diseases, eye irritation.	A large number of developing and developed countries.
Aquatic Ecosystems			
Marine	*Biological contamination, Pollution* Oil contamination Water contamination with waste water (HEED, 1999). Further deterioration of marine ecosystems from a severe imbalance due to severe navigation, sewage discharges. Harmful (toxic and non-toxic) algal blooms from the rapid reproduction and localized dominance of phytoplankton (HEED, 1999) Shellfish poisoning, wildlife mortalities, sunlight penetration prevention, oxygen shortages, reservoirs for bacteria.	Gastroenteritis, eye and skin infections, decrease in life expectancy, typhoid, malaria, dyphteria, Poisonings, diarrhea, dehydration, headaches, confusion, dizziness, memory loss, weakness, gastroenteritis, bacterial infections, swimming related illnesses, neurological diseases, deaths, cholera.	South Africa, Black/ Azov seas Caspian Sea, FSU, United Kingdom, France, Southern and Gulf States, a large number of countries in Latin America.

Fresh	*Pollution, Dam Construction, Degradation* Hydrogeological cycle changes (TERI, 1998) Inundating of lands Contaminated river systems. Fecal water pollution (Chen, et. al., 1997) Fallen water tables. Chemical contamination (Homer-Dixon and Percival, 1996).	Epidemic of schistosomiasis; Infection rates in the Diama region went from zero before the dams to more than 90% of the population. Fecal infections, intestinal diseases Progressive and irreversible kidney damage Diarrhea Hepatitis Cholera outbreaks Infectious diseases Intestinal parasite	Africa: Senegal River Manantali and Diama Dams, South Africa, Central Asia, FSU Bangladesh, India, Palestina, Israel, China
Terrestrial Ecosystems			
Vegetation	*Deforestation, Natural disaster, Intensified agriculture* Soils destabilization Clearing and intervening the forests (TERI,1998) Changes in local hydrological cycles, firewood shortage, land degradation Forest and rangeland fires due to high temperature, strong winds and low soil moisture content (WHO, 1996) New breeding grounds for insects, Agroecosystem development: inundating of lands due to rice growing Conversion of forest into cotton and sugarcane culture, and cattle pasture (WRI, 1998)	Malaria, trauma, allergic reactions, aches, cuts, infections, respiratory diseases, cancer, yellow fever, Ebola epidemics, burns, smoke inhalation, malaria, hemorrhagic fever Displacement of population	South Africa, Kenya, Cote d'Ivoire and some other African countries, Nepal, China, India, Australia, USA, Peru, Bolivia, Brazil, Venezuela, Central America
Land Degradation	*Changed agricultural patterns, Desertification, Soil contamination* Destruction of the agricultural ecosystem (WHO, 1996) Increased availability of breeding sites for insects Fertilizers and organic manure contamination (TERI,1998) Transformation of agricultural ecosystems (PAHO, 1999) Increase in nitrate level leading to the high levels of nutrients in rivers Mining activities leading to land degradation (NIEHS, 1999) Soil qualities impairment Contamination with pesticides (WRI, 1998)	Malaria, human African trypanosomiasis (sleeping sickness), raising incidence of cancer, birth defects lyme disease, lung diseases. Possibility of carsinogenesis Infections of respiratory and digestive tracts Population migration Immune suppression	East African highlands and Madagaskar, Siberian and Arctic regions, Western Europe, USA, FSU, some countries in Latin America

However, there are some environmental changes that directly impact the quality of human health such as temperature rising which causes thermal stresses or respiratory problems and deterioration of aquatic ecosystems, which lead to water-borne diseases. While, in general, most of the health impacts of the ecosystem collapse/ degradation would be mediated by changes in other systems and processes, such as proliferation of bacteria, distribution of vector organisms or quality and availability of water suppliers. In view of the above, it seems that the problems and concerns are relatively well understood and significant benefits could be achieved if concerns about environmental threats to health are incorporated into development planning at the onset.

The significant changes in health conditions are posing a demand for knowledge and are calling for new solutions in implementation of ecosystem health policies.

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CHAPTER 3

An Ecosystem Approach to Health and Communicable Diseases

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When the construction of the Serra da Mesa hydroelectric dam was started in the Zocantins river, in the State of Goias, there were many who never thought this work would contribute to the spread of malaria in the region (Bulcao, 1999). Neither was this possibility conceived by the hundreds of workers in the State of Sucre, Venezuela, when they set out to work in the gold mines in the south of Venezuela. And, even less would they realise that their trips would help spread malaria among their relatives after their working period was over.

The Tupi-Mondé indigenous groups live in the Brazilian Amazon, very close to the border with Bolivia. For many centuries their lands were worked with traditional slash and burn techniques, until occupation by new migrations led them to work in coffee plantations and to have a new kind of contact with the soil; a contact which was different from the one they had always experienced and this change connected them to a fungus hidden under the soil, causing them a disease, unknown until then: *Paracocidioidomycosis (Blastomycosis sudamericana)* (Coimbra et Alters, 1994).

The economic crisis in Peru led many Sierra indigenous groups to move to the Amazon jungle where they cleared the forest for agriculture. This proximity to the forest placed them in contact with leishamaniasis vectors and, having no immune defence, they became more susceptible to diseases (Calmet, 1999).

The *Tripanosoma cruzi*, the parasite that transmits Chagas disease, has been circulating among haemotophague insects that have always fed on animals in their natural cycle. When rural families needed to cover their houses, they cut palm leaves to build their roofs and thus brought the insect's eggs into their homes. And as they also cleared land for agriculture, they eliminated the sources of natural food for the vectors and the latter turned to the families to ensure survival (Briceno-León, 1990).

When these families could no longer survive on their crops, they migrated to the city and this urbanisation process reduced the incidence of Chagas disease. However, it exposed them to other risks. Cities have grown a lot and have created problems in the water supply to their citizens. When the haemorrhagic dengue epidemic broke out in Venezuela, the water utility of Caracas put out severe warnings stating that they would restrict the service to enable lower-income populations to obtain their provisions of water. Shortly after, health authorities requested water tanks to be emptied to avoid the

reproduction of the vector of this disease (Briceno-León and Montoya, 1995). The situation is very similar in Rio de Janeiro and, despite the fact that authorities affirm there is a broad coverage supplying water and removel of garbage, studies show that such services are restricted and that the lack of water, the accumulated garbage and the urban culture of waste, favour procreation of the mosquito (Magalhaes de Oliveira, 1999).

There are many examples. The systematic changes we introduce in nature and the changes occurring at the level of society, have both a positive and a negative impact on human health. This is why we need to have an approach to the health-disease link that goes beyond immediate causes. A limited perspective of the disease may produce quick and efficient responses in the short run, but never sustainable responses over the years. We should not attempt to avoid the disease but rather to attain a level of health that can be sustainable in that specific ecological and social environment.

When in 1987, the World Commission on Environment and Development introduced the term "sustainable development", many researchers and development workers looked for ways to join concerns for economic development with protection of the environment. At the same time, epidemiologists working on human health and disease have been expanding their "webs of causation" to include many social and environmental variables.

Over the years, the need for a holistic explanation of the health-disease process – as well as the dissemination of the sustainable development theory – has led to a proposal for an ecosystem approach to human health.

What is the ecosystem approach?

The ecosystem approach was developed and applied by ecologists working with the International Joint Commission of the Great Lakes (Allen et al 1991). These huge freshwater lakes, which straddle the Canada-US border, are ringed with some of the biggest industrial cities in North America- such as Chicago, Cleveland, Hamilton and Toronto. Thus, standard approaches for environmental management, which were designed for smaller areas, or parks not usually inhabited by people, did not seem appropriate.

The approach is based on an underlying view of such human-dominated ecosystems as complex socio-ecological systems (Kay et al 1999). A system is simply a set of elements which interact with each other within a certain boundary. Unlike computer systems, socio-ecological systems are characterized by existing in nested hierarchies (sometimes called holarchies; Allen & Hoesktra, 1992; Checkland & Scholes, 1990). Unlike say, a military hierarchy, in which there is a chain of authority, each unit (holon) in a holarchy is itself a whole thing, but contains other wholes and is a part of something larger. For instance, individual people are parts of families, which are parts of neighborhoods or villages, which in turn make up larger communities and so on. This means that an initiative, such as improving public hygiene, taken at any given scale (for instance the neighborhood) has implications for other parts of the same system (the city's water supply infrastructure as well as individual family behaviour).

A second characteristic of such systems is that they have many positive and negative feedback loops. For instance, it is not difficult to see that people engage in various economic activities - such as clearing land for agriculture, irrigation, mining, house-building – in order to make money to improve the quality of their lives. Wealth

generated by these activities may be used to build better roads, schools and sewage disposal facilities. People who have more schooling may be better able to solve social and public health problems at which time they may see that some of the activities which made the schools possible may themselves be identified as problems. Agricultural activities or manufacturing may, for instance, result in greater pollution of the water supply and the environment, heavier stress on energy use, and general deterioration of the ecosystem. Some diseases may be prevented when swamps are drained, even as habitats for new ones are created.

Furthermore, these feedback loops tend to organize themselves in certain patterns (systems researchers call this self-organization into 'attractors'). Most ecosystems – because of the energy and resources available to them – seem to have available to them a certain limited set of possibilities. Changes between system states may be quite sudden. This is both hopeful and a little frightening. It means that a few well-placed changes may have large implications. An enforced policy on low-pollution transportation could within a few years result in cleaner air, less respiratory disease, healthier people who walk more – as well as the loss of income from motor-related activities and a change in the physical structure of the cities and in structure of the national economy. The exact outcome could not be predicted.

Because such complex feedback loops have both positive and negative effects, different people will look at the situation – and evaluate it – differently. Where one person sees the excitement of economic activity, another person sees deforestation, where one person sees disease control by draining swamps, another person sees loss of wildlife and clean water provided by the filtering effects of wetlands. Where one person sees disease control through metal roofing, another person sees increased costs and less comfortable houses.

One problem with usual systems descriptions is that of selecting what to put into them and what to leave out. We cannot describe everything about everything! 'Normal' science assumes that we can construct clear hypotheses use them to predict outcomes; yet these complex systems in which we live are structured in such a way that prediction is always very uncertain. How then can we make decisions with any degree of certainty that we are doing the 'right' thing? How can we do scientific research?

It seems clear that, in situations where the stakes, the level of uncertainty and the ethical conflicts are high, all the members of the public who are being affected must have the opportunity to become part of the process of defining the problems and their solutions (Funtowicz & Ravetz 1994; Roling & Wagemakers, 1998). Since there are many perspectives on how to understand the complex social and ecological context we live in, it is important to bring together as many of those perspectives as possible in order to gain a rich picture of the constraints and opportunities. This means that the practical, social and institutional dimensions are of as much concern to researchers as the scientific and scholarly concerns. This can get very complicated very quickly, if we remember that these systems are holarchies. Thus, even if the people in one region can agree on a common plan of action, they will need to pay attention to the larger system of which they are a part. On the one hand, urban neighborhoods may not be able to solve all their water problems without help from city or even national authorities in charge of water distribution systems; on the other hand, if local neighborhoods clean up their streets simply by shipping garbage elsewhere, this may create a much bigger, more concentrated problem than the one we started with.

What does this mean for research into public health and ecological sustainability? Basically, it means that BOTH the scientific work and participatory action research (PAR) are necessary, and that BOTH must be re-oriented to a systems understanding of reality. Participatory development without science is just politics; science without participatory development is an academic exercise, and without a systems perspective, neither can be used effectively to promote sustainable development or ecosystem health.

Recently, an Adaptive Methodology for Ecosystem Sustainability and Health has been developed as one way to account for many of these complexities. This draws heavily on the theoretical base elaborated by Kay et al (1999). In brief, this methodology begins with getting as rich and full a picture of the communities and ecosystems as is possible. What is their history? How have they developed socially and ecologically? Who lives there? What are their occupations? What are the roles of men, women, different tribes or castes? This is accompanied by a clear analysis of who the stakeholders or actors in this system are, and how they are organized. Who is making decisions about the major issues of concern?

Working with the different groups of people in the communities, we can arrive at different systems diagrams and visions of this system, and which things are most important to different groups. This gets us past the problem of deciding what to include in our systems descriptions. In reaction to purely scientific-researcher descriptions, talking about energy use, water flows, disease rates, sociological classifications, and so on, we now sometimes have people using purely community-derived systems descriptions. We need BOTH. A physician may not be able to tell you how you feel, but she certainly can tell you whether you have a fever, or whether certain parasites are making you sick. Thus, this methodology accommodates both basic scientific work and participatory work – both re-oriented to a systems view of the world. Once we have different descriptions of the communities and ecosystems, we need to find ways to put them together.

In a project in Kenya, we have found that villagers as well as researchers were able to draw complicated 'influence' diagrams, which look a lot like a plate of spaghetti with meat balls. The "meat balls" are the issues that concern people – water quality, income, education, equity, food security. The noodles are arrows connecting them – for instance, increased income may result in better water quality and food security; improved water quality may improve health, result in fewer sick people put less stress on the medical system, but all of these positive effects only occur if the wealth is re-invested in the community instead of going out. If people grow their own food, and have enough of it, they may have more energy to go to school, and so on. One of the jobs of researchers is to ensure that important elements are not left out of these systems descriptions, whether those be based on a concern for the poor and marginalized, or on an understanding of the roles of wildlife, soils, water flows and energy use in ecological sustainability.

Based on the issues they have chosen and the systems influence diagrams they have drawn, people in the community need to negotiate what they wish to change, and implement those changes. How will we know if the situation is getting better or worse? Changes are monitored by looking at indicators, and these are based on the original goals which community people have negotiated. Usually, there are two sets of indicators – those used by people in the community – Can we drink the water without getting sick? Do we have fuel to cook our food? When it rains, do the storm sewers work? Do our

children have diarrhea? – and those used by researchers – What is the bacterial count in the water? How efficient is energy use in the community? Is the water table rising or falling? How prevalent are parasites and pathogenic bacteria in food or among people? Sometimes these indicators may be the same, such as disease or mortality rates.

This monitoring may lead people in the community to re-evaluate what they are doing, choose new issues to address, or look again at their influence diagrams to see if the connections they had suggested were correct.

What are the roles for researchers in this process? First of all, in many cases researchers will initiate and/or facilitate the start of such an adaptive process (that is, a process by which those who make and implement decisions in a community can re-visit, re-evaluate and respond). This kind of involvement focuses on the participatory action kinds of research. Secondly, researchers are essential to help define the nature of some of the problems – who is getting sick and when, what are the main sources of water contamination, what are the habitat requirements for essential species to survive. Some issues, such as equity between men and women, or how to involve marginalized people, are too sensitive for the community to deal with itself, and it is up to the researchers to ask questions about them. Thirdly, researchers play a key role to help people see their communities systemically – not just competing environmental, health and social problems, but a range of elements connected in a complex system. Finally, researchers study the process itself to discover how it works, and why it works in some places and not others, in order to better understand and facilitate the development process in other places. Thus researchers may look at how people think about health, how they view connections between health and environment, what the social organizations in the community are and how they function, and so on. This will also enable the communities themselves to grow and change and to help each other.

What is Health?

The ecosystem approach can be used to address a variety of outcomes – indeed it is always necessary to look at a wide variety of outcomes. However, we may at various times be more interested in some outcomes than others. One of those outcomes may be sustainable health.

Good Health, says the World Health Organization, is '... a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.' The WHO has also added that health is not 'an objective for living, but a resource for everyday life.' If we look at various definitions of health that have been published about plants, animals, people and communities, we find that most of them include some notion of balance and harmony, and some notion of reserve, or capacity to respond, adapt to a changing environment, and achieve reasonable goals (Waltner-Toews & Wall, 1997). These goals will most certainly include ecological and physical ones, but also social and cultural goals.

Health needs to be differentiated from medicine. In medicine, a doctor analyses a situation, makes a diagnosis, and proposes a treatment. The focus is on disease and the emphasis is on authority and hierarchy – we don't want to negotiate with the doctor in the emergency room. Health, on the other hand, is focused on synthesis and the improvement of well-being (How can we put things together in such a way that our lives are improved?) (Waltner-Toews & Wall 1997). To promote health, we use negotiation and conflict resolution in the context of holarchy. Disease is just one constraint on health, and may not always

be the most important one. Thus biomedical research, while providing information that may improve health, may actually undermine health if it is not done in such a way that the information generated goes back to the people who need it.

It is important to note that the ideas of complex systems have important implications for health. Because each action has multiple outcomes, across various temporal and spatial scales, an important component of health is to foster flexibility, or adaptability in the face of unexpected feedbacks. This is why both social and technical skills are essential and why education is so important. Because there are many different views and interpretations of an ecosystem, there will always be some individual winners and losers, even though overall the community may win; therefore, it is important that deciding community goals is done is a fair and open manner.

Finally, it is not possible to maximize health at all levels of the holarchy; a healthy population of animals requires that some die even as some are born. A healthy economy means that some kinds of businesses disappear even as new ones are formed. Therefore there will always be some tragedy involved in change. This means that cultural and spiritual rites and traditions, music and poetry to help face necessary tragedy, are important to maintain a healthy community ecosystem.

Tropical Diseases in Latin America

Traditional approaches to tropical disease studies have focused on i) the biological cycle of etiological agents, including transmission mechanisms, reservoirs and human populations at risk, ii) host-agent interactions, including immunological properties and pathogenesis mechanisms, and iii) epidemiological parameters. Few studies have focused on the complex ecological and social environment where these entities are present.

Furthermore, academic culture has led to a common interaction with local populations tending to intervene in an authoritarian way that has been developed throughout the continent, independently from the affected communities and ecosystems.

In order to broaden perspectives for dealing with infectious diseases, an ecosystem approach has been proposed. This approach considers interactions between environmental, health, economic and social factors; it draws strongly on community organizations in its design and implementation, leading to an effective participation in resolving disease problems. Instead of determining rates or parameters that will merely inform the scientific community about the size and seriousness of the problems, the intention of this new approach is to work with people to identify more effective and sustainable ways of managing ecosystems to promote human health.

While traditional scientific studies seek to define diseases and their determinants in global terms, the ecosystem approach situates both the definition of the problem and the solutions in specific ecological and social contexts and is applied to understand a wide variety of disease situations. Thus, the process emphasizes finding solutions together with communities, rather than the importation of global solutions which, at all events, are often ineffective. Tropical diseases, occurring in Latin America – obvious candidates for such a strategy – are described below.

Malaria

Malaria affects approximately 300-500 million people per year and is a major threat to world

health (WHO, 1995). Factors such as the emergence and dissemination of drug resistance, mass migration due to populations seeking work, rapid urbanization of rural areas and non-programmed agricultural development with irrigation schemes and colonization of new areas, make this disease an important target for epidemiological control. Control measures are largely based on mosquito eradication, personal protection, early diagnosis and effective treatment of human cases. However, experience has proved that in several foci, interruption of transmission cannot be sustained locally using these traditional approaches.

Working with local populations to consider the complex, site-specific interactions of social/ political factors, environmental modifications and land-use changes may bring new insights and more effective and sustainable methods of control in these "resistant" areas.

Chagas Disease

Chagas disease is an excellent candidate for an ecosystem approach. In fact, the most important phenomenon related to the etiological agent of this disease, T. cruzi , is an ecological relationship, sustained for more that 60 million years, between the protozoan parasite and marsupials and, more recently, with primates, with the aid of triatomines, the insect vectors. Environmental disruptions, socio-economic and political factors enabled some species of triatomines to find favorable habitat crevices in the walls of poor-quality houses in rural areas and in unplanned urban developments. The eventual contact of an infected vector with humans propitiated the appearance of Chagas disease, considered to be an important public health problem receiving increasing priority for control. Approximately 18 million people in Latin America are infected with the protozoan parasite and it is estimated that it is responsible for an economic loss of US$ 6,500 million per year (WHO, 1995). Nowadays, 25% of the Latin American population is at risk of acquiring Chagas disease (Moncayo, 1999).

Presently, several Latin American countries have controlled active transmission of the disease by i) vector control measures, such as pesticide spraying, pyrethroid paints and fumigation canisters, ii) house quality improvement and iii) health education. However, there are still some geographical scenarios where these control measures are completely inadequate. In the Amazon basin, areas involving Brazil, Colombia and Venezuela, humans are encroaching into the sylvatic environment, taking part as a putative host in the T. cruzi sylvan transmission cycle (Coura et al., 1999). Which are the ecological, professional, economical and social determinants and organizational structures of populations that favor human infection by the protozoan?

Understanding the complex interactions among these determinants, and working with the human populations directly affected, may lead to better (more sustainable) control of the disease than the conventional vector-human-parasite interaction.

Leishmaniasis

Leishmaniasis is considered to be one of the most abundant tropical disease in the world, accounting for 2 million new cases per year (WHO, 1995), one third is visceral leishmaniasis and two thirds are the cutaneous presentation.

A shift in the epidemiology of leishmaniasis has been seen in different settings in Latin American countries. The traditional configuration of a rural disease with a professional profile is being progressively substituted by an emerging urban disease with an intra-domiciliary transmission cycle, potentially affecting males and females, adults and children. The diversity of parasite

species, vectors, reservoirs and epidemiological settings coupled with new settlements in rural areas, environmental changes, wars and unplanned urbanization has resulted in an increasing number of leishmaniasis cases. Considering these aspects, a new approach to the study of this disease, involving non-traditional parameters might bring new perspectives to control the disease. The socio-economic environment, family organization, community structure, political ruptures and ecological modifications should also be considered as dynamic determinants of the disease. An holistic model that considers, not only the parasite, vector and human/reservoir, but also the social and ecological system in which these determinants interact, could be the master key to understand the disease.

Onchocerciasis

Although a decline may be seen in the prevalence of onchocerciasis infection and morbidity, it is still a major public health problem in Latin America, especially for some indigenous populations (Shelley et al., 1997). Seventeen million people are affected with the disease in the whole world and 4.7 million are at risk of acquiring the infection in Latin America (WHO, 1995).

Blindness, cutaneous nodules and disfiguring lesions affect humans and lead to important social problems, such as social ostracism due to blindness during the age of production. In the Americas, the Onchocerciasis Elimination Programme distributes specific treatment to at least 6 different countries (Blanks et al., 1998). In spite of this effort, the number of cases among the Yanomami indigenous groups and the Colored population of the coast of Ecuador deserves attention. An ecosystem approach to that issue should consider the traditional habits of these population clusters, the structure of their society and the ecological relationship that is maintained between these minorities and the jungle environment.

Dengue

The Dengue virus is transmitted in a cycle involving humans and mosquitoes, Aedes aegypti being the most important vector. In 1997, all the American countries presented reported cases of Dengue, except Canada, Chile and Bermuda, with a global number of over 300.000 cases (*La salud en las Americas*, 1998).

The domestic habits of the vector lead to infection occurring in and around human settlements. In the Americas, the frequency of epidemics has increased dramatically and multiple dengue serotypes have been introduced. The emergence of dengue has been attributed to several factors that an ecosystem approach would cover comprehensively. Demographic changes due to human population growth and urbanization, favoring contact with the vector, ecological changes linked to indiscriminate urbanization, leading to poor sanitation, inadequate piped water requiring water storage favoring the breeding of the vector, are variables that foster the appearance of the disease.

Furthermore, in modern times, rapid movement by means of air travel of infected humans has disseminated the different serotypes of the virus. Studies of the urbanization phenomenon in several settings in Latin America have been submitted, considering ecosystemic parameters that can define the economic, social and ecological determinants of the disease.

Social Dimensions and Level of Analysis

In the study of ecosystems it is possible to relate the different levels in societies, that is, what has been called the micro-social, mezzo-social and

Table 1. **Multiple dimensions and Analysis Levels**

	Cultural	Social	Economic
Individual	Knowledge, Perceptions. Roots	Gender role	Individual Benefits
Family Housing	Housing perception	Roles Space use Patterns.	Bednet costs
Ethnia	Disease traditions, Culture of disease. Food traditions	Indigenous, Isolation or Relation, Migration	Type of production
Community Organization	Fraternities	Organization for vector control Brigades, Schools For Mothers, Distribution of coconuts	Benefits or costs of activity
City, Municipality	Local pride and shame identities	Mayors, Health authorities	Economic incentives
Region	Regional Rivalry, Self-identity and Hetero-identity	Growth plans Environmental authority, Environmental migrations	Poor management of resources; migration to other ecosystems (region) As a resource deficit Trade-off
County/World	Growth of environmental awareness	Health Ministry; Environmental Legislation, International Agreements, International Conflict, wars.	Hydrocarbon crisis Deterioration of terms of exchange: agricultural products *versus* industrial products.

macro-social levels. All "problems" or "diseases" have links with each one of these levels, however, that link is not always clearly seen, nor do we attempt to study it – because we do not consider it relevant or because it is simply beyond our interest or the researcher's temporary financial possibilities. However, in an ecosystem project these different levels must be taken into account, akthough emphasis can be placed on one or the other, and a large number of such variables should be studied as the interest lies not on a detailed description of one or another variable but rather on understanding the relationships that cause either disease or health. In order to proceed with this approach, the different dimensions and levels that we propose in the following table should be considered:

At the level of the individual

The majority of communicable disease projects work at the level of the individual. This might sound absurd as it is evident that the starting point in most research interests is the health problem of an individual. However, it is not necessarily so as the focus could well be placed on the vector or the institutions, therefore, the individual is not taken account of.

However, individual approaches can vary as the individual can be taken as focal or pivotal point in a project. In other cases, only the cultural aspects of individuals are considered, together with their knowledge, perceptions and opinions as expressed in their evaluations or preferences. This should be underscored as, although culture is a collective fact, it only exists as such when internalised by each individual.

In a more complex approach, we should consider that the use of value hierarchies as an ecosystem approach requires negotiation and cooperation of the stakeholders involved and this is only possible when the stakeholders consider this problem to be important, and this importance is always subjective and a result of their values. The values to determine an individual's preferences are also relevant as there are always different possibilities or avenues to choose from and both an analysis of the situation as well as the values themselves are important to determine the reasons why one or the other choice is made (Briceno-León, 1998[a]).

Social roles of individuals based on gender and age must also be taken into account for the projects. However, it is not just a matter of sex and age but rather how both are reflected in their social behavioural patterns.

At the level of the family

Family organisation roles must be taken into account in particular. The family constitutes a very important component in Latin American society and even more so in rural areas. For example improvement in housing, largely depends on the stage of family life: In the case of a young couple with small children they would probably have a good chance of improving their housing as they will consider it important to raise their children and they will also have the physical possibility of doing the job. If we consider elderly people who do not have young children to help them in physically demanding chores, or in the case of single-parent families, the possibilities of home remodelling to protect health are lower (Villarroel, 1999).

At the level of ethnic groups

Ethnic groups constitute a very important factor. It is a human group that, over the years has been able to adapt to a given ecosystem and that has a long tradition and culture that can greatly help in describing how the ecosystem works. This kind of identity provides coherence to human groups and helps understand – from the historical point of view – the rationality of the way they occupy a territory and the relationship between the culture and their use of nature, the management of the ecosystem that brings benefits to the population and also harms their health due to diseases (Foller, 1990).

The community

The community can be a part of a city or a small town or even a village. The definition, in terms of a scale of levels, is more territorial than cultural, as is the case with ethnic groups. But cultural identities can also be an important element in building a sense of community. The community can be, on the one hand, a privileged dimension for a micro-social analysis of interactions with other levels, but at times it can also become a collective stakeholder if it is organised on the basis of common interests. Thus it would become the basis of so-called community participation (Briceno-León, 1998b). A specific unity of action must be identified.

At the level of the city or municipality

The stakeholders to be considered at this level are mainly institutional, related to the municipal government and health or environmental authorities. This is a medium level requiring further development. It has not been subject to

much study and deserves more attention as it can provide important but often neglected data.

At the regional and global levels

The purpose is to establish links in a given ecosystem with the more macro dimensions of the environment, the economy and the social organisation. This should not always be considered as a component of a project but should be included in the study and analysis in order to pursue the principle of thinking globally and acting locally.

The different levels of society have their respective levels of interference and relation with the ecosystem. However, the capacity to draw benefits or cause damage occurs jointly, and at different levels of society, stakeholders experience varying degrees of dependency or influence.

An Ecosystem Approach to Health and Disease

What does all this have to do with research on infectious diseases? For research into basic science – transmission mechanisms, mechanisms of infection, pathogenesis of diseases, even epidemiological characteristics related to incidence, morbidity, mortality and economic impact – these ideas are not very relevant, because the "window of observation" can be made to be sufficiently small so that we do not have much uncertainty. Indeed, what has happened in general is that we have carried out "small window" studies to maintain proper scientific control and certainty, and then tried to "market" our findings to public decision-makers trying to convince them to do something. In some cases this has worked (for instance large scale vaccination programs of general public or economic interest), and it may be the most appropriate approach.

Even in the best case scenario, however conventional, the scientific researchers become just another special interest competing for the attention of politicians, with the "winners" being those with the best public relation skills. When there are limited funds, why should the government, at whatever level, spend money on rabies vaccination, or malaria treatments, or meat inspection, versus spending it on new roads, or schools, or power stations? And what should politicians do if control measures for one disease result in conditions which foster other diseases? Decisions like this are best made if people can visualize the multiple connections between their ecological and social environments. It is at this point, at which we move from understanding basic mechanisms to looking for ways to promote sustainable health, that ecosystem approaches are most useful.

If we are truly interested in improving public health and ecological sustainability, it makes more sense to embed our research in the context of real human activities, where all the problems of uncertainty and complexity described come into full play. By helping communities create a coherent socio-ecological narrative of where they have been and where they would like to go – *given their ecological, economic and social constraints and opportunities* – we foster health while as we study.

What are the roles for researchers in this process? First of all, although many communities already do this on their own, in many cases researchers will initiate and/or facilitate the start of such an adaptive process. This stage focuses on participatory action kinds of research. Secondly, researchers are essential to help define the nature of some of the problems – who is getting sick and when, what are the main sources of water contamination, and so on – as well as to ensure that both ecological and socio-economic dimensions of the community

are adequately addressed. Some issues, such as equity between men and women, or how to involve underprivileged people, are too sensitive for the community itself to deal with, and it is up to the researchers to ask questions about them. Thirdly, researchers play a key role in helping people to see their communities systemically – not just competing environmental, health and social problems, but a range of elements connected in a complex system. Finally, researchers study the process itself to discover how it works, and why it works in some places and not others, in order to better understand and facilitate the development process in other places. Thus researchers may look at how people think about health, how they view connections between health and environment, what the social organizations in the community are and how they function, and so on. This will also enable the communities themselves to grow and change and to help each other.

The outputs of this work should be: 1) two sets of system descriptions – those made up of issues considered to be important by different stakeholder groups and actors (women, men, etc.), and those created by ecologists describing interactions and flows of water, energy, species, etc.; 2) based on this understanding of systems, goals for each of the issues which are believed to improve ecosystem sustainability and health; 3) action plans to achieve those goals (again, within the system framework) and 4) indicators which can be used to monitor changes.

Ecosystem approaches to health in general, and AMESH, as a methodology, are being adapted and tested in various degrees in Peru, Kenya, and now in Nepal, although not all its components are being equally applied in all countries. Our hope is that it will provide a framework for scientists and development workers, community people and researchers, to work together to learn our way to a sustainable and healthy future.

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CHAPTER 4

An Ecosystem Approach to Human Health: Communicable and Emerging Diseases

A joint IDRC, UNEP, FIOCRUZ and PAHO International Workshop
Rio de Janeiro, November 7 to 12, 1999

Selected Abstracts

The following abstracts were presented at the International Workshop "An Ecosystem Approach to Human Health: Communicable and Emerging Diseases" that was held in Rio de Janeiro, from November 7 to 12, 1999 at the National School of Public Health (FIOCRUZ). The final proceedings of the workshop include in total twenty-one scientific papers that were published as a special number of the scientific journal Reports in Public Health (*Cadernos de Saúde Pública*, Vol. 17, suppl. 2001). In order to access full versions of all papers please visit the web page: http://www.scielo.br/scielo.php?script=sci_issuetoc&pid=0102-311X20010007&lng=en&nrm=iso

1. **An Ecosystem Approach to Health and its Applications to Tropical and Emerging Diseases** by *David Waltner-Toews* (Department of Population Medicine and Network for Ecosystem Sustainability and Health, University of Guelph, Guelph, Ontario, Canada)

Disease and health outcomes occur within complex socio-ecological systems characterized by feedback loops across space and time, self-organization, holarchies and sudden changes in organization when thresholds are reached. Disease control programs, even if they are successful, may undermine health; conversely, programs in agriculture and economic development designed to improve health may simply alter disease patterns. A research and development strategy to promote sustainable health must therefore incorporate multiple scales, multiple perspectives and high degrees of uncertainty. The ecosystem approach developed by researchers in the Great Lakes Basin meets these criteria. This has implications for community involvement in research, development policies, and for understanding and controlling tropical and emerging diseases. Even if unsuccessful in achieving specific outcome targets, however, the requirements of this approach for open and democratic communication, negotiation and ecological awareness make its implementation worthwhile.

2. **Chagas disease prevention through improved housing using an ecosystem approach to health** by *Antonieta Rojas de Arias* (Instituto de Investigaciones en Ciencias de la Salud, Asunción, Paraguay)

This Chagas disease prevention project via housing improvement aims to determine the efficiency of different interventions in vector control. The following study describes the target

communities, disease magnitude, and housing improvements. Transmission levels are analyzed from an ecological and socioeconomic perspective. Special interest was focused on the peridomicile as the origin of domiciliary reinfestation. In the original project, three intervention programs were proposed, one for each of the three communities: a) an insecticide spraying program, b) a housing improvement program and c) a combined program of spraying and housing improvement. The three communities currently have different risks of exposure to triatominae reinfestation as a consequence of the type of intervention carried out. A new multidisciplinary approach which integrates participatory, community-based research and socioeconomic dimensions will allow to determine the efficiency of models for territorial ordering, community education, and environmental interventions in Chagas disease control.

3. **Health, biodiversity and natural resource use on the Amazon frontier: an ecosystem approach** by *Tamsyn P. Murray and José Sanchez Choy* (Centro Internacional de Agriculture Tropical (CIAT), Eco-Regional Centre, Pucallpa, Peru)

This study aims to improve the health of rural Amazonian communities through the development and application of a participatory ecosystem approach to human health assessment. In the study area marked seasonal fluctuations dictate food availability, water quality and disease outbreak. Determining the causal linkages between ecosystem variables, resource use and health required a variety of forms of inquiry at multiple scales with local participation. Landscape spatial mapping of resource use demonstrated the diversity of the ecological resources upon which communities depend. Household surveys detailed family and individual consumption and production patterns. Anthropometric measurements, parasite loading, water quality and anaemia levels were used as indicators of health status. This was complemented with an ethnographic and participatory health assessment that provided the foundation for developing community action plans addressing health issues. Discussion is focused on three attributes of an ecosystem approach; i) methodological pluralism, ii) cross-scale interactions and iii) participatory action research.

4. **An ecosystem approach to human health and the prevention of cutaneous leishmaniasis in Tumaco, Colombia** by *Carlos A. Rojas* (Centro Internacional de Entrenamiento e Investigaciones Médicas, CIDEIM, Cali, Colombia)

A study was conducted during 1996-1997 in 20 villages of Tumaco, Colombia to evaluate the effectiveness of personal protective measures against cutaneous leishmaniasis (CL). The intervention was effective, but the high costs of the preventive measures and the lack of a more holistic approach hampered the intervention's sustainability. This paper analizes the results using an ecosystem approach to human health. Using this approach, we found that CL has been present in the study area for a long time and affects farmers and those living close to the forest. The forest constitutes the habitat for insect vectors (sandflies) and parasite reservoirs (wild mammals). Four spatial scales were identified in this ecosystem: residential, village, region and global. From the ecosystem perspective, three interventions are proposed to prevent CL in these 20 villages: improve housing construction, organize village housing in clusters, and make diagnosis and treatment of CL more accessible. The design and implementation of these interventions require active involvement by

people with the disease (village inhabitants) and decision-makers (local authorities).

5. **Inadequate management of natural ecosystem in the Brazilian Amazon region results in the emergence and reemergence of arboviruses** by *Pedro F C Vasconcelos[1], Amélia P A Travassos Da Rosa[1,2], Sueli G Rodrigues[1], Elizabeth S Travassos Da Rosa[1], Nicolas Dégallier[1,3] & Jorge F S Travassos Da Rosa[1]* ([1] WHO Collaborating Center for Reference and Research on Arboviruses, Department of Arbovirus, Instituto Evandro Chagas, Belém, Pará, Brazil; [2] Department of Pathology, University of Texas Medical Branch, Galveston, Texas, USA; [3] Institut de Recherche pour le Development, Brasília, Brazil).

A total of 187 different species of arboviruses and other viruses of vertebrates were identified at the Evandro Chagas Institute (IEC) from 1954 to 1998, among more than 10,000 arbovirus strains isolated from humans, hematophagous insects, and wild and sentinel vertebrates. Despite intensive studies in the Brazilian Amazon region, especially in Pará State, very little is known about most of these viruses, except information on date, time, source and method of isolation, as well as their capacity to infect laboratory animals. This paper reviews ecological and epidemiological data and analyzes the impact of vector and host population changes on various viruses as a result of profound changes in the natural environment. Deforestation, mining, dam and highway construction, human colonization, and urbanization were the main manmade environmental changes associated with the emergence and/or reemergence of relevant arboviruses, including some known patoghens for humans.

6. **Wetlands and Infectious Diseases** by **R. H. Zimmerman** (Florida Medical Entomology Laboratory, Institute of Food and Agricultural Sciences, University of Florida, USA)

There is a historical association between wetlands and infectious disease that has lead to the modification of wetlands to prevent disease. At the same time there has been the development of water resources projects that increase the risk of disease. The demand for more water development projects and the increased pressure to make natural wetlands economically beneficial creates the need for an ecological approach to wetland management and health assessment. The environmental and health interactions are many. There is a need to take into account the landscape, spatial boundaries and cross-boundary interactions in water development projects as well as alternative methods to provide water for human needs. The research challenges that need to be addressed are discussed.

CHAPTER 5

Reflections from Regional Consultations

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1. International Workshop: An Ecosystem Approach to Human Health: Communicable and Emerging Diseases Rio de Janeiro, November 7 to 12, 1999 IDRC – UNEP – FIOCRUZ – PAHO

Four working groups, composed of 10-12 participants each, discussed ecohealth approaches to tropical and emerging diseases at the Rio de Janeiro workshop. The outputs of each working group are presented in this chapter.

They analysed the implications for, and made recommendations on:

- strategies for research using an ecosystem approach to health
- integrated policies to support ecosystem management to promote human health
- education and training incorporating an ecosystem approach to health
- institutional arrangements and partnerships involving North and South

Summary of the Working Groups

1. Strategies for research using an ecosystem approach to health

Involving the community

A community may be seen as an object of research and as a partner in the research itself. Both these external and internal views of the community have a necessary role in ecosystem approach research, but neither is sufficient. If the community is to be a co-researcher, its members must see some benefit to themselves. In conventional research, some kind of compensation may be given. In some cases researchers may need to stimulate or mobilize community organization for the research to be successful.

Researchers should contact communities before they plan to do research in them in order to

identify leaders, interested parties and organized groups in the community. It is important to obtain a history of the community, because it changes over time. Researchers need to listen to, and work with, the problems as prioritized by the community. This may be done at the beginning of the research, by having the people in the community tell their history, and by identifying strategies already present for promoting health. The communities may have very different perceptions of risk and different priorities from western-trained researchers. Unless these are accounted for, solutions will be neither appropriate nor sustainable.

Apart from this, members of the community should be involved in various technical tasks which are part of the research, including monitoring and training. Pilot systems may be set up in the community to demonstrate selected strategies for dealing with disease or other health issues.

Methodological issues

Individuals who are new to ecohealth concepts feel that more time, effort, and interaction will be needed to develop an adequate and better understanding of the concepts. Part of this understanding is the recognition that researchers and various people within the ecosystem or actors affecting it, may have very different perceptions of what constitutes the ecosystem. This means that in stakeholder analyses, different stakeholders may not agree on an issue simply because they are in fact talking about differently perceived, although overlapping, systems.

A basic assumption in the discussion was that a plurality of methods was essential, using both primary and secondary data. For the most part, we are not talking about creating new methods, but rather about the harvesting and systematizing of methods to achieve various aspects of the goals of the ecosystem approach. It was also clear that different researchers will have different entry points (disease, environmental problems, poverty) but that, whatever the entry point, in the end we are seeking the same integrated, ecosystemic understanding.

It is clear that we are dealing with a multi-scale approach related to both landscapes and people. In most cases, data will not be collected at all levels, and temporal and spatial integration will only take place at specific scales. The scales of data collection and the format of the outputs need to be specified at the beginning of the research.

Major issues identified for selecting methods are as follows:

- Is our primary outcome of interest health or disease?
- What scales are we working at?
- What are the primary determinants of sustainability in the area?

There are two complementary streams of inquiry which are essential to an ecosystem approach: one addresses the ecological context, and the other addresses the human dimensions and aspirations. If we are speaking of sustainable health, then environmental sustainability must take precedence over social and economic factors.

Some of the approaches (not specifically methods or techniques) which were seen to be important in implementing an ecosystem approach were:

- The landscape approach: comparing landscapes with various levels of human disturbance. Landscapes can then be classified according to various measures of vulnerability and resistance.
- Inventory diseases or pathologies in an area. This could involve data from quantitative epidemiological studies, as well as

demographic census data, including socio-economic data, so that populations could be stratified on risk or vulnerability before the actual field research began. Then the socio-cultural context (perceptions of diseases and their causes) could be assessed.

- Historical and ethnographic approaches to identify goals, aspirations, current and past adaptation and coping strategies.
- Socio-economic studies are necessary, including resource costing, cost-recovery, and cost-effectiveness. Since many funding agencies (e.g., World Bank) demand evidence of value before providing funds for research or development, there may be a need for cost-benefit analyses (or cost-effectiveness analyses as a way to get around the ethical problem of placing price on life and health) to demonstrate the comparative value of integrated (systems) approaches vis-à-vis conventional or non-integrated approaches.
- Long term longitudinal studies at particular sites, including the natural histories of infectious agents, local ecology, relationships between natural resource base and nutritional health, ethnographic and social studies and other similar studies will be necessary in order to gain a better understanding of an ecosystem approach to health. Projects already in the field should be built on and such projects need to be identified and linked.

Logistics

The terms, *multi-disciplinary*, *inter-disciplinary* and *trans-disciplinary*, were used at various times, but no consistent definition for them was given or used. The teaching of multi-disciplinarity was considered essential, involving not only such professionals as geographers, ecologists and health professionals, but also social workers from the community, community leaders and representatives from the government. A common language for participating individuals is needed, and the system under study must be seen in its global context. The cultural content is important, and this can be linked to the spatial data base (GIS). There is also recognition that it may not practical, possible or desirable for all specialists to sacrifice their specialties, making them all become generalists. A balance is needed in the mix of specialists and generalists. The research team needs strong leadership in order to remain functional.

- Researchers need to work closely with local health care systems. It is desirable for instance to work through new programs which have been developed by the health care service.
- To work closely with local institutions such as schools. By involving school-children in the research and by teaching courses in the schools, the work is more likely to be sustainable.
- Local non-government organizations may be excellent research partners. Nevertheless, one needs to be careful as they have their own agendas and may involve researchers in unnecessary turf wars as they compete for legitimacy and funding.
- Need to link with organizations having data, and that can also implement some of the solutions. For instance, a sanitation department may have information on solid waste production and disposal which may be important for the research. They may also be important in delivering solutions. If they are involved from the start, then they are more likely to follow through at the end.
- Geographic information systems (GIS) are critical for surveillance and monitoring, as they constitute a very valuable set of tools, providing a spatial perspective of the ecological, social and health indicators. Research will be needed to integrate local participatory mapping with more formal cartographic and geo-referencing procedures. There is a need to look at the relationship between health and non-health issues.

Information exchange and networking

There is a need to consider how to get experiences, methodologies, results, etc., out quickly. Formal journals are often slow and may be reluctant to publish novel ideas. The use of a web-page strategy will improve information exchange.

2. Integrated policies for ecosystem management to promote human health

Some discussion attempted to tie down a definition of policy. One view is that policy is an action plan along with a formal democratic strategy for implementation. Policy is needed to help enable the research and later to implement the ideas on a broader scale if the methodology and the approach prove effective. Some recognized that an evidenced-based policy was essential. This evidence based on case studies can also contribute to the ecohealth framework.

Various views expressed included:

- Policy must be implementable and verifiable.
- A bottom-up policy formulation will probably not work.
- At the village level, one person may implement actions on behalf of more than one government agency or ministry.
- At the international level, an effective way of policy-making may be through PAHO acting as a catalyst during the yearly meetings of ministers of agriculture and health in Latin America.
- At the international level, Agenda 21 is already policy and section 7 addresses health and environment. Agenda 21 calls for national and local action plans. This can serve as the basis for policy.
- Policy must rest on an ethical base that considers the following factors among others: democratic processes such as bottom-up development, equitable access to health and natural resources (production of nature for equity). An ethical analysis of the ecosystem might be useful.
- Policy must be placed in the context of an international world, national government mandates, and a position to inform stakeholders.
- Policy development can learn from the best examples of indigenous societies that have thrived in balance with nature (e.g., the Incas).
- Policy development must involve ministries of finance as well as health and natural resources. It may be necessary to use the World Bank or other influential international organizations to make effective contact with financial institutions.
- Messages to each ministry must be tailor-made to match their receptivity.
- In some cases, corporate actors may be useful stakeholders, but in others, firms involved with trade may constrain adoption of ecohealth principles. Often, local people will give health a low priority in order to maintain jobs, income, etc. Within communities, some segments will oppose ecohealth friendly policies and regulations, while others will support them. International control may be necessary to press for appropriate standards at local and national levels.
- Policy may be required to maintain incentives to keep essential technical actors available and willing to serve on ecohealth projects. Often, trained people are unwilling to spend time in isolated communities.

What factors drive sustainability?

- There is a need to evaluate successful (and perhaps unsuccessful) ecosystem-based projects to identify determinants of success and failure. Case examples from Latin America are essential to convince Latin American

politicians and decision-makers of the value of the ecohealth approach.

- Indicators of sustainability are needed for both the researchers and for the people in the community. IUCN may offer some useful methods and examples from Latin America. Follow-up monitoring is essential in ecosystem based projects.
- Conflict resolution. Methods are needed to deal with conflicts among stakeholders. The consensus was that consensus was not possible.

3. Education and training incorporating an ecosystem approach to health

There was a general consensus that, although we may introduce these concepts into the professional and undergraduate curricula, what is needed is to create open-minded specialists.

It is difficult to transform conservative donors, medical schools, universities, governments, etc., from reductionist to integrative strategies of learning and research. It can take many years to make radical changes in the structure of educational institutions. In many schools the faculty is discouraged from and professionally penalized for taking interest in multi-disciplinary activities. The ecosystem approach is not compatible with the structure of most institutions. Most institutions are trapped in a reductionist mode of thinking. In many countries, since Agenda 21, there has been no progress in achieving greater integration of environmental issues into sectorial training and development. Medical-environmental links are scarce, but public health – environmental links are more common. While there is a need to transform or change entire curricula, the practical step may be less ambitious at first and the group considered the ideas in the following paragraph.

Possible strategies, among others, for producing open-minded professionals could be the following:

- Evidenced-based and case-based, real live multi-factor studies are needed as an entry point to demonstrate the efficacy of the ecosystem approach. At the training level, teams of young professionals or students with an appropriate mix of experience and skills can form teams to use an ecosystem approach to describe communities and their problems in collaboration with community participants and other essential stakeholders. This approach will probably lead to the identification of important non-health issues. This may lead to the expansion of the ecohealth approach to one using ecosystem approaches to development.
- Delivery of short courses to professional ecosystem managers already in the work stream. The use of web-based and CD-based University courses might be considered to assist training of isolated ecohealth practitioners. Web-board discussions can be used to encourage exchange of experience over multi-national geographic scales.
- Approach open-minded educational institutions that are interested in integrated teaching and research. Some examples were given from Europe, Mexico, South America, the USA and Canada, but there is a need to catalogue them more formally.
- Development of long-term research sites which can be used for case or problem based learning. There already appear to be the basics and the networks for such sites, and these should be built upon: e.g. Network for Ecosystem Sustainability and Health (NESH: D. Waltner-Toews), The Resilience Network (C.S. Holling).
- Education at all levels is needed. One suggestion was to expand the Aquatox 2000â concept (international network of young student researchers to assess water pollution in their own surroundings, funded by IDRC – website: *http://www.idrc.ca/aquatox*).
- Dissemination of economically persuasive results from evidence-based case studies to a

wide range of financial institutions and national science and technology councils or effective private institutions and NGOs.

4. Institutional arrangements and partnerships including North and South

- Constraints to be overcome include:
  - different professional languages;
  - difficulties in budgeting and allocation of resources, staff and responsibilities;
  - chains of communication between collaborating agencies are often obliged to pass through bosses, thereby interfering with effective exchange among actively involved lower level personnel;
  - continuing dominance of technology-oriented projects;
  - personalities and individuals' agendas may interfere with communication and collaboration.
  - short term funding by donors undermines sustainability.
- We are still at a stage at which the validity of the ecohealth concept must be proven and sold to the various potential institutional partners.
- Initially, institutions with potentially similar programmes can be identified (UNICEF, World Food Programme, FAO, World Bank, PAHO, NOAAs Office of Global Programs and NGOs) that could be linked as partners to support initial case studies. NGOs that emphasize capacity development in both environment and health could be useful.
- More permanent networks (such as those mentioned under education) need to be created and nurtured. However, there was a sense that much of the progress in this area will be made through ad hoc personal networks.

* Unlike say, a military hierarchy, in which there is a chain of authority, each unit (holon) in a holarchy is itself a whole thing, but contains other wholes and is a part of something larger (extracted from Chapter 3, p. 30).

5. Example of an ecosystem that shows an increase in an emerging and re-emerging disease

The difference in how one defines reemerging or emerging dictates which one of these diseases is reemerging or emerging. It was agreed that Dengue is a true emerging disease and will be the disease discussed in this part.

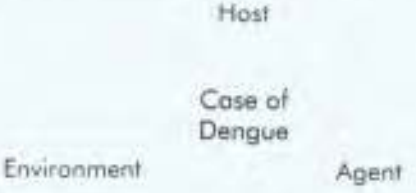
- Examples in urban ecosystem: Dengue, Filariasis, Visceral Leishmaniasis
- Examples in rural ecosystem: Malaria, Chagas, Leishmaniasis, Schistosomiasis.

Dengue was chosen as the entry point to construct a model that would be useful using an ecosystem approach to guide intervention to control this disease.

Rio de Janeiro (the *Favelas*) was chosen as the site for analysis – i.e. an urban ecosystem.

The nested hierarchical structure selected for modeling purposes was composed by the following units:

- Individual affected by Dengue and represented by the classical triangle of disease pathogenesis



- Family dwelling
- *Favela*
- City
- Region
- Biosphere

These holons* were represented by a series of concentric rings around the same point (see next

Model of Urban Ecosystem Hierarchy focused on Dengue as the entry point

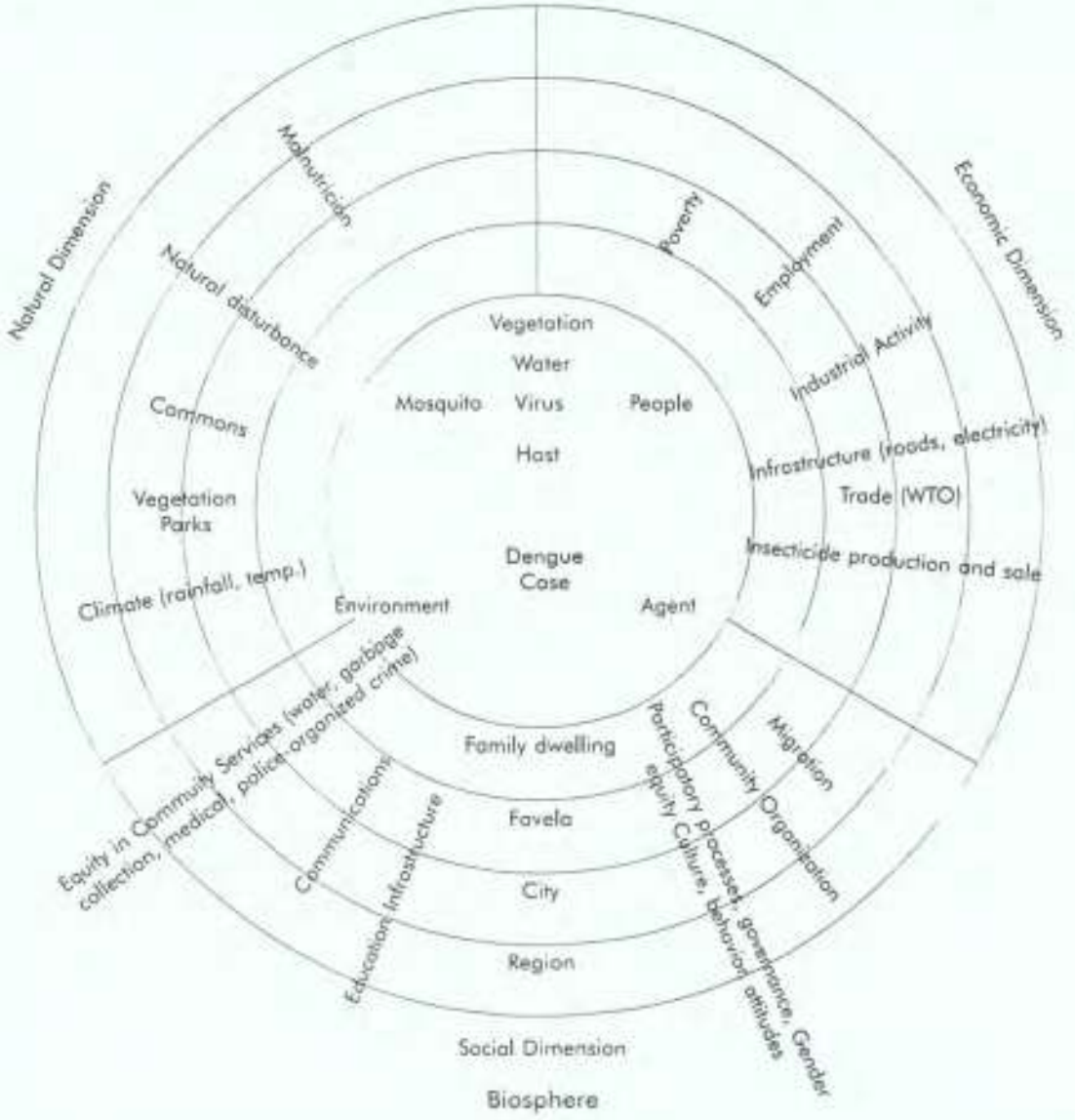


figure). In the central holon i.e. the family dwelling where a case of Dengue occurs the group considered the following were essential elements in producing this disease:

- people (susceptible and carrier / infected)
- virus
- mosquito
- vegetation (e.g. house plant)
- water

The analysis proceeded by identifying links to these primary elements in the model hierarchy (holarchy). The "target diagram" was divided into three sectors to represent natural, social and economic dimensions (see figure above).

Natural Elements:

- Climate: this has an impact on the entire hierarchy and circumstances such as global

warming having an influence on rainfall could be a factor.
- Vegetation including ornamental and houseplants are necessary for mosquito survival and occur across all holons.
- General health level of people at risk would play some role e.g. malnutrition, etc. – of particular importance in the *favela*.
- Natural disturbances e.g. storms, can create unusual conditions favoring spread of the agent.
- Commons used for garbage in *favelas* and elsewhere can provide a breeding ground for mosquitoes.
- Insecticide and anti mosquito programs.

Social dimensions

- Communications: all levels need accurate sources of information e.g. media
- Education: both the level of knowledge and infrastructure are considered important especially at the *favela* level.
- Community Services – Equity is an important issue.

  Inequity at the *favela* level:
  - Water delivery: irregular delivery leads to the need for storage in vessels that permit mosquitoes to breed.
  - Garbage collection: irregular and ineffective, leading to pods of water in which mosquitoes breed.
  - Police protection. Ineffective control of organized crime. Criminal organizations extort money from residents for essential services such as water delivery.
  - Medical and laboratory services
- Gender equity: women not given equal access to health and education at *favela* level.
- Human migration: from rural to urban environment
- Presence and strength of community organizations at the *favela* level can be a determinant of the quality of community services.
- Culture, behavior, attitudes, trust, are important factors at play in the system.
- Participatory processes
- Governance processes

Economic dimensions

- Poverty – All factors related to poverty will be at play
- Employment
- Industrial activity
- Insecticide production and sale
- Quality of housing
- Infrastructure
  - roads
  - electricity
- Trade – Trade policies adopted at the international (W.T.O.) and national levels can have impacts on employment and poverty down to the *favela* level.

Conclusion

The model proved useful for discussion purposes and to create a general perspective on the problem. The following step of more closely specifying and prioritizing the links to dengue was not possible because of time constraints.

2. Ecosystem Disruption and Human Health. A Joint IDRC/UNEP consultation at the Canadian Conference on International Health November 14 to 17, 1999

A Summary of the Consultation Proceedings

Challenges of an Ecosystem Approach to Human Health

The ecosystem approach to human health presents many challenges as it cuts across traditional research boundaries. Participants at the IDRC/UNEP consultation held working group sessions which focussed on these challenges. A brief synthesis of the challenges identified and discussed follows:

Finding a Shared Vision

An ecosystem approach requires input from a variety of individuals and institutions. Research teams will be quite large and diverse. The teams need to build a consensus regarding a definition of the health problem and an understanding of how the ecosystem influences health. The challenge lies in finding methodologies that support communication and equal partnerships, among disciplines and across all levels of society.

Assuring Community Access

Communities possess important information and perceptions about their health and their ecosystems. Communities must play a central role in setting development and research priorities. The challenge is to ensure that community members are able to participate regardless of age, sex, ethnicity or other socio-economic distinctions. Another part of the challenge lies in the opportunity which exists for the community and other researchers to access and exchange new knowledge through their relationships. Research objectives and development activities must be continuously realigned in light of this new knowledge.

Gaining Credibility

Gaining support and funding for research into non-traditional interventions can be a difficult task, such as obtaining funding for a department of agriculture instead of the department of health when the research issue might be malaria. The challenge is to establish credibility in the research and the donor community by producing carefully documented projects that convincingly illustrate the concept and the strengths of the ecosystem approach to human health.

Measuring Success

New indicators may be needed to characterize unique and complex systems or to allow health or ecosystem status to be measured by community members. The challenge lies in creating the unique indicators that may be required to suit the specific context of each project.

3. Latin American Perspectives.
A joint IDRC, UNAMAZ and CENDES consultation
Caracas, November 30 to December 1, 2000

Keynote Speech:
Better Ecosystem Management for Improved Human Health: the Ecosystem Approach to Human Health

Gilles Forget

International Development Research Centre

Models attempting to take into account the relationships between the environment and human health have considerably progressed during the twentieth century. Initial efforts at modelling the interactions of human kind with the environment and concomitant impact on human health were attempted by medical practitioners in order to understand the transmission of infectious diseases. This was not simple, however, as we lead our every day life in the context of a multitude of factors which can affect our health. These factors, by their very nature, are not readily controlled through the strict medical reductionist approach no matter its sophistication. It is for this reason that four years ago, IDRC proposed a new research strategy for health: an *Ecosystem Approach to Human Health*. This new development paradigm posits that improving human health through better ecosystem management options is a cost-effective complement to existing primary health care programs.

This new approach to human health bridges integrated environmental management (Ecosystem Health) with global/ecological health promotion. The Ecosystem approach to human health offers a new opportunity to promote human health through enlightened management of the ecosystem. While it is desirable to manage the natural resources and the biophysical environment to achieve this, one must also take into consideration all relevant social, economic and cultural factors inherent to a given ecosystem. In order to be successful, the approach must be participatory and transdisciplinary, with a particular reference to the needs and aspirations of different social groups, especially the differences which exist between men and women.

The approach is based on managing ecosystems. How does one define an ecosystem? In the present context, we are proposing a more global notion than what is usually recognized in ecology. For our purpose, an ecosystem represents an analytical unit rather than a biological one. The limits of an ecosystem under study are defined by the user according to the task at hand[1]. If in general the area will constitute a natural ecological setting such as a water-catchment area or a region, it can just as well be a farm, a neighbourhood or a rural community.

The World Health Organization [2] defines the health of an individual in relation to that individual's perception of his/her position in life in the context of his/her cultural and value system, in relation with goals, expectations, norms and worries. *Quality of life* is an inclusive concept which factors in an individual's physical health, his/her psychological state, personal belief system, social relations and links with the environment. The ecosystem approach to human health explores the relationship which exists between the components of a given ecosystem in order to define and determine the priority health determinants of human health and of the ecosystem's sustainability. To this end, the strategy emphasizes the design of interventions based on alternative management options of the ecosystem rather than mainstream health sector interventions

In order to manage an ecosystem's resources sustainably, there must be a tight integration of policies and actual resource management. This will ensure that the link between humans and their environment is constantly in mind during the design and implementation of management interventions. By definition, the ecosystem approach to human health is based on societal objectives. Indeed, while it is often possible to predict the outcomes of given changes on an ecosystem by analysing them in the light of existing scientific knowledge, the societal impact of those changes is much more subjective, and may vary considerably from one community to another, depending on their social aspirations, their culture or their needs. Some communities may be more adverse to risk than others, some may be more needful of the resources of the ecosystem and thus more willing to take the consequences of their use; finally some communities may find that some management options are simply not compatible with particular spiritual values. This is why the ecosystem approach to human health must be based on a participatory strategy.

This strategy may be unusual for scientists trained in the strict reductionist approach. The transdisciplinary research strategy which is necessary for a successful ecosystem approach to human health project is based on the integration of multiple disciplines from the protocol design stage trough the field work to the final analysis and interpretation stages. It is an approach which often brings about the generation of new theories and innovative concepts, thanks to the synergy which characterises transdisciplinarity. While the project will always depend on the expertise of the different scientists who are members of the research team, it is the holistic project management and data interpretation which ensures the success of the approach.

Scientists who have been trained according to a traditional reductionist stream may have difficulty in adapting to this new way of doing research. They may also be uncomfortable with participatory strategies. Participation is predicated on the active involvement of communities into the research process carried out in their ecosystem. It is seen as a condition for success, since it allows communities to ensure that their preoccupations are taken into consideration as well as their needs and their own local knowledge. Communities members must not be subjects of the research but rather actors who will ensure that the development of ecosystem interventions will indeed reflect the needs and aspirations of the community.

The principal critique directed at the approach has been the perceived difficulty of implementing such projects. In many cases, scientists hesitate to use such a holistic approach because they anticipate personal difficulties associated with loss of control of the project activities when a larger team of scientists must participate and partial control is relinquished to members of the community. One successful strategy to assuage these concerns has been the organization by IDRC

of pre-project development workshops involving researchers, policy makers and community representatives during which project goals and objectives are discussed as well as methods and feedback strategies.

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Summary of the Working Groups

1. Guide for discussion

The participants at the Workshop were split into three groups and worked on the discussion guide that follows:

1.1 Ecosystem approaches to human health (Ecohealth) in Latin America and the Caribbean: thematic priorities. The discussion focused on priority research issues related to the following "stressors":

- Urbanisation processes
- Mining
- Intensive agriculture

1.2 Relevant aspects in building the approach

1.3 Implementing the approach: challenges and strategies

The working groups discussed the most appropriate proposals to respond to the main challenges identified at the International Consultation conducted during the Canadian Conference on International Health (November 14-17, 1999). A description of these challenges is included in chapter 5.2. They are as follows:

- Achieving a shared vision and strategy
- Secure access to the community
- Enhanced credibility
- Measuring success

1.4 Promoting the approach: suggestions for capacity building and dissemination.

2. Suggestions presented by the working groups

2.1 Thematic priorities

Two out of the three groups considered that the urbanisation processes in Latin America pose the biggest research challenges to develop the ecosystem approach to human health. The accelerated population concentration process in

urban and peripheral areas is followed by significant constrictions in the urban ecosystem. This is closely related to the conditions of poverty and lack of services in large sectors of the population; these have serious impacts on health conditions. As a priority issue, the need to promote trans-disciplinary research based on an ecohealth approach to improve management, access and quality of water at the urban level, was highlighted.

2.1.1. Urbanisation process

The groups emphasised the importance of analysing the urbanisation process from an inter-sectorial and trans-disciplinary perspective. In this regard, they pointed to the need to develop instruments for the appropriate analysis that break through disciplinary barriers and facilitate a comprehensive approach to the complex multi-cause network of factors that determine the state of human health at the level of the urban ecosystem. Among them they highlight socio-economic factors that lead to:

- increased rural-urban migration
- disorganised urban growth
- lack of public inter-sectorial policies in land management,
- growing social inequity conditions
- degradation of the urban environment,
- poverty and lack of access to basic services affecting large human groups living in areas along city belts.

A specific issue deserving more emphasis was undoubtedly the management, access and use of water in the urban context. They pointed to the importance of approaching this issue from a perspective that includes the inter-relation of social and environmental phenomena inherent to rural-urban interface. The need to contribute better knowledge to the integral management of water basins becomes more important in order to ensure water supplies to cities and to avoid excessive erosion and floods of the lower parts of basins.

Accordingly, the development of applied research projects based on a perspective of integral management of the urban ecosystem and water basins is considered of the utmost importance, and the following aspects are to be distinguished:

- protection of water sources
- fair allocation of water resources inside and outside the city
- inequality in access to water, which obviously represents a highly relevant factor in public health
- quality problems derived from pollution by agricultural, industrial and mining waste, municipal sewage and garbage.
- the inter-relation of social and environmental variables (for example floods), and their connection to diseases such as malaria, dengue and acute child diarrhoea, that still affect the more vulnerable social sectors.
- Access and use of water in marginalized urban areas, the inter-relation between poverty, environmental deterioration and lack of services and the resulting impact on health
- Cultural and gender differences in the use of water
- Treatment of effluent water and the study of distant pollution impact, which generate significant problems in ecosystems situated "downstream" from urban centres affecting the health of lake and sea-coastal ecosystems, generating growing risks to health in far-off populations.

The characteristics of research should:

- Favour environmental, social and cultural management models based on social participation and oriented to the promotion of healthy ecosystems.

- Nurture inter-sectorial policies based on integrated urban ecosystem management to improve health conditions.

Therefore research should be oriented to act on factors determining health from a systemic perspective to:

- Incorporate mechanisms for the interaction of different social actors in project planning, so as to promote negotiation and articulation of public-private management and community organisation.
- Develop pilot projects aimed at breaking the vicious circles of poverty, generating better standards of living and higher empowerment of social organisations.
- Develop the right strategies for a feedback of results, involving the communities and the different social and political actors.

One of the groups developed their concerns focusing on urbanisation issues in the Pan-Amazonia region. In these countries, urbanisation becomes critical with the establishment of unplanned cities associated to the development of economic activities such as metal-mining and hydro-electric dam projects.

From the perspective of food security, growing urbanisation also implies challenges to reach a better understanding of the complex processes in the production and distribution of food, and its impact on the ecosystem. As a result of the pressure on food production, a series of phenomena occur, such as the use of agro-toxic products and its impact on the physical environment and human health.

2.1.2 Mining

Special emphasis was put on the study of informal mining, which dominates several regions in Peru, Bolivia, Colombia and Ecuador. One of its characteristics is the high social complexity, associated to a demographic profile that includes mobile populations that can hardly organise and who many times are in conflict with local settlements and indigenous communities.

This goes together with a strong impact on both the environment and human health. Whereas occupational risks have been studied more in depth, there is still ignorance as to the impact on the population in general. Informal mining goes hand-in-hand with a high incidence of indirect risks on human health. Some, such as violence and sexually transmitted diseases, are connected to the social structure and lifestyles. Others are associated to environmental and dwelling conditions such as water-transmitted diseases and the increase in cases of malaria and other vector-transmitted diseases.

Small and medium-sized mines also generate impact on the health patterns of the population in general, through the pollution of ecosystems with cyanide and heavy metals. Insufficient studies in this area are acknowledged and projects have been promoted to cover the study of mechanisms that generate contamination, routes and dynamics of contaminants in the environment, ways in which the population is exposed and impact on human health. In particular, more attention must be paid to chronic effects caused by the prolonged exposure to heavy metals.

In turn, mining activities conducted by large entrepreneurial concerns leave behind great amounts of waste in the ecosystems causing significant negative impact on their health. More attention must be paid to environmental impact from the exploratory phase until the time of closure.

2.1.3 Intensive agriculture

This issue is similar to the former. There are two systems based on different patterns of agricultural production: one is organized on the basis of large intensive agriculture enterprises and the other operates on the basis of small family business concern. Both were recognised as significant issues for an ecohealth approach.

The expansion of intensive agriculture production patterns are linked to growing deforestation, soil erosion, use of pesticides and fertilisers and determine a high level of damage that affects biodiversity, as well as the health of both human beings and ecosystems.

In addition, it is necessary to study the impact of mono-crops, on the ecosystem, as well as on the health of the population and quality of food available in the communities.

Large scale agriculture may determine important effects on the health of ecosystems. Family farming – and frequently this is the case of entrepreneurial farming – incorporate an additional labour risk when workers do not meet the conditions to adequately use their input.

There is more research referred to the exposure of workers to agro-toxic products. However, research referred to the assessment of chronic effects to indirect environmental exposure of the population is, in general, very recent.

The permanent introduction of transgenic varieties created with the help of genetic engineering represents at present a new challenge for research; its use should be known better and it is necessary to assess its risks.

The ecohealth approach should also take into consideration an evaluation of the impact of agricultural changes on the nutritional condition of large sectors of the Latin American rural population. This is associated to the intensification of mono-crops for exportation and inequities in the distribution of food among economies and societies.

2.2 Relevant aspects in building the approach

The three groups have underlined the strengths of the ecosystem approach and pointed out two essential characteristics: its trans-disciplinary and holistic nature integrating the health, social and environmental visions.

Research should not only be applied but also applicable; this means emphasising the use of research and the design of concrete interventions that develop appropriate technologies in ecosystem management.

The ecohealth approach should take into account cultural differences.

Indigenous cultures depend directly on the integrity of the ecosystem they live in, in terms of their health and wellbeing. The preservation, valorisation and/or rescue of traditional knowledge must be accounted for in the ecohealth approach. Research, in turn, should take into account all conflicts generated around the defense of indigenous territories.

In the southern countries – and especially in Latin America – the notion of equity should become more relevant within the approach. When speaking of sustainability we should also speak of equity, always bearing in mind that communities are heterogeneous.

In building the approach different levels of analysis and dimensions should be borne in mind:

- Scenarios for action: analyse the wellbeing of humans in a comprehensive way, including the different social, economic and family, cultural, physical and mental wellbeing, etc. settings (holistic collective vision).
- Differentiated analysis units: different analysis levels must be studied, such as the individual, family or household, community, work and society. In addition, local communities as well as distant communities should be taken into account, as all these may be affected by a rupture in the ecological balance and the dissemination of pollutants.
- Areas to emphasise: social equity should be underlined due to poverty and growing inequalities in Latin America societies. The influence of national and international economic dynamics on the countries and their ecosystems, should also be taken into account.

2.3 Implementing the approach: challenges and strategies

2.3.1 Finding a shared vision and strategy

The different groups underlined the importance of generating processes that involve different social and political actors to work jointly with researchers. In order to achieve more accountability and success, this must be ensured from the very early stages when research priorities and project objectives are discussed.

The integration of disciplines is essential to break with the territorial approach of academics. To this effect, apart from the integration of the research team, it is necessary to develop democratic mechanisms for an equal distribution of power in the multi-disciplinary team, to avoid hegemony in the case of certain visions. It is also necessary to generate early processes of interaction between researchers from different disciplines.

There are different kinds of collaboration that take place at different levels: community and researchers, community and government (both local and national), civil society and its own communities.

2.3.2 Sure access to the community

The community must be seen as the essential and leading actor of all research processes. This vision differs from the traditional or paternalistic perspective where the community is seen only as the beneficiary of project outcomes. Participation should be seen as a permanent activity that constitutes a feedback between the inter-disciplinary team and the community. Consultation with the community must be carried out from the very outset of the project.

It is necessary to consider that in the Latin American context there are, in general, important conflicting interests in managing the ecosystem and natural resources. Therefore, it is important to be clear about the concept of community and develop a strategic mapping of the different civil society groups and actors in the public and private fields. It is not always possible to conciliate interests. Therefore, the approach should know how to integrate capacities inherent to conflict solving, taking the basic assumption that interaction among social actors must favour the core objectives of the project.

In summary, it could be stated that:

- research must respond to the real needs of the community and not the interest of academics,
- to involve the community implies to go beyond the individual level where relations are limited to individuals or groups of people, reach a more macro vision that involves different levels and social actors and favour social participation and community organisation. In this sense, people in the organised community must become subjects and not objects of research. This

implies building permanent partnerships of key actors at the level of the ecosystem (researchers, local governments, public institutions, community organisations, business sector, unions, etc.) to define research priorities, collect data, interpret results, plan and implement actions, monitor outcomes and provide feedback on the results.

2.3.3 Increasing credibility

The ecosystem approach to human health must face important challenges to increase credibility at different levels: academic, community and political.

- Academics feel more at ease when keeping within the fields of their disciplines and maintain control over the research process in the traditional way.
- For many decades communities in Latin America have seen how researchers approach them to obtain information without consulting them and many times without even letting them know the results.
- Politicians demand simple and concrete instruments that provide short-term results.

In order to increase scientific credibility it is necessary to build capacity to publish results in scientific magazines, which is an evident shortcoming in the case of Latin American researchers. This is closely related to the need for regional capacity building.

In order to achieve academic, social and political accountability, it is necessary to give more priority to publication and dissemination of successful projects.

Lastly, in so far as communities and the different social and political actors are involved in the projects, accountability and relevance will increase.

2.3.4 Measuring success

In the first place, the need to build indicators based on the holistic vision of the ecohealth approach was highlighted.

The importance of having baseline information was also made relevant, both in terms of human health and ecosystem, to measure the ultimate impact of interventions.

The elaboration of ideal profiles for healthy communities that serve as reference to measure the real situation, was suggested.

Specific proposals:

- develop indicators that incorporate the gender perspective, evaluate the variation in terms of exposure and impact according to gender roles
- develop ecosystem indicators than take into account social equity and evaluate poverty and social inequality in Latin America
- promote life quality indicators (similar to the WHO indicators) adjusted to the cultural context of each region.

2.4 Promoting the approach: suggestions for capacity building and dissemination.

The ecohealth approach requires the development of institutional frameworks that are more permanent and help enhance research capacity and achieve a broader regional dissemination.

The development of new innovative strategies to expand and develop the regional research potential is considered essential.

New regional discussion and consideration instances are necessary and can be accomplished through conferences and workshops that convene key groups working with this approach, to foster mutual exchange and collaboration.

The new communication technologies must play a key role. Eectronic communication should be intensified among research teams. To this effect, there is a suggestion to design and support the most adequate instruments to facilitate communication and integration among regional groups, so as to break down the current isolation.

The creation of a regional ecohealth network could play a key role in the promotion and dissemination of the approach.

Publication of results must be encouraged, especially in successful cases, by developing instruments and formats appropriate to the different publics.

Local forums at the municipal level are important instances to reach local actors.

Dissemination of the approach at the community level requires the development of material designed according to the cultural context and planned with the purpose of favouring training, participation and empowerment of communities. This task must be promoted throughout the research process so as to achieve a higher identification with and commitment to the project in the community.

As a long-term goal the creation of regional post-graduate courses on ecohealth should be promoted, as well as recognised training courses and a higher integration of health and environment university programmes.

It is understood that different agencies should articulate their regional strategies better and actively seek a convergence with agencies such as IDRC, UNEP and PAHO.

CHAPTER 6

Final Reflections

The Ecosystem Approach to Human Health (Ecohealth) presents many challenges as it cuts across traditional research boundaries*. In fact, it is a new approach that bridges integrated environmental management with a holistic understanding of human health, taking into consideration relevant social, economic and cultural factors inherent to a given ecosystem**. This publication has brought together significant contributions from different regional consultations. Throughout these meetings, the new approach has received an increasing support of a diverse group of representatives of academic institutions, non-governmental institutions, international institutions and national governments.

This chapter summarizes the main reflections and conclusions of the working groups. Intensive debates took place with regards to thematic priorities, challenges and strategies for research and ecosystem management, and suggestions for capacity building and dissemination.

Thematic priorities

In Caracas, the working groups considered that the urbanisation processes in Latin America imply significant research challenges for developing the Ecohealth approach. The regional economic and demographic patterns leading to a persistent increase in the urban population and the explosion of poor neighborhoods in peripheral areas are closely associated with relevant challenges for ecosystem and human health.

Participants placed emphasis in developing new methods and tools to facilitate the understanding of the complex web of factors that determine the state of human health at the level of the urban ecosystem. A multi-dimensional and transdisciplinary approach is needed to analyse the relationships between socio-economic factors associated with increased rural-urban migration processes, disorganised urban growth and the lack of public inter-sectorial policies for land management, growing conditions of social inequity and degradation of the urban environment, poverty and lack of access to basic services affecting large human groups living in areas around city belts.

The specific issue deserving more emphasis was the management, access and use of water in the urban context. This must be considered in the context of the inter-relation of social and environmental phenomena inherent to rural-urban interface. The need to contribute with better knowledge to the integral management of water basins becomes more important in order to ensure water supplies to cities and to avoid excessive erosion and floods of the lower parts of basins. Other urban issues were also highlighted as the challenges posed by air pollution, domestic and industrial waste management.

With regards to mining, special emphasis was put on the study of informal mining, characterized by high social complexity, mobile populations and frequent conflicts with local settlements and indigenous communities. This goes together with a strong impact on both the environment and

human health. Whereas occupational risks have been studied more in depth, there is still ignorance as to the impact of environmental risks on the general population. The challenge is to develop a critical mass of research and support comprehensive studies including the analysis of mechanisms of contamination, routes and dynamics of contaminants in the environment, patterns of the general population's exposure and impact on human health. In particular, more attention must be paid to chronic effects caused by the prolonged exposure to heavy metals

The expansion of intensive agriculture was recognized as a severe ecosystem challenge demanding new studies. The impact of mono-crops, growing deforestation, soil erosion, use of pesticides and fertilisers, determine a high level of ecosystem damage that affects biodiversity and human health. As for mining, available research mostly refers to occupational health. Agro-ecosystems research referred to the assessment of chronic effects due to the general population's environmental exposure is, in general, very recent.

Research should also assess the impacts of new agricultural patterns on the nutritional status of large sectors of the Latin American rural population, associated with intensification of export mono-crops and inequities in the distribution of food among economies and within societies.

In Rio de Janeiro, the meeting was devoted to assess the validity of the Ecohealth approach to understand and prevent communicable and tropical diseases. Participants analysed the multiple associations between the disruption of agro and urban ecosystems and the increase of emerging and re-emerging diseases. The final proceedings (published as a special issue of Reports in Public Health, vol. 17 supplement 1, 2001) include a varied range of case studies.

Challenges and strategies for research and ecosystem management

The three consultations underline the strengths of the Ecohealth approach and its holistic nature (integrating the health, social and environmental visions). Different researchers will have different entry points (disease, poverty, environmental problems) but, whatever the entry point, in the end they will be seeking the same integrated, ecosystem understanding.

In coherence with its holistic nature, this new approach is sensitive to social and cultural differences. Special emphasis should be made with regards to indigenous cultures that depend directly on the integrity of the ecosystem they live in, in terms of their health and well being. The preservation, valorisation and/or rescue of traditional knowledge must be accounted for in the Ecohealth approach. Research, in turn, should take into account conflicts generated around the defense of indigenous territories.

In the countries of the South, social equity becomes specially relevant to the approach; sustainable and equitable development are conceived as mutually integrated challenges.

Ecohealth research is based upon a gender integrative approach. Understanding the differing roles and positions in society constitutes an essential input in the analysis of the impact of human activities on ecological systems. Furthermore, understanding role differences can lead to a better understanding of the different patterns of exposure to environmental and health risks, to better ensure that health issues are addressed and to more beneficial and equitable interventions and successful ecosystem management*.

Research should not only be applied but also applicable; this means the need to emphasize the use of research and the design and implementation of concrete ecosystem management interventions to promote human health.

Three main methodological guidelines are strongly supported: transdisciplinarity, community participation, and the gender integrative approach.

The Ecohealth approach implies significant methodological challenges. A basic consensual assumption is that a plurality of methods (qualitative and quantitative) is essential, using both primary and secondary data. For the most part, the discussion is not referred to creating new methods, but rather to harvesting and systematizing methods to achieve the goals of this new approach.

Ecohealth research deals with a multi-scale approach related to both landscapes and people. In most cases, data will not be collected at all levels and temporal and spatial integration will only take place at specific scales. The scales of data collection and the format of the outputs need to be specified at the beginning of the research.

Finding a shared vision and strategy

The integration of disciplines is essential to break with the territorial approach of academics. To this effect, in addition to achieving the integration of a multidisciplinary research team, it is necessary to develop democratic relationships within the team and generate early processes of interaction between researchers from different disciplines.

Different kinds of collaboration should take place at different levels: community and researchers, community and government (both local and national), community and its own civil society. Intensive interaction between academics, community representatives and key stakeholders should be conceived as a continuos process along the research process.

Sure access to the community

Communities must be seen as leading stakeholders in the research process. They must play a central role in setting development and research priorities. Consultation and community participation must be carried out from the very outset of the project.

A successful ecosystem approach includes individuals from the community in the research team and ensures their active participation*. However, community participation must go beyond the individual level where relations are limited to individuals or groups of people, and reach different levels of participation and multiple sets of stakeholders. At this level of complexity, methods are needed to deal with conflict among stakeholders.

Gaining Credibility

The Ecohealth approach must face important challenges to increase credibility at different levels: academic, community and political. The need for regional capacity building is widely remarked. Subsequently, in order to achieve scientific credibility it is necessary to build capacity to publish results in scientific journals – an evident shortcoming in the case of Latin American researchers.

In order to achieve academic, social and political accountability, it is necessary to give priority to the publication and dissemination of successful projects. Lastly, insofar as communities and relevant stakeholders are involved in the projects, accountability and relevance will increase.

Measuring success

New indicators may be needed to characterize unique and complex systems or to allow health or ecosystem status to be measured by community members. The challenge lies in creating the unique indicators that may be required to suit the specific context of each project*.

Having baseline information is relevant in order to measure the ultimate impact of ecosystem interventions. Specific proposals are made to develop gender integrative indicators, develop ecosystem indicators that take into account social equity, and promote life quality indicators adjusted to the cultural context of each region.

Capacity building and dissemination

There is a general consensus that, although it may be necessary to introduce Ecohealth concepts into the professional and undergraduate curricula, what is essentially needed is to plan and implement complementary strategies to create open-minded professionals and specialists.

A main conclusion is that the Ecohealth approach requires the development of permanent institutional frameworks to help to enhance the research capacity and achieve a broader regional dissemination. Isolated and/or short term efforts are not effective.

The new communication technologies must play a key role. Development of long-term sites can be used for case or problem based learning. Electronic communication should be intensified among research teams. The creation of a regional Ecohealth network is strongly recommended and could play a key role in the promotion and dissemination of the approach.

Publication of successful results must be strongly encouraged. Developing appropriate vehicles for dissemination should include specific formats and strategies vis-à-vis the different audiences.

With regards to training, the delivery of short courses to professional ecosystem managers already in the work stream, the creation of regional post-graduate courses on Ecosystem Approaches to Human Health, and a better integration of health and environment University programmes are particularly recommended.

Concluding remarks

A significant number of institutions and researchers have joined these consultations, expressed their commitment to the Ecosystem Approach to Human Health, contributed to introduce regional perspectives in the definition of thematic priorities, and suggested strategies for research, capacity building and dissemination. Participants agreed on the value of this new approach to promote human health and well-being by managing ecosystems better, in the context of sustainable and equitable development.

Roberto Bazzani
Gabriella Feola

Notes

* From "Ecosystem Disruption and Human Health". A Joint IDRC/UNEP Consultation at the Canadian Conference of International Health. November 1999.

** Chapter 5.3: Keynote Speech: Better Ecosystem Management for Improved Human Health: the Ecosystem Approach to Human Health. Gilles Forget

Annexes

Annex I

International Workshop

An Ecosystem Approach To Human Health: Communicable And Emerging Diseases

Rio de Janeiro, Brasil, 7-12 November 1999
IDRC – UNEP – FIOCRUZ – PAHO

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Agenda

Sunday, November 7

19:00 Opening - COPACABANA MAR HOTEL
Rua Ministro Viveiros de Castro, 155
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Tel: (55-21) 542 5141; Fax: (55-21) 275 2299)
- Dr. Eloi Garcia (Presidente da Fundação Oswaldo Cruz)
- Representante do Ministro da Saude - Brasil
- Sponsors: ENSP-FIOCRUZ: Paulo Buss (hosting institution)
  IDRC: Don Peden
  PAHO: Jacobo Finkelman

Monday, November 8

8:00 Bus from hotel to ENSP-FIOCRUZ

8:30 - 9:00 Registration

9:00 - 10:30 Opening Conferences

Ecosystem Approaches and Public Health Paradigms
- Coordinator: *Paulo Buss* (ENSP-FIOCRUZ)
- Ecosystem Approaches to Human Health: *Ole Nielsen* (Canada)
- New Public Health Paradigms: *Jaime Breilh* (Ecuador)

10:30 - 11:00 Coffee Break

11:00 - 12:30 Plenary Session

Ecosystem Approach to Tropical Diseases and Human Health
- Coordinator: *Don Peden* (IDRC)
- Re-assessment of TD Projects based upon an Ecosystem Approach: *Roberto Bazzani* (IDRC)
- Integrated Control of TD: *Silvio Gómez* (Colombia)
- Ecosystem approach to TD: *David Waltner-Toews* (U. Guelph - Canada)
- Guidelines for Analysis of TD Projects: *Roberto Briceño-León* (UCV - Venezuela)

14:00 - 15:30 *Panel on Ecohealth Approaches to Tropical Diseases*

Panel 1: Private space (domestic & peridomestics).
- Coordinators: *Octavio Fernandes* (IOC-FIOCRUZ)
  Roberto Briceño-León (UCV-Venezuela)
- *Alejandro Llanos* (UPCH - Peru),
- *Antonieta Arias* (IICS - Paraguay),
- *Carlos Rojas* (CIDEIM - Colombia),
- *Robert Zimmerman* (WHO Environment Cluster).

15:30 - 16:00 Coffee Break

16:00 - 16:30 Orientation to TD Working Groups

16:30 - 18:00 Visit to FIOCRUZ

18:00 Cocktail hosted by FIOCRUZ President (FIOCRUZ Castle)

Tuesday, November 9

8:15 Bus from hotel

9:00 - 10:30 *Panel on Ecohealth Approaches to Tropical Diseases*

Panel 2: Public space.
- Coordinators: *Silvio Gómez* (Colombia)
  David Waltner-Toews (Canada)
- *William Rojas* (CIB - Colombia),
- *Jaime Calmet* (CIPA - Peru),
- *Gabriel Carrasquilla* (FES - Colombia),
- *Palmira Ventosilla* (UPCH - Peru).

10:30 - 11:00 Coffee Break

11:00 - 12:30 Working Groups - Ecohealth Approaches to Tropical Diseases

14:00 - 15:30 Working Groups - Ecohealth Approaches to Tropical Diseases

15:30 - 16:00 Coffee Break

16:00 - 17:30 Working Groups - Ecohealth Approaches to Tropical Diseases

Wednesday, November 10

8:15 Bus from hotel

9:00 - 10:30 *Conceptual basis for Emerging Diseases: the scope of the problem from an ecosystem approach*

- Coordinator: *Ole Nielsen* (Canada)
- Introducing Emerging Diseases: *Hermann Schatzmayer* (IOC - FIOCRUZ)
- Public Health Challenges and Emerging Diseases: *Luis Jacintho da Silva* (UNICAMP - Brazil)
- Ecological approach to Emerging Diseases: *David Waltner-Toews* (U. Guelph - Canada)

10:30 - 11:00 Coffee Break

11:00 - 12:30 *Case studies: Examples of Interaction between Ecosystem & Human Health*

- Coordinators: *Jacobo Finkelman* (PAHO) *Antonio Carlos Silveira* (PAHO)
- Urbanisation and Ecology of Dengue: *Pedro Luiz Tauil* (Univ. Brasília)
- Hantavirus and Haemorrhagic Fever in Argentina: *Sergio Sosa Estani* (CeNDIE - Argentina)
- Ecosystem Disrupture & Epidemiology of Paracoccidioidomycosis: *Carlos Coimbra* (ENSP - FIOCRUZ)
- Environmental Changes & Epidemiology of Arbovirus in the Amazon Region: *Pedro Fernando Vasconcelos* (Instituto Evandro Chagas, Belem - Brazil)
- Rift Valley Fever in East Africa, Climate & Disease Connections *Assaf Anyamba* (NASA - Biospheric Sciences Branch)

15:30 - 17:00 *Open Conference Session*
(open to the academic community of FIOCRUZ and invited participants)

Public Health Challenges and Ecosystem Approaches to Communicable Diseases and Human Health

- Coordinator: *Paulo Sabroza* (ENSP - FIOCRUZ)
- *Jack Woodal* (UFRJ - Brasil)
- *John Ehrenberg* (PAHO)

17:00-17:30 Press briefing

Thursday, November 11

8:15 Bus from hotel

Panels on Emerging Diseases - Ecosystem Approach

9:00 - 10:30

Panel 1: *Social-Demographic & Environmental Aspects on Communicable and Emerging Diseases*

- Coordinator: *Roberto Briceño-León* (UCV-Venezuela)
- A Human Ecology Perspective: *Maj-Lis Foller* (Sweden)
- Holistic Approaches: *Joao Carlos Pinto Dias* (U.F.Minas Gerais - Brazil)
- Gender and Social Dimensions: Elizabeth Moreira dos Santos (ENSP - FIOCRUZ)
- Cost-Benefit Analysis: *Martha González Moncada* (CIES - Nicaragua)
- An Assessment of Risks & Threats to Human Health due to Collapse/Degradation of the Ecosystem: *Lada V. Kochtcheeva* (on behalf of UNEP - Sioux Falls)

10:30 - 11:00 Coffee Break

11:00 - 12:30

Panel 2: *Development Projects: Ecosystem Challenges and Public Health*

- Coordination: *David Waltner-Toews* (U. Guelph - Canada)
- Ecological Approaches to Development Projects: *Sandra Diaz* (U. Córdoba - Argentina).
- Wetlands and Infectious Diseases: *Robert Zimmerman* (WHO Environment Cluster)
- Ecosystem Approaches to Health and Biodiversity on the Amazon Frontier: *Tamsyn Murray* (CIAT - Peru)

- Human Health Improvement through Arthropod Population Control and Adequate Resource Management: *Johan Baumgaertner* (ICIPE-Kenya)
- Hydro-Electric Dam and Malaria in Brazil: *José Antonio Simas Bulcao* (FIOCRUZ/ Electrobras - Brazil)

14:00 - 15:30

Panel 3: *Integrated Policy Options for Prevention*

- Coordination: *Carlos Coimbra* (ENSP-FIOCRUZ)
- Guidelines for Emerging Diseases Epidemiological Surveillance: *Angel Valencia* (PAHO)
- Mapping Microbes from Space: Remote Sensing as a Tool for Landscape Epidemiology: *Louisa Beck* (NASA Ames Research Center)
- Interactions between Health, Environmental and Socio-Economic Determinants to be considered in Control/Elimination Strategies: *John Ehrenberg* (PAHO)
- Local Strategies & Dengue Control: *Rosely Magalhaes de Oliveira* (ENSP - FIOCRUZ)

15:30 - 16:00 Coffee Break

16:00 - 17:30 Working Groups - Emerging Diseases

Friday, November 12

9:00 - 11:00 Working Groups - Emerging Diseases

11:00 - 11:15 Coffee Break

11:15 - 12:00 *Plenary Session: Strategies for follow up*
- Coordinators: *Roberto Bazzani* (IDRC)
  John Ehrenberg (PAHO)

12:00 - 13:00 Report of Tropical Diseases Working Groups

13:00 - 13:15 Coffee Break

13:15 - 14:15 Report of Emerging Diseases Working Groups

14:15 - 14:45 Conclusions and Recommendations. Closure.

15:00 Lunch (FIOCRUZ Castle)

Annex II

International Workshop

Ecosystem Approaches To Human Health: Latin American Perspectives

Caracas, Venezuela, 29 - 30 November 2000
IDRC – UNAMAZ - CENDES

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Agenda

Thursday November 30, 2000

08:30 - 09:00 Opening

09:00 - 10:20 *Building the Ecosystem Approaches to Human Health (Ecohealth). Ecosystem Health and Human Health conceptual roots, thematic interfaces and trans-disciplinary approach.*

- Sonia Barrios (Venezuela) MODERATOR
- *David Rapport* (Canada) - Ecosystem Health (Origins -roots- and conceptual framework)
- *Gilles Forget* (Canada) - Ecosystem Approaches to Human Health

10:20 - 10:30 Questions

10:45 - 12:15 *Ecosystems and Human Health: Building synergies with emerging holistic paradigms and regional visions*

- Gilles Forget (Canada) MODERATOR
- Elssy Bonilla (Colombia-Santo Domingo)
- Edna Castro (Brasil)
- Charles Aker (Nicaragua)
- Donna Mergler (Canada)
- Alexis Rodriguez Acosta (Venezuela)

12:15 - 12:25 Questions

12::25 - 13:00 Plenary Debate

14:30 - 16:00 *Projects in Latin America. Discussion*

- Miguel Lacabana (Venezuela) MODERATOR
- Donna Mergler (Brasil)
- Oscar Betancourt (Ecuador)
- Carlos Botto-Dario Bermúdez (Venezuela)

16:30 - 18:00 *Projects in Latin America. Discussion*

- Carlos Monedero (Venezuela) MODERATOR
- Mario Henry Rodriguez (Mexico)
- Omaira Mendiola (Colombia)
- Rosa Carmina de Couto (Brasil)

Friday December 1, 2000

08:30 - 09:30 *Tools for environmental health impact assessment. Training activities, post graduate courses, and distance education*

- Lia Tovar-MODERATOR
- Francisco Javier Velasco (Venezuela)
- Rosa Carmina de Couto (Brasil)
- Alexis Mercado (Venezuela)l
- Lourdes Yero (Venezuela)

09:30 - 09:45 Questions

09:45 - 10:45 *Perspectives and views of international agencies and policy-makers*

- Antonio de Lisio (Venezuela) MODERATOR
- Roy Kwiatkowski (Canadá)
- Rosa Acevedo (Brasil)
- Norbert Fenzl (Brazil)

10:45 - 11:00 Questions

11:15 - 11:45 *Guidelines for Working Groups, objectives and thematic presentation.*

- Roberto Bazzani (IDRC - Uruguay)
  Ecosystem Approaches to Human Health: Priority issues and relevant thematic challenges in LAC
  Implementation: strategies for addressing obstacles and challenges

11:45 - 12:00 Questions

12:00 - 13:00 Working Groups

14:30 - 16:00 Working Groups

16:00 - 16:40 Working Groups Conclusions. Questions

16:40 - 17:30 Plenary Debate

17:30 - 17:45 Closure

What is IDRC?

The International Development Research Centre (IDRC) works with researchers to help find practical long-term solutions to social, economic and environmental problems in developing countries. In particular, support is directed towards developing the indigenous research capacity necessary to sustain policies and technologies that can build healthier, more equitable and more prosperous societies.

IDRC was established in 1970 by an Act of the Parliament of Canada.

For further information on IDRC's ECOHEALTH Program Initiative, please contact:

ECOHEALTH at IDRC (Ottawa)
Telephone: (613) 236-6163, ext. 2533
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E-mail: ecohealth@idrc.ca
Web site: www.idrc.ca

Or contact IDRC's Regional Office (LACRO, Montevideo):

E-mail: lacroinf@idrc.org.uy

What is UNEP?

The mission of the United Nations Environment Programme (UNEP) is "to provide leadership and encourage partnerships in caring for the environment by inspiring, informing and enabling nations and people to improve their quality of life without compromising that of future generations."

UNEP was established in 1972, after the Stockholm Conference on the Human Environment, as the environmental conscience of the United Nations system.

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