

**An Ecosystem Approach to Human Health:  
building a transdisciplinary and participatory research framework  
for the prevention of communicable diseases.**

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**Abstract (F8-165)**

Ecosystem Approaches to Human Health (Ecohealth) aim to improve community health by focusing on social and ecological interactions in the analysis of health determinants and responses to health problems. The lens of analysis moves to the ecosystem level as a means to strengthen social involvement and intersectoral responses to relevant development problematiques. Projects use ecosystems as analytical constructs defined relative to the research problem. Human health determinants are conceived in a systemic perspective, as part of complex socio-ecological contexts within specific temporal and spatial scales. Diseases are considered as entry points to the study of complex underlying processes affecting people's health and well-being associated to ecosystem stressors. Ecohealth approaches can contribute to the prevention of communicable diseases, such as malaria and dengue, and other vector-borne diseases. The ecology and transmission of vector-borne diseases are closely related to environmental resource management, social and behavioural patterns. This paper presents a research framework that incorporates social equity in health as it addresses communicable diseases. The three key methodological elements of the approach are: transdisciplinarity, social and gender equity, and stakeholder participation. Multidisciplinary teams are encouraged to interact with critical stakeholders at all stages of the project, which greatly increases the chances of research uptake and translation of the knowledge generated into action. The article concludes by illustrating the application of this research framework to the prevention and control of dengue .

# I

## Introduction

This paper briefly explores the use of ecosystem approaches to human health in the prevention of communicable diseases. It discusses the challenges that such diseases create including social equity aspects, introduces the Ecohealth approach, and explores its use in the specific case of dengue. Communicable diseases are the single most important contributor to the burden of disease and to mortality in developing countries. While communicable diseases globally represent 31% of the total Disability-Adjusted Life Years (DALYs) (World Health Report, 2002), in Africa alone, they account for 61% of total DALYs. Infectious diseases, such as malaria and sleeping sickness, kill millions each year, primarily among the poorest populations in developing countries. The development gap (associated to poverty and ecosystem degradation) is exacerbated by a deep research gap: only 10% of global spending on health research is devoted to diseases that account for 90% of the global burden of disease (Global Forum for Health Research, 2002).

Marginalized people also suffer the burden of neglected diseases such as Chagas, guinea worm and leprosy. While virtually ignored in terms of drug development, they are characterized by having very high rates of DALYs and mortality rates, and underlying factors associated with poverty and degraded environmental conditions.

In the last decade, there has been increased attention to the threats posed by emerging and re-emerging infectious diseases. Among emerging diseases, new diseases have appeared in the last decades at a rate of almost one per year (The World Health Report 2003). In addition to the dramatic threat posed by HIV, other new pathogens of marked severity have emerged, such as the arenavirus causing hemorrhagic fever or Hantavirus causing the Pulmonary Syndrome, both of which have a close environmental link. Simultaneously, old pathogens responsible for cholera, plague, dengue hemorrhagic fever and yellow fever have re-emerged in many developing countries. Wilson (2001) has grouped emerging or re-emerging infectious diseases into four categories: (p 306)

Newly described or recognized (eg. diverse hemorrhagic fevers due to arenavirus, Ebola hemorrhagic fever, AIDS...)

Expanding distributions (eg. dengue fever) associated with spread of infected people and vectors and with ecological changes such as urbanization

Increased local incidence (eg. malaria in the Amazon Region) due to a mix of factors such as migration and deforestation

Increased severity, duration or resistance to treatment, which are mostly due to antibiotic resistance or population with compromised immune systems

Except for the last category, the others offer several examples of the emergence or resurgence of diseases determined by a complex ecological web of causation, including social, economic environmental and biological components.

Infectious diseases can also be classified according to their transmission patterns. This typology is particularly useful to clarify the potential role of the social and ecological underlying factors:

Direct anthroponoses are transmitted from humans to humans (eg. STDs, respiratory diseases, etc...). They mostly depend on changes in human behaviour; ecological influences have a lower impact in the transmission of this group.

Indirect anthroponoses are transmitted from humans to humans mediated by a vector or vehicle (so humans are the exclusive reservoirs). Four relevant diseases are included in this group: malaria, dengue, schistosomiasis and lymphatic filariasis.

Direct zoonoses: are transmitted from animals to animals, and occasionally transmitted to humans. Hantavirus and Hemorrhagic Fevers are emerging diseases closely associated with agricultural production, land use and abundance of rodents.

Indirect zoonoses: are transmitted from animals to animals and occasionally to humans, mediated by a vector. In this group we can identify relevant diseases such as Chagas and Trypanosomiasis Africana (sleeping sickness), leishmaniasis, and plague (considered as re-emerging).

Pathogens that spread from animals (zoonoses) or by indirect means (vector borne diseases as malaria and dengue) are highly influenced by ecological conditions. While communicable disease experts acknowledge a complex 'web of causation' of these diseases, their focus remains on biological and ecological mechanisms of disease transmission. Rarely do they consider social, cultural, political and economic factors that may help explain the occurrence of the disease in the first place, and/or guide the design and implementation of responses to prevent and control transmission.

Yet the ecology and transmission of most infectious diseases is closely related to environmental resource (mis) management, social interaction and behavioural patterns. Their persistence is largely rooted in social inequity, with poverty being the major impediment to their control and elimination (Hartigan, 1999). Gwatkin and Guillot (1998) estimated that the poorest 20% of the world population experienced 47.3% of deaths worldwide associated with communicable diseases. The spread of infectious diseases depends on transmission of agents. The transmission of agents that are water borne or air borne, are in turn dependent on environmental and social conditions, requiring therefore to understand these in a linked manner. The increasing challenges and the burden of disease posed by infectious diseases in developing countries, affecting the poor disproportionately, calls for more integrated thinking on health and environmental issues and more inclusive processes to address the pressures and conditions that result in the generation and spread of communicable diseases. It is in the context of this need that this paper discusses the use of Ecohealth approaches to communicable disease prevention.

## II

### **Ecohealth approaches to human health and well-being**

Ecosystem approaches to human health draw on earlier ecosystem-based initiatives to improved environmental management, many of which were pioneered in North America (IJC, 1978, Constanza et al, 1992, Rapport, 1995, Kay 1999). Ecohealth approaches, however, are centered on the improvement of human health and well-being (see Mergler, 1999, Waltner-Toews et al, 2001, Feola G and Bazzani R (eds) 2001, Forget and Lebel, 2001, Lebel, 2003, Noronha, 2004).

Ecohealth-type research “explores the relationships between various ecosystem components to define and value the priority determinants of health and human well-being” (Forget and Lebel, 2001, p S 16). While employing a holistic definition of health as being “... *a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity*”, the actual use of the approach has involved a broader conceptualization, which goes beyond the health of an individual to capture the social dimension. Health is seen as a resource for everyday life,<sup>1</sup> a means, but also an end in itself.

“Ecosystems” in this research framework, are used as analytic constructs, defined relative to the research problem. They refer to the **social and ecological contexts**, both on a temporal and a spatial scale, of human lives. For example, in a research study, the ecosystem can be a household, a school, a neighbourhood, a slum, an urban area, a watershed, or a forest. Human activities alter these contexts and create stresses and changed patterns that may compromise the health of people. These result from changes in ecological conditions as they interact with social, political and economic behaviour and conditions. Ecosystems need to be seen as ‘nested hierarchies’ so that relevant processes and critical stakeholders at various levels can be identified and engaged with.

The framework includes three core elements: **transdisciplinarity; social justice and gender equity; and stakeholder participation**. All three are essential to understand social and ecological interactions that lead to disease, as well as to arrive at feasible ways to prevent transmission and improve health. **Transdisciplinarity** involves moving across disciplines, from the social, health and natural sciences. To understand the interactions between social and ecological systems, one cannot use the traditional discipline-bound methods and tools of just one or the other, but instead need to engage with ‘conceptual and methodological presuppositions and limitations which are tied to each disciplinary perspective ... in the light of the problem under study’<sup>2</sup>. It also requires an engagement with local non-scientific actors, as these provide access to different knowledge systems that may contribute to important insights for understanding the problem. The need to arrive at acceptable and practicable solutions and policy

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<sup>1</sup> WHO: A discussion document on the concept and principles of health promotion. *Health Promotion* 1:73-78, 1986

<sup>2</sup> See Becker and Jahn, 1999 for a fascinating discussion on transdisciplinarity in the context of linking social and ecological systems . p 13

suggestions requires the **engagement and participation of different stakeholders** (those who have a stake in the problem – either in the causation, the understanding or in the solutions). This engagement helps ensure a clear ownership of the project. But the methods and tools that can be used to involve stakeholders are flexible and will vary depending on the context. Given the asymmetry of power and the diversity of interests between stakeholders, the approach places special emphasis on community empowerment in terms of increasing the ability of community members to articulate their concerns, be informed, and involved in decisions that affect their lives.

The third element is **gender and social equity**, in recognition of the fact that different population groups have different levels of vulnerability to disease and can have different needs to arrive at similar health levels. These differential conditions and needs can arise from a variety of social, cultural, and biological factors.. For example, studies have found pregnant women to be more susceptible and vulnerable to malaria. Pregnancy increases the likelihood of contracting the disease and can cause maternal anaemia, leading to an increase in maternal and neonatal morbidity and death.(Malaria Consortium, 2003). Women who contract malaria are also more likely than men to delay treatment due to lack of time or because they are tied down due to childcare arrangements. This delay often can prove fatal. Other studies indicate that due to the social stigma attached, women will not seek treatment for tuberculosis. Case studies that focus attention to social and cultural conditions of ill health suggest that there are lesser chances of women's illnesses being detected and treated because of different attitudes to morbidity.<sup>3</sup>

Different social groups or individuals in a community experience reduced well-being from communicable diseases in different ways. Some become more ill while others less. Some suffer more, others die. The social, emotional and economic effects also differ between individuals and groups. The cost of not working due to illness, for example, can bring single-parent or elderly led households into severe financial crisis and food deprivation. Equity aspects relevant to communicable diseases can be divided into the following broad (and overlapping) categories:

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<sup>3</sup> See Murray for a discussion on different types of morbidity: self perceived, observed and both self perceived and observed..( p 143)

Exposure levels to harm (frequency, duration, intensity, multiplicity)

Vulnerability in contracting disease

Access to health resources

Coping capacity in experiencing disease

Ability to influence policy and decision-making that impact health production

Inequities in each category are shaped by social and/or ecological processes and to a large extent determine who is affected by a disease and how the person and household are affected. These occur at different ecosystem levels or scales, from the individual, the household, the community, the watershed, and so on.

Table 1 below summarizes some of the social and ecological conditions that create a vulnerability to a certain disease, or aggravate conditions that make things worse. These conditions call for gendered and socially sensitive responses if preventive approaches are to work.

The literature suggests that initial endowments, support networks, access to health care and other resources are factors that determine coping capacities and resilience and affect the level of impact and human stress. Prolonged exposure to disease, reduced immunity and the erosion of existing social security nets can often heighten vulnerability. Access to resources and initial conditions can be primary factors that determine the vulnerability of people to certainty health hazards. Slums, for example, are areas where infectious diseases can develop and spread fast due to overcrowding, congestion, lack of sanitation, contaminated water, dumping of garbage and waste. This suggests the need for research on the differential vulnerability and burden of disease on men and women, on different social groups and the need for responses that integrate gender sensitivities and address social inequities in improving access to and control over resources that are central to improved health and well-being.

Table 1: Social and ecological conditions that predispose and exacerbate disease

<b>Level</b>	<b>Types of factors influencing vulnerability to ill health</b>	<b>Examples of predisposing conditions</b>	<b>Examples of communicable diseases</b>
Individual (biological, cultural, and health related factors)	Genetics, Sex, Age, Status of Immune System, Pregnancy Status, Health Status (multiple diseases, nutritional status)	Malnutrition, Pregnancy	Cholera, TB, Malaria
Household (social, cultural, environmental, and economic factors)	Poverty, Nutritional Status, Gender Dynamics, Health Belief Systems, Health-Seeking Behaviour, Education, Religion, Access to and Quality of Natural Resources, Household Environment	Poor housing  Poor ventilation, Indoor Air Pollution, Crowded Housing	Cholera, TB, Chagas  Respiratory Diseases
Community (social, cultural, environmental, political, and economic factors)	Poverty, Gender Dynamics, Health Belief Systems, Health-Seeking Behaviour, Education, Ethnic, Religious & Political Affiliations, Health Services (availability, quality, access, relevance), Access to and Quality of Natural Resources, Quality of Bio-Physical Community Environment	Poor Sanitation, Poor Drainage, Unsafe Drinking Water	Cholera, Intestinal Parasites, Dengue, Schistosomiasis
State, Nation, and above (social, cultural, environmental, political, and economic factors)	Quality of Bio-Physical Environment, Access to and Quality of Natural Resources, Drug resistance, Migration Patterns of Populations, Health Services, Health Policy, Development policy	Degraded Environments, Weak Institutions, Ecological (eg. migration due to natural disasters, disease vector proliferation) and Political Factors (eg. migration for jobs, armed conflict)	Cholera, Intestinal Parasites, Malaria, Dengue, HIV, Schistosomiasis

The use of Ecosystem approaches to prevent the occurrence of communicable diseases involve an engagement with understanding how disruptions in the social and ecological contexts lead to the occurrence and transmission of specific diseases. Even if diseases are commonly defined through biomedical parameters, most of them, as in the case of communicable diseases, are socially and ecologically determined.<sup>4</sup> The use of ecosystem approaches involve going beyond an exclusive focus on biological mechanisms through which disease operates to an engagement with ecological, political, social and economic interactions that can explain why a disease occurs in the first place and how it gets transmitted, with a view to arrive at preventive interventions. The intention is to generate new knowledge on people’s attitudes, behaviour and relations to the environment and identify the social, economic and governance structures and processes that contribute to the occurrence and transmission of disease. Table 2 contrasts the Ecohealth research framework to the more traditional approaches to health research.

Table 2: Types of Health Research for Development

Level	Determinants	Responses	Goal
<b>Individual</b>	Bio-medical	Clinical & pharmaceutical research	Less ill people
<b>Community</b>	Epidemiological research (health status and risk factors)	Research on health policies, health systems and health services	Improve community health
<b>Ecosystem</b>	Ecohealth research: Transdisciplinarity, multi-stakeholder participation, gender and social equity; addresses complexity of ecological & social interactions	Multi-stakeholder, multi-sector, participatory research (design & testing of interventions)	Healthier community through sustainable development

<sup>4</sup> Increasingly links are made between malnutrition, lowered health status and risk of infectious diseases. This is specially evident for tuberculosis and malaria.

The focus of the approach is oriented to prevent diseases through a better understanding of the modifications of the ecosystem dynamics. Two issues are immediately of importance: 1). How to avoid the creation of such conditions? and 2). How to increase the resilience of people to such outbreaks? In the next section, we briefly outline the possible use of this approach to address the prevention of dengue.

### III

#### **Using Ecohealth approaches for communicable disease prevention – The case of dengue**

Dengue has re-emerged as a major escalating global health problem in developing countries. More than 653,000 DALYs (World Health Report, 2002), 50-100 million illnesses, including 250 000-500 000 cases of dengue haemorrhagic fever and 24 000 deaths per year have caused a worldwide public health alarm (Gibbons, 2002). The increasing spread of the mosquito, *Aedes Aegypti*, main vector responsible of its transmission, has to be analysed far beyond the micro local scale level dynamics. Dengue resurgence is nowadays a global health problem (Gubler, 1997). While dengue respects no social groups, its impact can be more pronounced and damaging on the poor and the weak as their ability to cope is already low.

An increasing number of projects have since the last decade embraced research studies at different levels of analysis. Koopman (1991) analyzed dengue determinants in Mexico and brought evidence on environmental variables. While median ambient temperatures during the rainy season were the strongest predictor of dengue infection, the proportion of households with uncovered water containers was a significant contributing factor. Because these factors have effects beyond the individual household, authors concluded that both the level of analysis and the organization of control efforts must be done at the community as opposed to the household or individual levels. More recently, Tran (2004) studied spatial and temporal scale patterns of dengue transmission in French Guiana using GIS and analyzed environmental factors to establish a model of epidemic dynamics.

As a response to the dramatic increase in dengue in several Brazilian cities, several national researchers have presented complementary approaches and studies. Tauil (2001) investigated demographic changes linked to dengue with a focus on the interactions between urbanization, poverty, social and sanitary facilities in overcrowded cities. In fact, large sectors of the population in large and medium-sized cities live in slums or under similar conditions and are so exposed to social and environmental factors such as the lack of regular water supply and public garbage collection that foster the proliferation of potential breeding sites for the main disease vector, *Aedes aegypti*. Simultaneously, another Brazilian researcher (Possas, 2001) highlighted the links between emerging and re-emerging diseases with societal determinants, and discussed historically dissociated paradigms, proposing a transdisciplinary approach, that of social ecosystem health, incorporating distinct perspectives into a comprehensive framework. Heukelbach (2001) studied risk factors in a *favela* in the northeast city of Fortaleza in Brazil. These studies reflect what Reiter (2001) concludes when discussing the controversial issue of climate change and infectious diseases: “the histories of three such diseases--malaria, yellow fever, and dengue--reveal that climate has rarely been the principal determinant of their prevalence or range; human activities and their impact on local ecology have generally been much more significant”.

Similarly, the focus of the Ecohealth approach is on how human-induced ecosystem changes have determined the proliferation of *Aedes Aegypti*. Using an ecohealth approach for dengue prevention suggests that it is feasible to improve community health, if social and ecological determinants of dengue are identified and modified through transdisciplinary research. The core hypothesis here is that proliferation of *Aedes Aegypti* and dengue transmission are social and ecologically determined. So, in order to develop appropriate preventive approaches, a twofold challenge exists: need for a better comprehension of societal and environmental causal dynamics and the implementation of participatory interventions and policies responding to specific local factors as well as to large-scale stressors. This suggests:

Firstly, the need for research to be multi-domain: factors arising from multiple domains, - environmental, economic, political and social - are analysed and confirmed as determining factors in different studies along the past decade.

Secondly, the need for research to recognize the temporal and spatial levels of analysis:

an ecosystem approach to dengue prevention will involve analysis at many levels and a sensitivity to multiple feedbacks from the individual level to a collective level of urban social dynamics, from the household focus to a community and ecosystem level of analysis, from the regional to a macro spatial and temporal lens.

Thirdly, the need to explore whether and how it is feasible to modify the web of causation if research is linked to social and political praxis, which involves local communities, and also has the commitment of other relevant stakeholders groups such as local governments, primary health care centres, builders and others.

This last point implies a major reorientation of predominant dengue prevention public health programs that are mostly based upon communication media campaigns and the promotion of household-level behavioural changes. The lack of achieving and having access, at least in the next 10 years, to an adequate dengue vaccine makes it unfeasible to reach a simple or single magic bullet solution (Gubler, 2002).

Within an ecosystem approach, the diverse set of factors associated with dengue must be considered in the context of complex analytical frameworks, linking the eco-biological aspects with the social groups dynamics and political economy of health. Accordingly, the proposed response to dengue prevention will move the lens of analysis from a predominant health services response to a concern with determinants. Ecosystem based strategies for remediation can be introduced at an earlier stage (prevention policies) thereby reducing the level of "ecosystem distress" (Cook, 2004). Table 3 below illustrates multiple dimensions of analysis and action envisaged by the approach.

Multiple studies have highlighted the importance of community involvement in dengue prevention (Lloyd, 1994). Specific strategies for social mobilization and communication have developed behavioural model changes at the household and community level (Parks, 2004). Beyond behavioural approaches and community participation, a comprehensive ecosystem based response to dengue should involve multiple stakeholders in order to bridge the links between research and ecosystem management policies.

Table 3: Multi-causality: multiple dimensions of social-ecological interactions

<b>MACRO LEVEL</b>	<b>NATIONAL / REG LEVEL</b>	<b>LOCAL / MICRO LEVEL</b>
Climate change	Deterioration of public health systems and services	Breeding sites of vector in household/neighbourhood/ community surroundings
Ecological impacts of globalization	Mobility of population	Increased use of non-biodegradable containers/ materials
Development patterns (non-biodegradable wastes such as tires, plastics)	Increase in intra-regional travel and transport	Households without water supply and poor sanitary conditions
Demographic changes	Increase in poverty and population density	Weak / absence of community-based organizations
Urbanization	Increase in un-served (water, sewerage, waste collection) urban areas	Deficient municipal services (waste collection & disposal, leaky water pipes and sewers, etc.)
Mobility of populations	Vector adaptability to new environments	
Increase in inter-regional travel and transport		

## IV

### Conclusions

The response to development and health challenges and complexities require a more integrated thinking in health research. Integrated responses need to involve a set of interventions that relate both to the social and the ecological systems that create disease and its transmission. There is sufficient evidence to suggest that some communicable diseases have highest prevalence where certain social and ecological conditions exist.

These conditions suggest the need to have a gender and social lens when addressing the prevention of disease. Attention to gender and to other marginalized social groups provides a context in which to discern how behavior, economic, social and cultural conditions, and the way environmental resources are managed (or mismanaged) influence the occurrence and transmission of a disease. The success and sustainability of interventions will depend to a great extent on the degree of social participation, existing health system, ecological conditions and involvement of policymakers and other relevant stakeholders.

A **research agenda** to address communicable diseases using an Ecohealth perspective thus calls attention to the following questions:

1. What are the social and ecological conditions that mediate the dynamics of human-environment relations that cause disease to emerge, and what are the mechanisms of transmission?
2. What is the potential for disproportionate exposure to and burden of disease arising from the social and ecological contexts of different groups in a society? Are there some groups that bear a disproportionate burden of disease relative to other groups, e.g. poor people, women, children, the socially excluded, the old or the sickly?
3. What causes this disproportionate burden? Is it current health conditions which result in

an increase propensity to disease (e.g. poor health and a low immunity resulting in higher tendency to malaria, or social and economic conditions; what are the connections between the two?)

4. What is the capacity of different groups to cope with such outbreaks in terms of alternative options to live in, to work; what is the nature of the trade offs that people make, what resources do they have or have access to, either in terms of human or social or financial capital to cope with the disease?
5. What is the nature of vulnerability to disease between genders and different social groups?
6. What is the role of governance in monitoring ecosystem conditions, enforcing laws, addressing grievances, adopting proactive roles?
7. How can one involve different stakeholder groups to proactively deal with the problem?
8. How can solutions be developed that are sensitive to the fact that different groups have different needs?

**To conclude**, when promoting an ecosystem approach to human health, responses to the disease are not based solely on improving biomedical clinical diagnosis or treatment, or to be channelled exclusively through health services, but encompass a holistic, systemic and participatory approach to addressing the social and ecological determinants of disease and its transmission. By going beyond health services responses and moving the research and interventions through the use of multi-stakeholder participation approaches, there is an increased possibility of greater connectivity with, and ownership of, the direction of change by those affected.

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