GEO Health: Methodology for Integrated Environment and Health Assessment

A focus on Latin America and the Caribbean

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GEO Health: Methodology for Integrated Environment and Health Assessment. A focus on Latin America and the Caribbean

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Foreword

After a long process that began in 2003 and benefited from the participation of many scientists and experts both in America and the Caribbean and from outside the Region, it gives us great pleasure to present the document *"GEO Health: Methodology for Integrated Environment and Health Assessment. A focus on Latin America and the Caribbean"* on behalf of the United Nations Environment Programme (UNEP) and the Pan-American Health Organization / World Health Organization (PAHO/WHO).

The preparation of the GEO Health methodology is an initiative motivated by the Declaration of Health and Environment Ministers of the Americas in Ottawa in March, 2002, where the commitments established in the Pan-American Charter on Health and the Environment in Sustainable Human Development and the Washington Action Plan of 1995 include: "the value, the importance and the need for the health and environment sectors to work more closely in defining the problems, identifying the solutions and in the instrumentation of joint initiatives with the participation of the public and private sectors, as well as civil society".

GEO Health methodology offers us a guideline for carrying out an integral assessment, creating an intersectorial, interdisciplinary and participatory space where reliable scientific information can be produced and addressed to the persons responsible for policies on environment and health issues. After having analysed the main instruments of environmental assessment applied in Latin America and the Caribbean, the components of the GEO Health conceptual framework were linked together, based on the synergy of the conceptual framework for environmental assessments UNEP's "Global Environment Outlook" (GEO) and the HEADLAMP Model (Analysis of health and environment for decision making), developed by the World Health Organization (WHO).

Today, more scientific evidence is available than at any other moment in history, showing us the distinct interrelations between ecosystemic integrity and environmental services, and human wellbeing and the quality of people's lives. This evidence of social – environmental links has begun to attract the attention of different stakeholders in our society. It is our wish that this GEO Health document, born of the intersectorial efforts of two United Nations agencies with mandates on environmental protection and vigilance over health matters, will provide the people responsible for policies regarding these matters, with a firm methodological base to design and apply future policies.

Finally, we express our thanks to the Environment and Health Ministries for their inestimable efforts, and to the scientists, researchers and institutions, for their valuable collaboration that made it possible to prepare this document. We give special recognition to the contribution made by the governments of Brazil and Argentina, countries in which the methodology was submitted to pilot testing.

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INTRODUCTION

1 INTRODUCTION

1-1. Background

In 1995 the United Nations Environment Programme (UNEP) began a process of environmental assessments called "Global Environment Outlook" (GEO). The aim behind this initiative was to promote a better understanding of the interactions between environment and society by raising awareness regarding social and ecosystemic consequences of environmental changes. Since then, the GEO environmental assessment process has been applied on different territorial scales and has resulted in a variety of products, including reports on environmental assessments at world, regional, sub-regional and national levels, as well as in cities in different parts of the world.

Drafting GEO reports implies making a scientific analysis of available information on the environment and society, as well as engaging in extensive discussions and participatory processes to provide an updated environmental outlook capable of promoting more efficient policy making.

The UNEP Regional Office for Latin America and the Caribbean (UNEP/ROLAC), through the Division of Early Warning Assessment, helps the countries in the Region to carry out environmental assessments to promote sustainable development. With over a decade of experience in Latin America and the Caribbean (LAC), the GEO process has been improved and adapted to different social, environmental, economic and political realities; it has assembled a set of lessons learned and has helped to strengthen local technical capacity for sustainable management of the environment.

Moreover, the World Health Organisation (WHO) and its regional component, the Pan American Health Organisation (PAHO), have developed and used a series of instruments that allow health problems, diminished functionalities and deteriorated quality of life caused by environmental impact to be approached from different perspectives. In recent years, WHO/PAHO hasmade notable advances in understanding the social determinants of health and the environmental burden of disease.

Likewise, there has been an increase in international scientific and academic interest to better understand the associations between environmental degradation and the loss of individuals' and communities' quality of life. To a large extent, this trend accompanies the growing demands from civil society organizations concerned with both the globalization of environmental problems and the unequal way their consequences affect society. Governments and international aid agencies have been quick to echo these demands.

A framework of particular interest in this sense was the United Nations Conference on Environment and Development, held in Río de Janeiro, Brazil, in 1992. That conference, the most important held until then, saw a number of commitments made concerning the global environment, including Agenda 21, an instrument to guide inter-sectorial policies in favour of sustainable development and a healthier environment.

Another important event of particular note was the signing in 1995 in Washington, D.C., United States, of the Pan American Charter on Health, Environment and Sustainable Human Development. This document defined the main common political and strategic principles that should be adopted by the countries of the Americas.

The Health and Environment Ministers of the Americas (HEMA) met once again in 2002, in Ottawa, Canada when the Ministers made a commitment to strengthen programmes and strategies that promote a healthier environment and better health conditions for the population within a framework of policies designed to reduce inequality and poverty, and to promote forms of sustainable development.

The HEMA working group met three times during 2004 and 2005 and achieved a consensus on the importance of adopting three priority topics for hemispheric action:

(i) integrated management of water resources;
(ii) human settlements and solid waste; and
(iii) chemical safety and integrated health and environmental assessment, particularly indicators regarding children.

In June 2005, in Mar del Plata, Argentina, another HEMA meeting was held. The meeting provided an

opportunity for dialogue and reflection on what had been achieved by this inter-sectorial initiative, on the challenges remaining, and on ways to approach them. In this respect, there was insistence on the need for continued support for local development and capacity building to make assessments based on indicators that simplify inter-sectorial public policy making regarding the environment and health. However, it was concluded that some countries need special support to make significant advances; this is because, given the limited technological and financial resources available, different national priorities, growing social malaise and disasters, they do not have enough of their own resources to make the investments needed to meet the goals that have been set.

1-2. The GEO Health Project

In response to HEMA's Ottawa Declaration, signed in March 2002, UNEP and PAHO, with the technical collaboration of the Oswaldo Cruz Foundation (FIOCRUZ) of the Ministry of Health of Brazil, decided to begin working on a joint integrated health and environmental assessments project that would later be called GEO Health.

The GEO Health Project was initiated in 2003 to create an inter-sectorial, inter-disciplinary and participatory arena where reliable scientific information could be produced for policy-makers dealing with environment and health in LAC. Right from the start, the proposal relied on the participation of a large number of institutions and specialists from different countries in the Region.

A major challenge has been to develop a participatory methodological approach based on environmental and health indicators that can be efficiently applied throughout LAC, taking into account regional limitations as to data, historical series and installed technological capacities.

As yet, the socio-environmental, political, cultural and economic heterogeneity of LAC demands the creation of a sufficiently flexible assessment adaptable to all local realities without losing its ability to establish parameters for spatial and temporal comparisons within and between the countries in the Region.

Box 1: GEO Health Project Objectives

- To help to better understand the complex interactions between the economic development model, the politico-institutional order, environmental impacts, ecosystemic services and human welfare.
- To promote strengthening installed capabilities and create new capacities, both human and technological (statistics, information sources, infrastructure for monitoring environmental and health variables).
- To foster horizontal participation among all the social stakeholders concerned with the problems discovered while seeking integrated inter-sectorial action.
- To establish priorities (problem, space, social group) to guide policy-makers on the need for short-term action.
- To recommend short-term action.
- To help draft integrated public policies on the environment and health (mid- and long-term action).
- To support the creation of an information system –an historical series of environmental health indicators– to become an instrument for environmental monitoring and environmental health surveillance at different levels of geographic aggregation.
- To prepare a report on "Environment and Health Outlook" that systematizes relevant information with a scientific basis – indices and indicators- directed to policy-makers and capable of making society aware of the need for sustainable development of healthy environments to promote health.
- To help achieve the Millennium Development Goals

The first steps in the GEO Health Project were to:

(a) prepare a critical review of the methodologies applied in LAC that in some way would allow for an assessment to be made of environmental impacts on health; and
(b) draft a glossary of technical terms.

The critical review of methodologies was headed by FIOCRUZ, while the process for developing the technical glossary was led by UNEP with assistance from the Universidad Autónoma de México (UNAM).

Both activities were supported by a strong network of experts headed by the collaborative partners of UNEP and PAHO. The criteria applied for the critical review of the methodologies were:

- Using indicators to develop the capacity to assess the effect on health of the environmental problems studied;
- Considering instrumental adaptability, budget conditions and installed technological capacity in LAC countries; and
- Including an inter-sectorial participatory approach in the methodology employed.

The document containing the analysis of the results of this review (summarized in Table 1), together with a first version of the technical glossary, were discussed at a workshop held in March 2004, in Brasilia, Brazil.

Later, a group of specialists co-ordinated by FIOCRUZ drafted a methodological proposal to develop participatory inter-sectorial assessments of environment and health in LAC. This document was discussed at a workshop held in San José, Costa Rica, in September 2004.

In February 2005, a workshop was held in Mexico City to discuss the profiles of the most appropriate indicators for an integrated environment and health assessment. Also discussed at the workshop were strategies for carrying out pilot tests of the proposed methodological approach that would allow operational procedures to be reformulated to include the identification of indicators so as to consolidate the GEO Health methodology.

Preliminary versions of the first three GEO Health Project products (the review of methodologies applied in LAC; the methodological proposal; and the English, Spanish and Portuguese versions of the technical glossary) were presented at the HEMA meeting in Mar del Plata, in July 2005. A summary of the critical review of methodologies was published as a special report by the *Pan American Journal of Public Health*, a PAHO scientific publication.[1]

Once the theoretical development stage ended, it became necessary to test the methodological proposal to make an empirical assessment of its weakness and make any necessary adjustments. Then the challenge was to select socio-environmental contexts that reflect the Latin American and Caribbean situation, at least in respect to health aspects, as well as to seek the support of governments from the Region to effectively apply the process locally. After a negotiating period, two pilot tests were agreed: one in São Paulo, Brazil, and another at two sites in Argentina: a rural community, Chabás in Santa Fe; and a metropolitan area, Munro in Buenos Aires. Both experiments were carried out in 2007.

In March 2008, a workshop was held in São Paulo, Brazil, to discuss the progress made and the results of the pilot tests. The workshop was attended by participants from the teams responsible for applying the tests, representatives from UNEP and PAHO, specialists and representatives from different government health and environmental management agencies in Brazil.

Thus, the process that began in 2003 accumulated knowledge, experience and lessons learned that allowed the GEO Health proposal to be transformed into the tested and consolidated methodology presented in the following chapters.

1 Schütz G, Hacon S, Hilton S, Moreno Sánchez AR, Nagatani K. Application of key frameworks to an indicator-based evaluation of environmental health in Latin America and the Caribbean . Pan American Journal of Public Health. 2008;24(4):276-85

Box 2: Why a GEO Health?

The aim of the GEO Health Project is to develop an instrument capable of assessing the relationship between the health of the environment and human health, using of matrix of duly organized, integrated and analysed basic indicators with a strong logical and conceptual framework.

In contrast to multi-disciplinary methods, GEO Health is not limited to presenting environmental and health indicators in the same report, but rather to promote their systematic integration.

The strength of the GEO Health proposal lies in offering policy-makers integrated environmental and health indicators prepared in a way that is inter-disciplinary, inter-sectorial and participatory. The integrated environmental and health indicators represent a valuable (and novel) tool for guiding public policies that will foster sustainable development, healthy environments, health promotion and citizen participation.

On the other hand, the challenge for the GEO Health proposal is the limited installed capacity in the Region. In effect, with the exception of a few cities, LAC suffers from a dramatic lack of secondary data on the environment and health, particularly in rural areas, small settlements and territories of socio-environmental interest. In these cases, the GEO Health process anticipates strengthening local capacities, using proxy indicators and, if it turns out to be indispensable, producing easily gathered and processed primary data.

Table 1: Key models for environmental health indicators found in Latin America and the Caribbean

Model	Agency (organization / country)	Scope of the integrated analysis	Methodological limitations	Participatory mechanisms throughout the whole process	implementation difficulties
Pressure - State - Response (PSR)	Organisation for Economic Cooperation and Development / OECD	Integrates economic aspects, except those related to health	Only uses existing data, produces very general indicators, does not make forecasts	They are not considered	Was formulated for a developed country context, even though it is conceptually simple
Global Environment Outlook (GEO)	United Nations Environment Programme / UNEP	Integrates socio-economic aspects, but not epidemiological aspects	Requires data that are not always available in LAC or are of dubious quality	Social stakeholders participate in defining priorities, but the mechanism for their participation is not clear	High costs of database construction and maintenance, and information systems required
Health and Environment Analysis for Decision-Making Project (HEADLAMP)	World Health Organization / WHO	Integrates socio-economic, environmental and health aspects on a multi-sectorial basis, but maintains the linear approach of the biome-dical model	It is limited by the paucity of quality data needed to build its indicators	Social stakeholders participate in defining priorities, but the mechanism for their participation is not clear	Epidemiological surveillance and systematic monitoring require huge investments and an infrastructure not always available in LAC
Environmental Disease Burden	World Health Organization / WHO	A tool for socio-environmental planning that aids in forecasting needs and future scenarios	The estimates tend to be very incomplete, due to a lack of data and consensus regarding measurement methodologies; requires a large amount of epidemiological data	Community influence in process implementation is not clear	LAC health services usually lack non-trans-missible disease records, which may be associated with environmental changes, making the basic estimate more difficult by this method
Ecosystem Approaches (ECOSALUD)	International Development Research Centre / IDRC, Canada	Makes a noticeable advance in conceptual understanding of socio-environmental factors that have an influence on human health	The methodological steps are not clearly defined; requires a level of knowledge of the ecosystem not always available in LAC	The social stakeholders participate in the whole process	Implementation and maintenance costs are usually very high
Comparative risk analysis	Environmental Protection Agency, United States	Allows good mapping of a community's environmental health risks and helps to identify priorities	Requires a large amount of toxicological and epidemiological data, without which the estimates produced are very incomplete	Community influence in process implementation is not clear	These studies demand a huge investment in terms of financial, human and infrastructure resources
Public health risk assessment	Agency for Toxic Substances and Disease Registry / ATSDR, United States	Provides an excellent inter-disciplinary systematic framework for assigning priorities to problems, allocating resources and avoiding future	Requires a set of environmental monitoring and epidemiological surveillance data not always available or reliable in LAC	Community influence in process implementation is not clear	Consists of a complex technical and scientific process; in LAC there are few qualified professionals with the capacity to implement this model
Protocol for assessing community excellence in environmental health	National Association of County and City Health Officials / NACCHO, United States	Its approach integrates the community's perception and does not require sophisticated epidemiological or environmental monitoring methods	The methodological steps are well defined, but its application requires an institutional infrastructure seldom seen in LAC	A participatory method at the community level that has shown good results	Demands a considerable technical effort and a huge investment in time and human and financial resources

Source: Schütz and others, 2008.

2

CONCEPTUAL BASES

CONCEPTUAL BASES

2

2-1. Guiding principles for the process

The GEO Health process is structured on three core principles:

- interdisciplinarity;
- intersectoriality; and
- participation.

As a method to make an integrated assessment by incorporating the environment and health, GEO Health offers the following new perspectives:

- Interdisciplinary production of integrated scientific information on environment and health;
- Integrating intersectorial technical teams and social stakeholders to identify and characterize environmental and health problems;
- Establishing an agenda for priority intersectorial action;
- Strengthening human capacities by using a disciplinary / sectorial profile to take action on interdisciplinary / intersectorial strategies.

The GEO Health analytical model's logical framework structure and conceptual framework are based on the principle of interdisciplinarity, unlike merely single discipline approaches (a single analytical outlook) or multi-discipline structures (that juxtapose information without integrating it).

Disciplinary segmentation of modern scientific knowledge has provided a useful structure for instrumental discourse about how to act on a particular dimension of reality. Nevertheless, no single disciplinary perspective is comprehensive enough to cover the complex and multi-disciplinary ways in which ecosystems and human society overlap.

Interdisciplinary discourse, on the other hand, is built upon various analytical outlooks, using a logical framework to integrate partial approaches. This allows more extended coverage of a complex reality. It should not be forgotten that in modern states segmenting public policies y sectors is also a consequence of the disciplinary segmentation of knowledge.

-Each management sector (health, environment, economy, social welfare, etc.) assumes its own discourse and is equipped with a set of instruments appropriate for meeting its own goals. However, different government sectors frequently have overlapping goals, especially in the environment and health sectors, with no common integration strategy Inconsistent sectorialization, in the best of cases, tends to have a bearing on how costs and efforts are duplicated and, in the worst cases, the results are antagonistic sectorial goals that waste resources and distract policy-makers' attention from health and environmental problems.

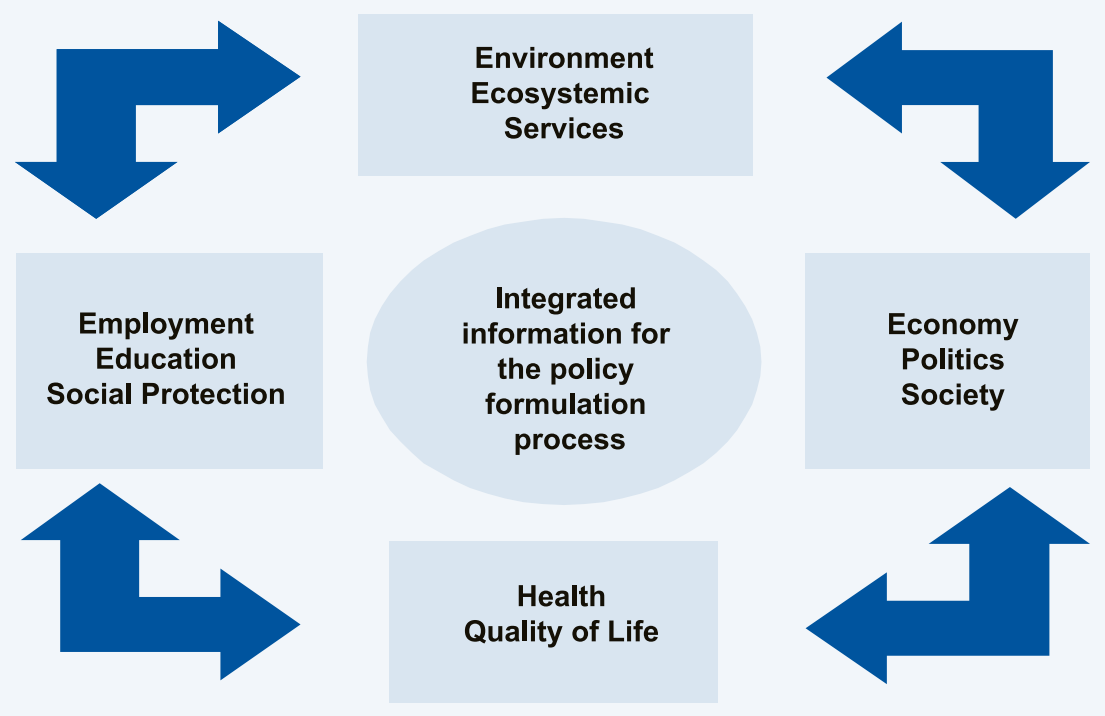
Incorporating intersectoriality into the design of government policies opens a space for communication where the goals, strategies and resources of a specific sector of public administration can be discussed with regard to the effect they have on the other sectors.

Intersectorial communication makes public administration more efficient, effective and successful, and optimises how resources are allocated.

Interdisciplinarity, just as with intersectoriality, does not imply subordination of one of the parts to another, but rather dialogue and cooperation among all the social stakeholders involved in a specific problem area.

Thus, for example, local assessment of interactions between ecosystem health and human health does not involve only the sectors that manage the environment and health, but it is also concerned with how natural resource are exploited (economic development policy), as well as with current public policies on labour, education and social welfare (Figure 1).

Figure 1: Interdisciplinary and Intersectorial Integration of Information



Source: UNEP 2007. Module 4

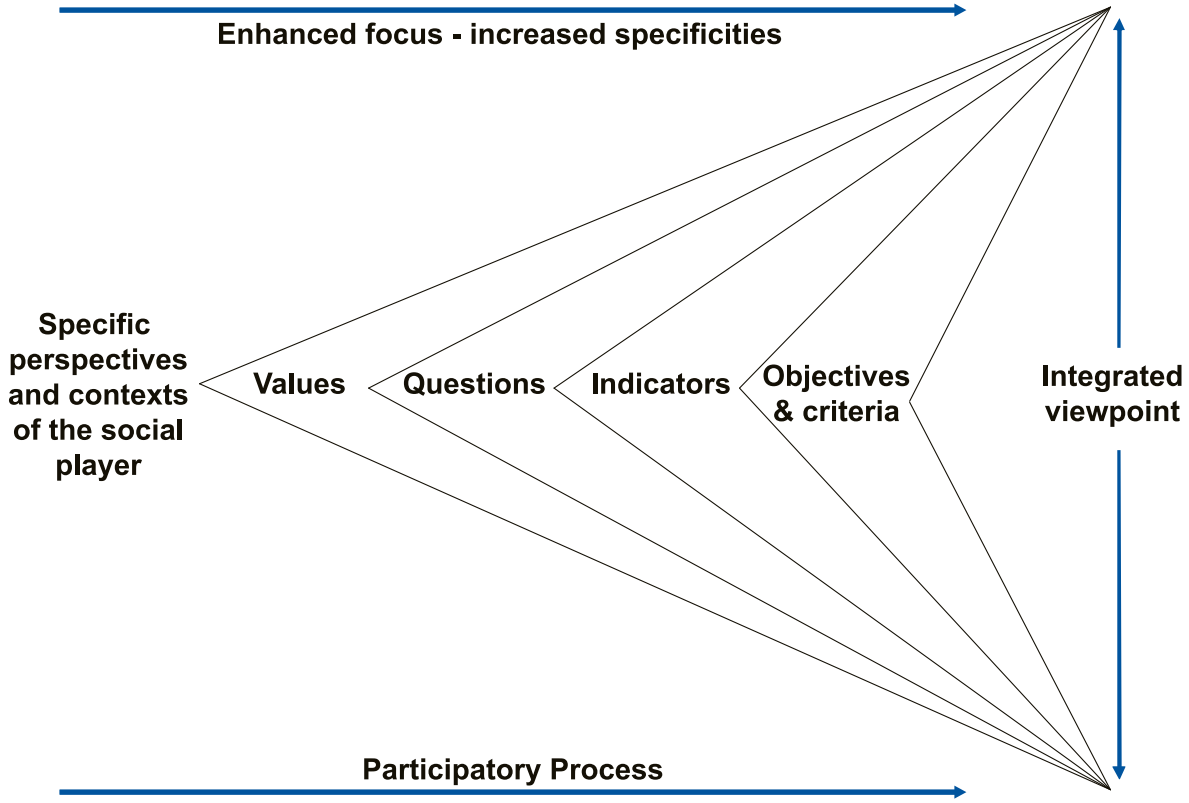
There is no doubt that drafting a public policy for environmental health in LAC that will integrate knowledge and management strategies on ecosystem services with knowledge and management strategies for a better quality of human life, faces the challenge of building an interdisciplinary and intersectorial space that is appropriate for the Region.

In this respect, if a healthier environment and a fairer and more equitable society is to be built, it is crucial, throughout the whole GEO Health process, to have democratic participation by very diverse social stakeholders to prepare an agenda on integrated action priorities based on scientific information,

The participatory process expands the analytical focus and makes assessment more specific. The social stakeholders' specific outlooks and contexts complement each other. If this path is followed, a wide-ranging debate about values, questions, objective indicators and criteria will provide a broader, more inclusive vision of the interactions between the environment and human wellbeing (Figure 2).

The participatory model of the GEO Health process helps to train the communities affected by environmental impacts as well as to instrument and strengthen local capacities already in place.

Figure 2: Participatory process and enhancing the integrated outlook



Source: UNEP, 2007. Module 4.

2-2. Conceptual bases

2-2-1 Health, wellbeing and quality of life

Common sense tends to identify health with (human) physical wellbeing because there is an absence of illness, suffering and disabilities. With this outlook, health care is reduced to keeping the human body healthy or restoring it when it is not.

Solid evidence shows that this concept is not enough. In fact, enjoying good health, besides personal care, requires a series of conditions determined by the interaction of individual, social and environmental factors.

This was understood by the nations of the world in 1948, when in the WHO constitution **health** was defined as "…a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity."

According to that definition, **wellbeing**[2] is the broadest concept of health not to be understood literally as a "state", but as a dynamic social construction built by a spatially defined historical process.

The individual perception of wellbeing is the result of a subjective process whereby different elements (absence of physical and/or mental problems, good family and social relationships, love, enjoyment, self-esteem, personal achievement) are related as being equal in a single synthetic category. Thus, wellbeing is being equally satisfied with all the different dimensions considered relevant for the human "being" to be content in a particular society. Not only those that are physical, but including affection, spirituality, sense of justice, freedom, and the quality of the relationship established with nature in his/her surroundings.

The perception of one's own wellbeing is the subjective component in the Quality of Life concept. **Quality of life** is a social representation constructed on the basis of *a subjective perception of wellbeing* and of the evaluation of *objective measures*, whose references are the satisfaction of basic biological needs and of human need created by a society's economic and social

2 The Millennium Ecosystems Assessment has updated the "wellbeing" concept, relating it to ecosystemic services. In this perspective, human wellbeing consists of five main interrelated components: the material bases for a good life, health, good social relationships, security and freedom of choice and action. The components of human wellbeing are determined in particular by the integrity of the ecosystems to provide environmental services. They also depend on education and guaranteed access to quality human services (WHO, 2005).

Box 3: The challenge of interdisciplinary between sectors in LAC

Most countries in LAC have government agencies to manage situations related with health, the environment, natural resources, housing, basic sanitation, agriculture, animal husbandry and fisheries, mining, education, labour, etc. Each sector is responsible for drafting public policies and implementing programmes within their respective "sector". However, there is very limited experience of action between government sectors.

One of the main reasons for this is the difficulty of reaching a consensus among the sectors involved, since it implies making significant shifts in paradigms and institutional cultures. However, intersectoriality can be achieved, as is shown by the progress made in building instruments to manage workers' health.

In several countries in the Region, environment / health intersectoriality has made advances on environmental health programmes. Environmental health management has generally focused on basic sanitation, controlling disease vectors, monitoring food, medicines, polluted sites, and environmental liabilities. However, the focus of this management process continues to be preponderantly epidemiological (mono-disciplinary), with few bridges built towards an ecosystemic health approach (interdisciplinary).

Integrated management of intersectorial problems, in addition to drafting a national policy to normalize it , requires very particular consensus building among all sectors involved, not only government but also the private sector and civil society. The slow advance of intersectoriality is not due to a lack of interest, but rather expresses the difficulty of articulating consensuses that have to prevail over the inertia of institutional culture, political and economic interests and society's diverse socio-cultural values.: The scientific academic field, civil society organizations and many promoters of environment and health in LAC, are aware of the need to integrate actions on promoting health that lead to the sustainable development of healthy environments. In fact, there are now several local initiatives with integrated environment and health management, particularly in cities and river basins, in which interdisciplinary approaches are used.

In principle, local management has the advantage of offering a more specific negotiating framework than that found at national level, and this makes it easier to form a consensus among social stakeholders. On the other hand, it faces the limitation that, in the absence of a national policy, actions will be restricted by the boundaries of the local political jurisdiction that do not usually correspond to the limits and problems of the ecosystem.

This makes it much more difficult for any interventions that might occur in environmentally complex territories to be integrated and effective, for example in water basins, metropolitan areas, marine coastlines and large forests, among others. Because of the foregoing, goals agreed when a GEO Health process is implemented should balance ambition against reality. If goals are too ambitious, even though legitimate, they do not generally result in immediate action, while those that do not pose challenges will find it hard to marshal resources or promote political reforms on healthy environments' sustainable development to promote public health.

development. In other words, quality of life is a notion that presupposes the subjective capacity to make a cultural synthesis of all of the elements considered indispensible for individual and collective wellbeing (Minayo and others, 2000).

2-2-2 Environmental quality as a determinant of human health

The quality of human health can be conceived as the result of a dynamic interaction between different levels of determination, whose scope and complexity increase as individuals gather together into ever-larger social collective groups.

Figure 3 shows the multi-level organizational outline of the health determinants from the most individual (proximal) to the most general (distal) in terms of social and territorial / environmental aggregation. The organizational outline for health determinants helps to identify the type of intervention in health and the expected result (Figure 4).

All the distal determinants of wellbeing reach completion in different ways for different social collectives, according to the particular aspects of the group / community and an individual's specific aspects, that is to say, a distal determination can only be made by means of the most proximal determination levels. This is the case of the

most important distal determinant of health in making an integrated assessment of environmental and health outlooks: the so-called **ecosystemic environmental services.**

In effect, ecosystems offer society a series of environmental services that act as a basis to develop human capacities directly associated to wellbeing. These services can be grouped into three categories: (1) Consumptive services (materials); (2) Non-consumptive services (symbolic); and (3) Ecosystemic services for regulation and life support (Table 2). It is worth keeping in mind that ecosystems still hold a potential that is as yet unknown to and/or unexplored by society.

Figure 3: Levels of health determinants

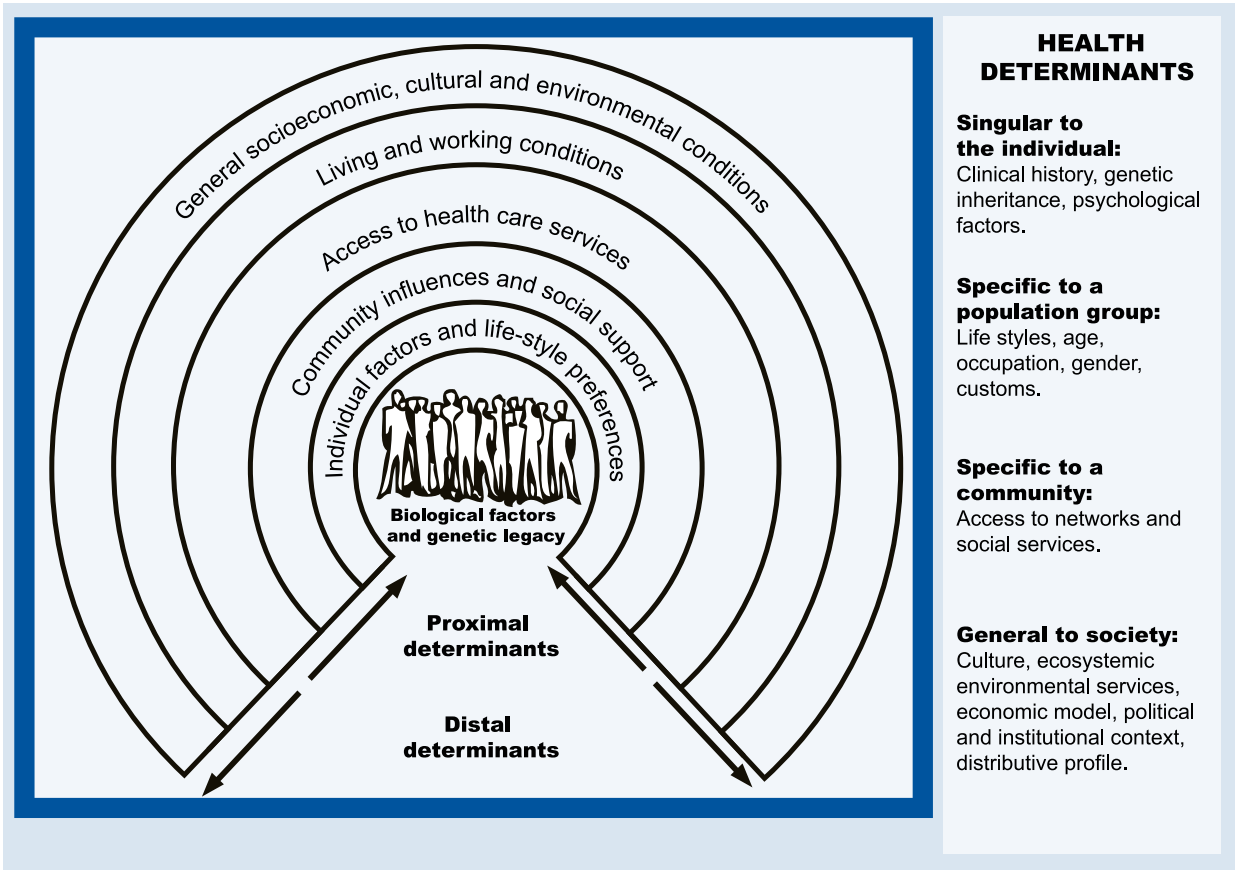
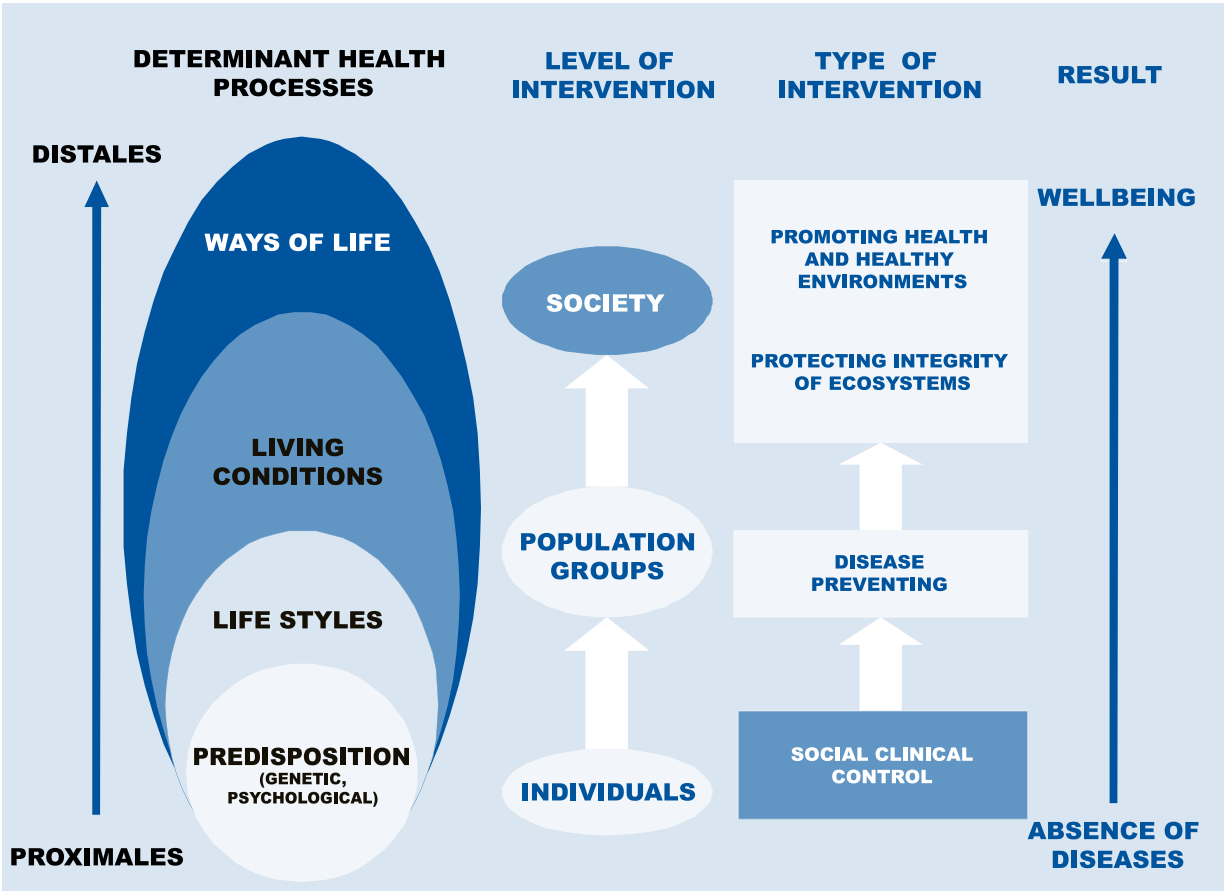


Figure 4: Determinant levels, intervention levels, type of intervention and expected health outcomes



At the level of the most proximal determinants (individual predispositions), there is a need for specific clinical attention, while in the face of unhealthy **life-styles**, social control is practised (heightening awareness, communication of risks). With these interventions, there is an attempt to prevent these diseases from becoming manifest. At this level, the Health Sector is the main agent of change.

At an intermediate level, **living conditions** define vulnerable population groups (that can vary from a small social collective to society as a whole). Intervention here is of a preventive nature. At this level, the health sector either struggles with externalities (activity of other sectors, such as, for example the environment and that of sanitation and urban organization) or, alternatively, is associated with them in an intersectorial manner to develop a joint agenda aimed at preventing possible sanitary or environmental health problems.

At the distal level, **life-styles** (e.g. unsustainable environmental consumption) involve all of society in a complex and multi-dimensional manner. To be effective, the intervention must be interdisciplinary, intersectorial and participatory, oriented to health promotion. The expected result is the wellbeing of the population.

Sources: Navarro, 1999. Modified.

Table 2: Human abilities fostered by ecosystem services

Ecosystemic environmental services*			Human capacities fostered**	
Type	**Function**	**Environmental assets**		
Provisioning services (consumptive)	Food supply	Nutrients such as proteins, vitamins, sugars, starches, plants, salts and fibres	Capacity to be adequately nourished	Capacity to freely opt to develop those individual and collective potentials that lead to wellbeing in a healthy, democratic, and equitable environment providing intra and intergenerational justice
	Materiel supply	Natural resources (water, air, soil, minerals, biodiversity) and energy resources	Capacity to promote human development	
Symbolic Services (non-consumptive)	Recreation	Harmonizing humanity with its natural milieu and other living beings	Capacity to express aesthetic, spiritual and cultural values	
	Cultural heritage and identity	Wisdom and culture-nature relationships. Ontological meanings		
	Cognitive benefits	Knowledge development. Education		
Regulation and life support services	Climate regulation	Maintenance of atmospheric gas equilibrium	Capacity to live in a healthy and sustainable environment	
	Prevent alterations	Minimizing environmental alterations		
	Absorption and recycling of contaminants	Biodegradation, bioremediation and neutralizing toxic and polluting substances		
	Nutrient cycle / ecological niches	Maintenance of inter-species equilibrium, recycling nutrients and creating biodiverse habitats		
	Resilience and resistance	Capacity to absorb natural and/or human disruptions by establishing new viable organizations		

Source: *Millennium Ecosystem Assessment 2003*, *Millennium Ecosystem Assessment 2005*, Modified.

Environmental quality is a distal determinant of human health, since it offers ecosystemic services with the potential ability to sustain society's general wellbeing. However, human society does not distribute these services equitably among all the constituent social collectives; rather, it does so by means of two different types of relationships:

(a) Society / Ecosystem Relationships: determined by the type and quality of environmental services (Natural Capital) that ecosystems offer society and the degree of human development (Human Capital) and technological capabilities achieved to take advantage of them.

(b) Society / Social Collective Relationships: determined by the dynamics of social inclusion / exclusion of ecosystemic environmental services (local, regional and global). This depends on the economic development model and, therefore, it also depends on the current social, cultural, political and institutional dynamics (Social Capital).

With the first relationship, wellbeing that comes from having effective access to quality environmental services may be directly or indirectly affected when ecosystemic integrity – in terms of structure, organization and resilience – is compromised as a consequence of society-generated environmental impacts. Thus, for example, polluting a waterway by industrial waste and sewage will expose local communities, that directly depend on it for their food supply, to disease, poisoning and loss of food security. Conversely, when the degraded environmental service becomes global in scope, e.g. climate regulation, the consequences affect all of human society.

On the other hand, the loss of wellbeing may be determined by having no access to ecosystemic services as a result of the second relationship's socio-economic, cultural and politico-institutional dynamics. In fact, the model of social distribution of generated wealth is historically defined by the model of a territory's human, social and economic development.

According to information published by the Economic Commission for Latin American and the Caribbean (ECLAC), the greatest social and economic inequality is in the LAC Region (ECLAC, 2006). This accentuated asymmetry is found both in unequal distribution, whether of socio-environmental benefits or risks, as well as in different profiles for access to health, education, security, sanitation and social protection services, among other asymmetries. In LAC, **poverty** is part of the Region's historical development model, and results in **exclusion** of social collectives and **inequity** (ethnic, gender and generational, among others).

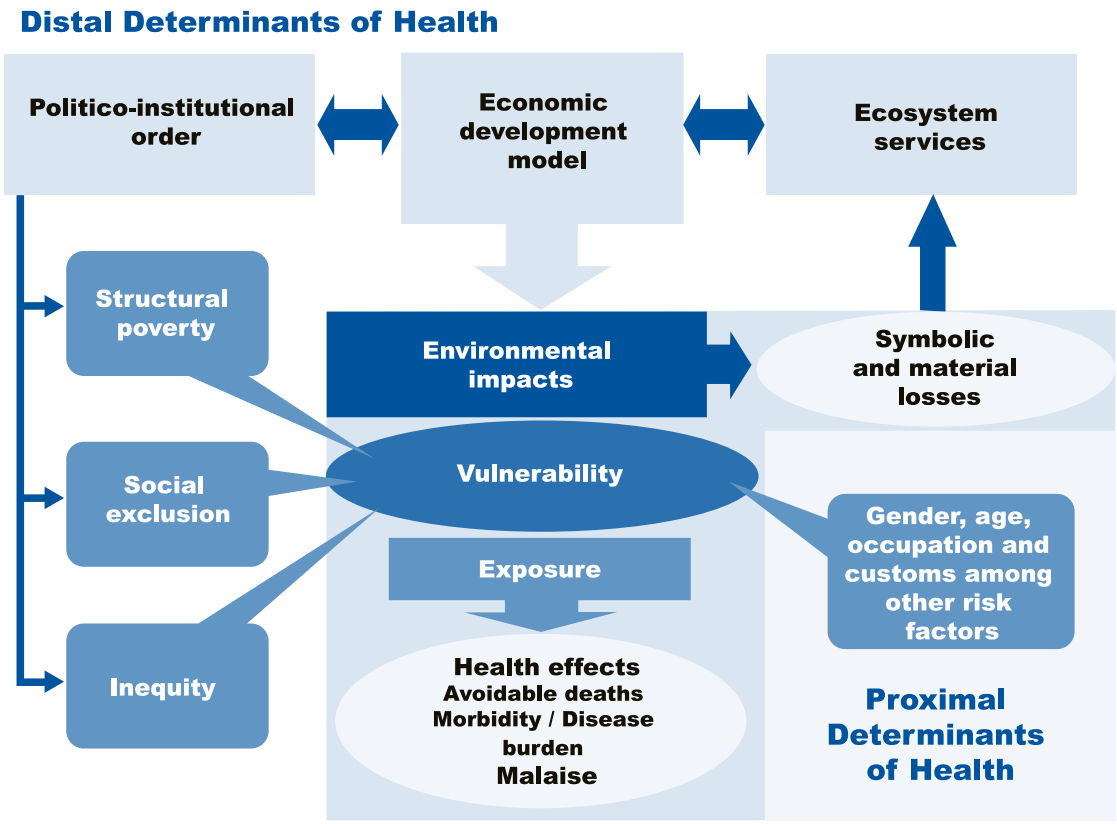
These weaknesses in human and social development determine distal levels of **vulnerability**. The more a group is excluded from social benefits, the more exposed it will be to impacts from environmental degradation, that is, it will run a greater risk of suffering **health effects** (avoidable mortality, morbidity, disease burden); **malaise** (psychological suffering, violence) and / or **material losses** (of that which is essential for a decent standard of living) and **symbolic losses** (loss of freedom of choice and action, loss of beneficial social relationships).

Individual and collective vulnerability to environmental impacts also depend on:

- Determinants more *proximal* to the individual, such as housing conditions, life-styles, degree of education, type of work, access to social services, infrastructure, sanitary aid and networks.
- Individual risk factors (genetic heritage, age, gender, psychological conditions, among others).

Figure 5 presents a schematic view of how all these elements compose the conceptual bases for GEO Health.

Figure 5: Conceptual Bases for the GEO Health Process



Box 4: Risk and social demands: Disease prevention or health promotion?

In the complex social dynamics of modern life, the way a society conceptualises the concept of "health" –as a differential element of wellbeing – will define the profile of the priority social actions required to protect it.

Thus, for example, the sudden appearance of an epidemic, or increased social awareness about a particular risk of illness or death, means that a different way has to be found to eliminate the identified threat. In this case, the social demand for health protection will make defensive prevention a priority.

A preventive / defensive strategy consists of planning and implementing a series of actions whose relative effectiveness is known, aimed at diminishing and or eliminating previously characterized risks. In the face of a multiplicity of possible risks, decision-making around which health prevention strategy should, or should not, be implemented is usually defined on the basis of epidemiological criteria that take into account the cost / benefit balance.

Nevertheless, there are social demands for preventive / defensive actions that come from a perception of risk, influenced by media-managed economic, political, religious or other interests. Whatever the nature of the manipulation, decision making in the sense of satisfying a demand for reasonably relevant risk management tends to imply the lack of technical, human, intellectual and financial resources that must be applied to managing what are known to be the more significant risks which, for one or another reason, are not included in the public debate agenda (Sunstein, 2006).

In contrast, at those historical turning points when society is free to debate about quality of life without being concerned about concrete threats of sickness or death from urgent or avoidable causes, epidemiological hazards lose their differences so that they become the same as the other determinants of wellbeing.

At these turning-points, social demands for health protection are not merely limited to plotting preventive / defensive strategies, but rather they seek to *promote* the bases society uses to determine human wellbeing in the broadest sense, including protecting the integrity of ecosystems and their services. Thus Health Promotion and a healthy environment become institutionalized.

3

CONCEPTUAL FRAMEWORK

CONCEPTUAL FRAMEWORK

3

3-1 Building the conceptual framework

After having analysed the main instruments for environmental assessment implemented in LAC (UNEP, PAHO, FIOCRUZ, 2004), the components of the GEO Health conceptual framework were linked together based on a syncretism of the **SPIR Model**[3] – initial conceptual framework for UNEP's GEO environmental assessments – and the **DPSEEA Model**, and HEADLAMP environmental assessments with health effects (Health and Environment Analysis for Decision Making) developed by WHO (Corvalán and others, 2000).

According to the SPIR model, alterations provoked to the **state (S)** of the environment by **pressure (P)** – whether anthropogenic or natural in origin – tend to induce environmental **impact (I)** with adverse repercussions, on human health for example. Society may (or may not) give some type of **response (R)** in this regard.

In contrast to the GEO Global Environmental Outlook, HEADLAMP is an environmental assessment focused on a specific type of environmental impact: health effects. As a result of this condition, the impact component (I) from the SPIR model is replaced by an **effect** component **(E)**.[4]

In the HEADLAMP approach, the DPSEEA (Driving forces, Pressure, State, Exposure, Effects, Actions) conceptual framework is derived from the environmental health hazard pathway. Thus, the **driving forces (D)**[5] are identified with human activities acting as source activities for environmental health hazards: agriculture, industrial activities, power generation, transportation, domestic activities and waste management act as **pressures (P)** on the environment by emitting contaminants during the production – consumption – waste cycle.

The concentration of pollutants in soil, water, air and food represents the **state (S)** of environmental hazard with an impact on the human organism, through **exposure** (first **E**)[6] and the **resulting health effects** (second **E**)[7] . Social responses are, in fact, **actions (A)** aimed at reducing the magnitude of the driving forces, the impact of the pressures, alterations to the state of environmental risks, exposure and effects.

Exposure and effects on health are the specific components of this conceptual framework. Exposure refers to how environmental hazards come into contact with the human organism (respiratory, water-borne, food-borne, cutaneous), the frequency (single event, repetitive, constant, chronic) and the intensity

Box 5: Environmental Impact / Health Effects

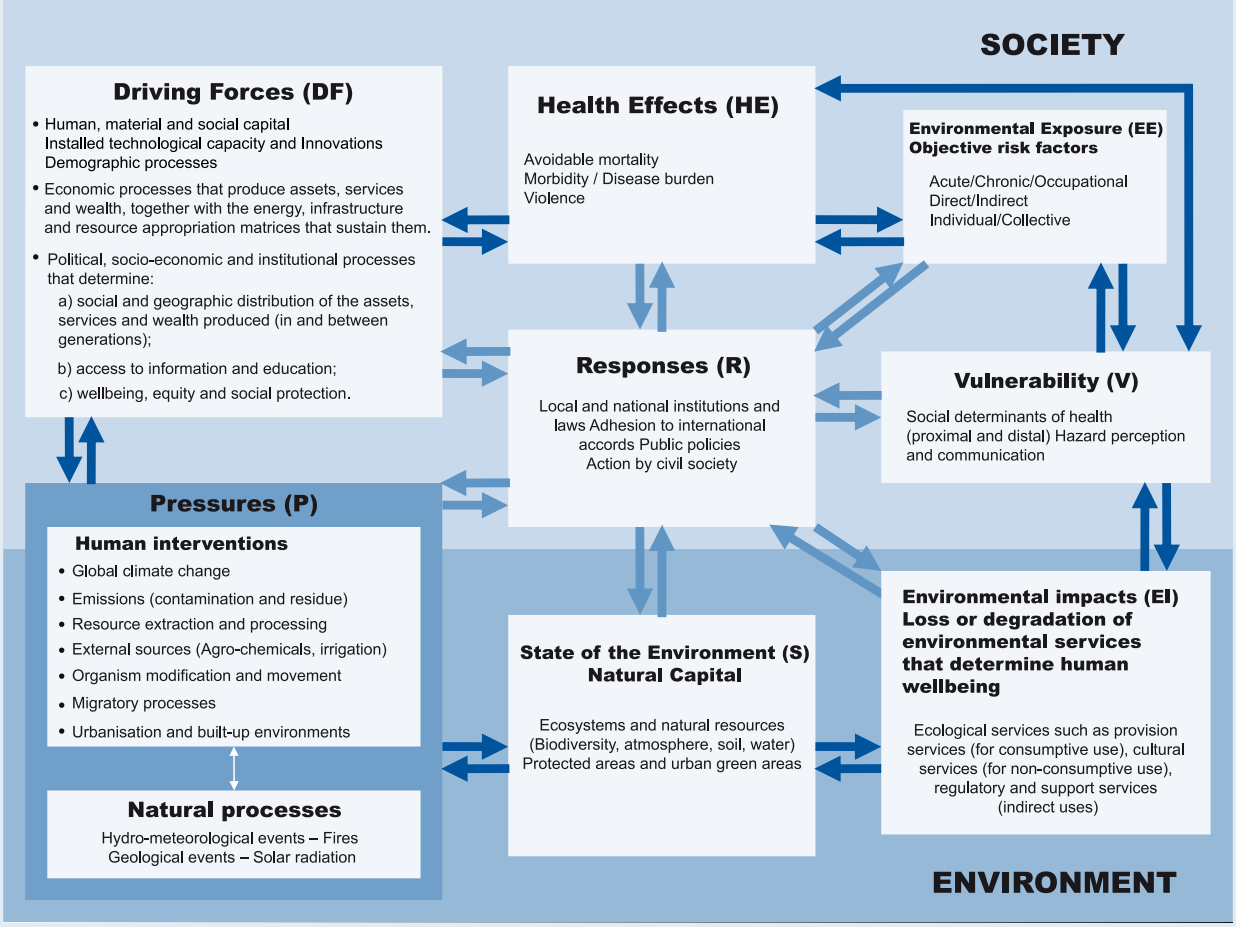
From an environmentalist perspective, impacts are a consequence of pressures acting on natural capital (atmosphere, soil, water and biodiversity) causing losses (to biodiversity, human health and quality of life); degradation and/or depletion (of the air, water, mineral resources and soil) and undesired phenomena (environmental accidents).

On the other hand, from an integrated environmental and health perspective, it is important to distinguish the "environmental impacts" (EI), understood as the adverse consequences of changes in the state of the environment on ecosystems and services; from the "health effects" (HE) that describe the losses to the quality of life of the populations that depend on these ecosystems and services. That is to say, environmental impacts are a part of the process that causes adverse effects on human health.

Conceptually, an effect indicator (E in HEADLAMP) does not cease being an environmental impact indicator (I in SPIR); after all, within the GEO Health conceptual framework (syncretic), indicators that assess the health dimension through variables of morbidity, mortality, the burden of disease or disability, rates at which healthcare service are used, etc., must be considered as health effect indicators.

3 After GEO-4, UNEP`s environmental assessments include the Driving Force component.
4 In GEO Health, Impact (I) from EPIR is divided into Environmental Impact (EI) and Health Effects (HE); the latter corresponds to the Effect (E) component of HEADLAMP.
5 For this component, GEO Health uses the abbreviation DF.
6 In GEO Health, this component is called "Environmental Exposure" and uses the symbol EE
7 In GEO Health, this component is called "Health Effects", and uses the symbol HE.

Figura 6: Conceptual Framework for GEO Health



The light blue background spans the social components, while the dark blue background contains the environmental components. Pressure is the sole component that combines (the thin arrow) social aspects (human interventions in the environment) and environmental aspects (natural processes). The dark blue arrows link the potential interactions (that may or may not be mutual) among the components without mediating the responses. The light blue arrows indicate potential interactions among the components and the response by society to mitigating or adapting to environmental and health problems.

of contact (dose). Furthermore, the effects tell about the early (sub-clinical), moderate (clinical) or advanced (permanent) appearance of the health problem from an environmental source.

Although it aids in specifying the problems of environment / health interactions, HEADLAMP maintains a totally biomedical focus that assesses a community's environmental health quality in terms of morbidity, disability and mortality that can be attributed to environmental exposure, but it does not include an ecosystemic focus of health as wellbeing. The GEO Health conceptual framework (Figure 6) proposes not only a explanation of the cause / effect association where a specific environmental exposure (physical, chemical or biological) carries with it health effects, but also seeks to assess (i) the way environmental changes that harm ecosystemic service quality affect the components of human wellbeing, and (ii) – the use of socioeconomic variables on a territorial scale – how and why different localized communities and/or social groups are more vulnerable to these exposures.

Box 6: Biomedical Paradigm / Ecosystem Approach to Health

From a biomedical point of view, health risks may be assessed by means of variables related to human morbidity, disability and / or mortality that are the classic health indicators (rates, prevalence, costs, etc.). Within this perspective, multidisciplinary methods to assess environmental health hazards are based on the juxtaposition of biomedical and environmental indicators, establishing linear cause (environmental) / effect (health problems) associations. Although the diagnoses made by these traditional methods are most useful for plotting preventive health strategies, they are not enough to design health promotion policies, since they do not report the objective effects of environmental impacts on the quality of human life; furthermore, they cannot capture the subjective dimensions of how society perceives these impacts.

Currently, there is widespread consensus that the quality of the environment is a major determinant of human wellbeing. However, there are still no conceptual tools capable of encapsulating in an explicit theoretical model the complex, multi-dimensional associations – objective and subjective – established between the environment, society and human health. However, a significant advance – based on evidence -- has been made at the global level to assess environmental impact / health burden that is capable of guiding how policies are formulated.

Within their spheres of competence, UNEP, UNDP and WHO have advanced in conceptually understanding the ecosystemic approach to human wellbeing; consequently, the conceptual frameworks of GEO-4, the Millennium Ecosystem Assessment and the Millennium Development Goals Reports consider the determinants of a society's wellbeing as being directly related to having effective access to quality environmental services. The process that built the GEO Integrated Assessment of Health capitalized on all these antecedents, as well as on its own lessons learned in executing its pilot tests.

In addition to syncretizing the components of the SPIR and DPSEEA models, the GEO conceptual framework incorporates a series of other analytical instruments which, alone or in combination, are very useful when making an integrated assessment of health and the environment.

GEO Health is characterised by proposing to assess environmental hazards to human health by using indicators that integrate health and environment, by using its ecosystemic health approach and by not reducing the meaning of health to the absence of the risk of falling sick or dying, taking into account all the components of human wellbeing (biological, material and symbolic) that could be affected by environmental impacts.

3-2 Components of the GEO Health Conceptual Framework

The Driving Forces (DF) are fundamental processes in society whereby activities are promoted that can have an impact on the environment and cause adverse effects on human health.

The magnitude of the impulse of a specific driving force depends on the state of human, material and social capital, as well as on installed technological capacity and the ability to incorporate technological innovations into social processes. The driving forces, also known as "promoters" and "indirect or macro-pressures" are expressed by the "direct" pressures they place on the environment.

Principal processes that act as Driving Forces

- **Demographic processes.**
- **Economic processes that produce goods, services and wealth, together with the energy and infrastructure matrices and the resource appropriation that supports them.**
- **Political, socioeconomic and institutional processes that determine:**
  - **The social and geographic distribution of goods, services and wealth produced (in and between generations);**
  - **Access to education and information;**
  - **Wellbeing, equity and social protection.**

Pressures (P) are the processes (anthropogenic or natural / social or environmental) that directly affect the **State of the environment (S)**. The state of the environment refers to the natural capital situation (natural resources, atmosphere, soil and water); it includes ecosystems and biodiversity, as well as taking into consideration protected areas and urban green areas.

Pressures on the environment do not always occur in the territory where the driving forces that cause them are found, and they do not affect in the same way all social groups within the same territory. A good example of extra-territorial driving forces would be the massive consumption of foodstuffs produced in ecosystems distant from the centre of consumption. This is the case of pink salmon and shrimp produced for export that can put severe pressure on local water resources (drainage basin or coastal management, organic matter, chemicals), may modify the local ecosystem (water, soil and biodiversity), and cause adverse environmental impacts and health effects on the communities that depend on them.

Changes in the state of the environment may result in **Environmental Impacts (EI)**, capable of influencing, either positively or negatively, those environmental services that determine human wellbeing. Figure 7 provides examples of interactions between environmental degradation and adverse effects on human health.

Furthermore, environmental impacts that affect human health are always mediated by factors of **Vulnerability (V)**. Individual vulnerability is determined by biomedical factors (genetic burden, clinical history) and personal factors (age, gender, customs). Collective vulnerability refers to population groups which, for some socio-environmental reason (e.g., polluted or disaster-stricken areas), are more exposed to health hazards (chemicals, disease vectors, radiation, malnutrition) or lack effective access to safe conditions (e.g., unsafe urbanization) or to social protection (situations of exclusion). That is to say, vulnerability varies between individuals and groups, depending on the territory they occupy, their socio-economic profile and their capacity to mitigate or adapt to environmental changes.

In those cases in which health hazard factors come into play, such as disasters, biological, chemical or physical hazards, health effects from environmental impacts are also affected by **Environmental Exposure (EE)** to these hazards.

Individuals or groups of individuals may be exposed to very serious or not so serious, acute or chronic hazards, whether only once, several times, or continuously. In this respect, hazard perception and communication are important factors when characterizing vulnerability to environmental exposures.

Pressures arising from human intervention:

- **Global climate change**
- **Emissions (contamination and refuse)**
- **Natural resource extraction and processing**
- **External sources (Agrochemicals, irrigation)**
- **Modification and movement of organisms**
- **Migratory processes**
- **Urbanization and built-up environments**

Pressures arising from natural phenomena:

- **Hydro-meteorological events**
  - Hurricanes and tropical storms
  - Storm surges and wave action
  - Tornados
  - Floods
  - Extreme temperatures
  - Droughts
  - Electrical storms, hail and snow
  - Sandstorms and dust storms
- **Geological and geo-morphological events**
  - Seismic activity
  - Volcanoes
  - Sea quakes / tsunamis
  - Mass shifts
  - Active fault lines
  - Subsidence
  - Coastal retreat
- **Solar radiation**
- **Fires**

On the other hand, when only subjective wellbeing factors (self-esteem, belonging, harmony, spirituality) come into play, there will be vulnerability, but there will be no measurable environmental exposure. For example, the advance of the agricultural frontier may result in the loss of local biodiversity and, in consequence, of traditional forms of subsistence, e.g., of original settlers. In many cases, it can be seen that the young men in a community emigrate in search of temporary work, while the women, the elderly, and children stay within the territory. These women and elderly people are vulnerable to psychological suffering because of family break-up, changes in their social roles, the unease they feel due to the deterioration of their traditional way of life (their medicinal plants disappear, as do sites, animals and plants with religious significance). The men who emigrated are more likely to suffer because they have been separated from their roots

The **Health Effects (HE)** associated with the degradation or loss of ecosystem services: **preventable mortality,** disease burden, psychological malaise / psychological suffering and violence (whether physical or symbolic).

Avoidable mortality is a health effect that must be distinguished from mortality as a demographic phenomenon. The causes of avoidable mortality associated with environmental impacts mainly affect children.

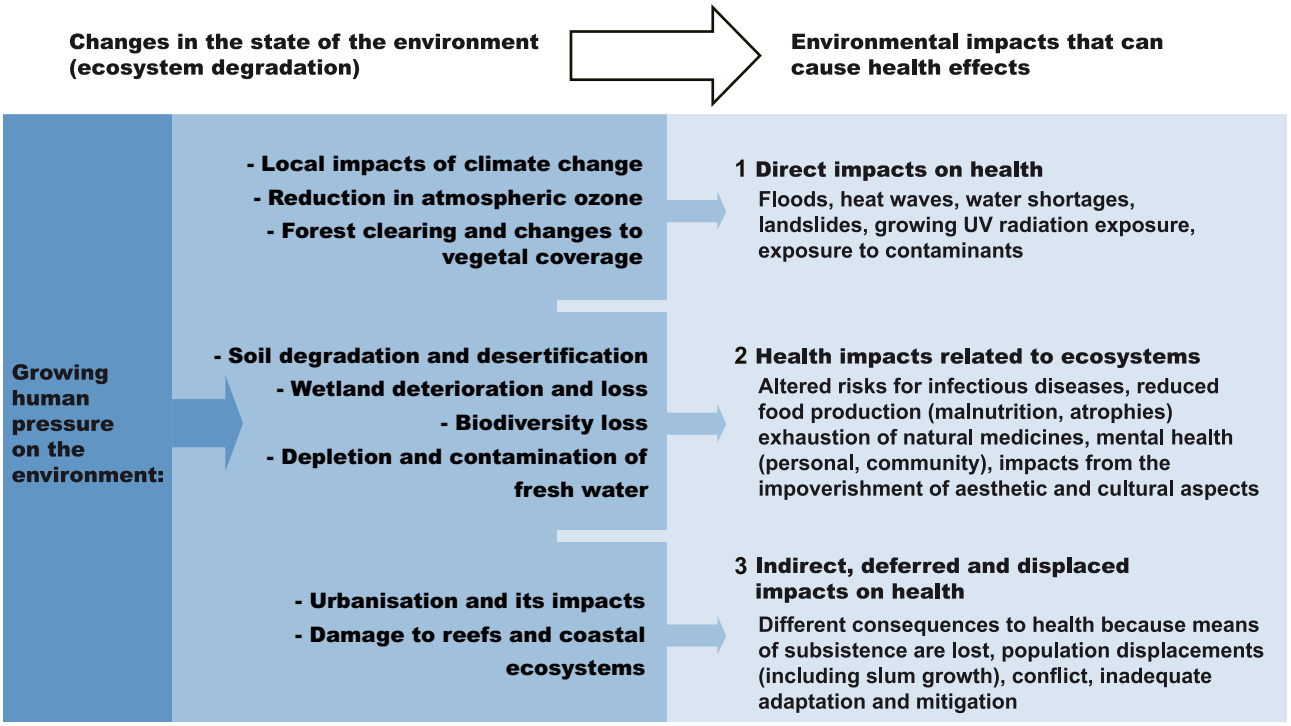
Morbidity refers to the incidence of specific pathologies and can be assessed in different ways (number of cases recorded; number of hospitalizations or medical visits).

Disease burden includes the years of life lost because of early death and the years lived with a disability.

Malaise and psychological suffering are subjective phenomena that may be determined by environmental impacts such as aesthetic or material losses (landscape, milieu) and of the feeling of belonging (forced migrants). Violence (physical or symbolic) is associated with the loss of good social relationships (social cohesion, mutual respect, social justice).

Finally, **Responses (R)** is the component of collective or individual actions that attenuate or prevent negative environmental impacts, mitigate or correct damage caused to the environment, conserve natural resources, reduce human vulnerability or levels of environmental exposure, prevent health being affected or help to improve the population's quality of life.

Figure 7: Adverse Effects on Human Health of Environmental Changes in Ecosystems



Source: WHO, 2005. Modified

The responses may be directed to one or several of the linked components within the GEO Health conceptual framework. However, the responses to causes (driving forces, pressures) are more effective than those to effects (environmental impacts, health effects).

As an illustrative example, Figure 8 shows the formulation of a GEO Health conceptual framework regarding the depletion of the atmospheric ozone layer.

Box 7: Natural Disasters: A Synergy of Environmental Pressures and Impacts

The existence of pressures on the environment caused by natural phenomena is independent of human interventions. Nevertheless, in recent years, the extent of human intervention on the environment has degraded, on a global scale, important ecosystemic protection and regulation services.

One important case is the so-called depletion of the atmospheric ozone layer, a natural filter for the sun's ultraviolet (UV) rays, as a consequence of the emission of chlorofluorocarbon gasses and the use of methyl bromide. Increasing UV radiation, particularly in the southern hemisphere, has had an effect on the fishing industry, food production and causes a series of adverse effects on human health (Figure 7).

Another relevant case is that of forest and grassland fires, natural phenomena in the biological cycle of some ecosystems but that recently have been occurring with a magnitude, frequency and at times an irregularity that exceeds the capacity and resilience of the ecosystem. Meteorological occurrences, such as extreme temperatures, associated with hydro-meteorological events, such as more intense droughts, could be acting in synergy and causing fires that become catastrophic. In fact, there is currently a growing fear that natural phenomena that previously occurred in more or less foreseeable seasonable cycles are now, because of their huge size, capable of producing true disasters.

Just as droughts and high temperatures cause fires (both natural and provoked) within a specific territory, suspended particulate matter generated during incomplete combustion of the burned biomass is blown by the winds, condensing atmospheric moisture in an irregular manner and perhaps altering the water cycle, that is to say the rainfall regime.

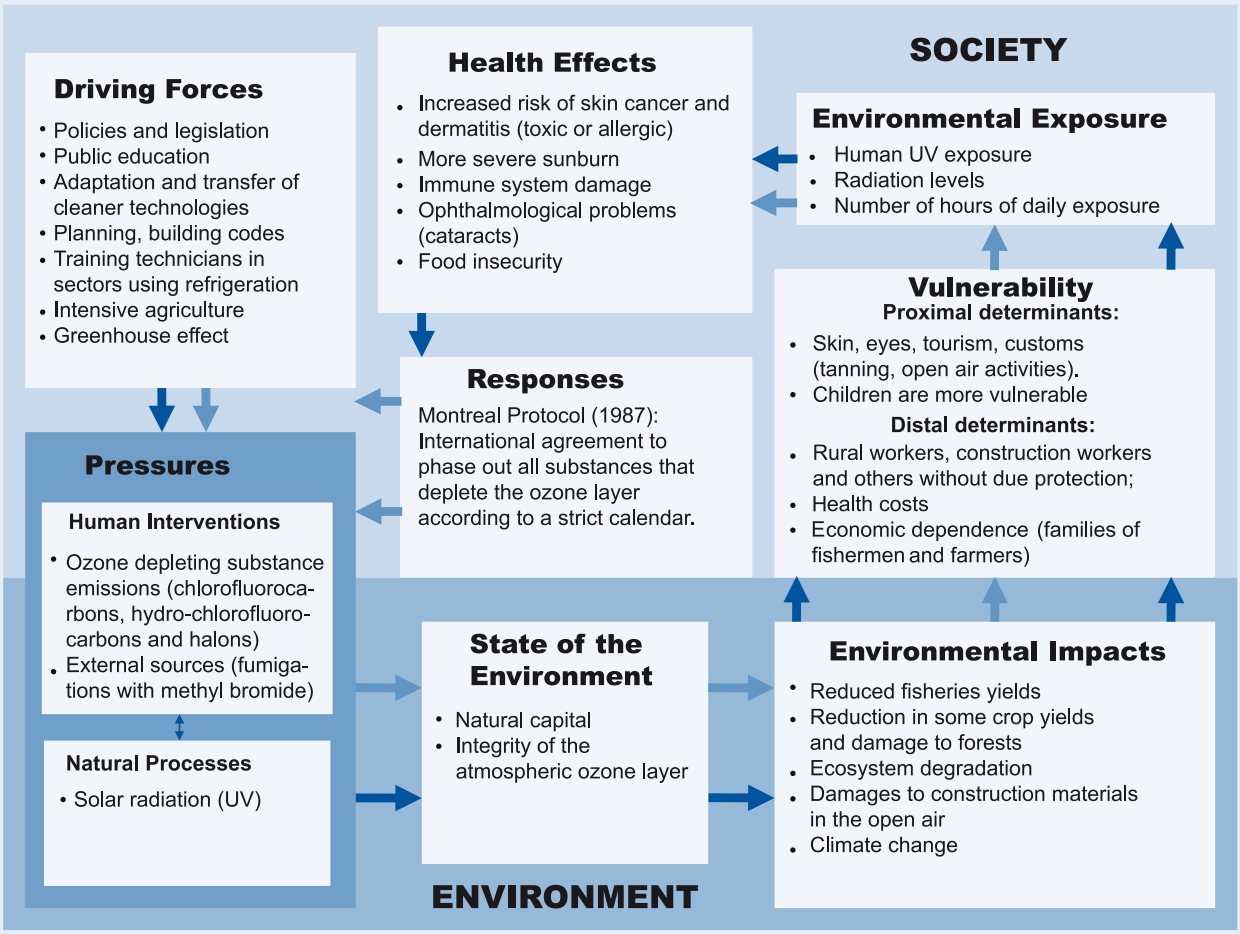
In deforested mountainous regions, together with the loss of biodiversity, the territory's soil characteristics are altered. Thus, there is deterioration of the soil's capacity to absorb and filter rainwater. On the one hand, this leads to loss of springs that feed rivers; but on the other hand, during periods of intense rainfall, the risk of mudslides and floods is also increased.

In addition to air temperatures, global climate change is also altering ocean temperatures. This determines, for example, the increase in mean ocean levels. As a result of this phenomenon, coastal populations suffer from the deterioration of the ecosystemic service that provides potable fresh water, due to the effects of salinization of subterranean aquifers. In the Caribbean, ocean temperature gradients are critical in causing hurricanes and tornadoes, whose frequency is overpowering the resilience of coastal and marine ecosystems.

All these natural disasters – aided by human activity on the environment - increase the risk of loss of quality of life, and of material and affective goods, and leaving the population more vulnerable to health emergencies (lack of potable water, food and medical care; exposure to viruses and bacteria); they affect the productive matrix, tourism and, in many cases, force the population to emigrate, leaving behind their lands and homes.

For these reasons, it is of vital importance that the region be aware of and apply the main detection, early warning and emergency systems, and put into effect disaster prevention and mitigation plans.

Figure 8: GEO Health Conceptual Framework applied to the depletion of the atmospheric ozone layer.



The dark blue arrows indicate that the linking process begins with the driving forces, which created the pressures that changed the state of the environment and causing about environmental impacts capable of affecting the health of individuals or social collectives vulnerable to environmental exposures. Both the environmental impacts and the health effects determine a response to the first links in the process, that is to say, the driving forces and pressures. The expected effects from the response expand across the chain following the light blue arrows.

4

PROCESS

4 PROCESS

4-1 Installation of the process

Different political reasons may motivate the demand for a GEO Health process to be implemented. Generally speaking, the concerns of policy-makers and managers about environmental and health problems are reactive, that is to say when the problems have become evident and there is a need for action to be taken at a determined level of territorial aggregation.

There are other factors that may also be motivating the demand to make an integrated assessment of environment and health: concern about maintaining ecosystemic services; public pressure; planning new economic activities, etc.

The magnitude of the geographic scales where the intention to make the assessment is a determining factor, not only because access can be had to relevant available qualified data and information, but also because of the number of members and the quality of the working team selected for the task. Therefore, once an official request is received to make an integrated environment and health assessment in a LAC country, city or sub-region, the first step is to define the scope of the problems to be considered, the geographical limits, and decide which social groups are of high priority, among others.

Table 3 shows the advantages and disadvantages of carrying out an integrated assessment of the environment and health in ecosystems compared to administrative jurisdictions' assessments.

In addition to an integrated assessment of the environment and health, GEO Health also tries to help to achieve other objectives, such as bolstering installed capacities, multiplying new skills, allowing different sectors of society to participate, and communicating its results and proposals to the largest possible number of social stakeholders in the local government and the general public (See also Box on "Objectives of the GEO Health project in section 1.2).

Once the decision has been made to carry out an integrated assessment, it becomes necessary to:

a) Estimate the costs involved, identifying forms of financing, and mobilizing resources;
b) Identify the main partners and
c) Make institutional arrangement and agreements.

As soon as the partners in the process have been identified and the accords formalized, collaboration strategies can be agreed. The partners should form a **Board**, with the power to decide how the process should be conducted and will be given periodic reports on goals accomplished.

Governments may use existing agencies or official departments to make the technical assessment or,

Box 8: Methodology of the GEO Health process and the scope of its application

As with any other GEO assessment, the territorial delimitation of the ecosystem in question (regional, national city), is a fundamental step in implementing the GEO Health process,). However, in contrast to these environmental assessments, GEO Health proposes to make a specific assessment of the association between environmental changes and health problems. As a function of this specific requirement, the GEO Health methodology includes an ecosystemic focus and methodological epidemiology tools with greater emphasis than the standard GEO methodology. This implies the need to identify – within a determined territory – cases of vulnerability and environmental exposure. In other words, establishing rigorous associations between ecosystemic changes and the state of human health depends on having very precise and territorially localized epidemiological information. It is recognized that such data are all too scarce in LAC.

In this respect, implementing the GEO Health assessment provides an excellent opportunity to help to strengthen the local technical and human skills needed to monitor the environment and health by using indicators and a series of historical data that consolidate local information systems.

Table 3: Advantages and disadvantages of integrated assessment carried out on ecosystems jurisdictions versus administrative jurisdictions assessment

Limits set by the ecosystem	**Advantages** ➔ More specific and significant interpretations of ecosystem-health relationships. ➔ Better understanding of the ecosystem as a functional unit. ➔ Direct relationship to ecosystemic-scale policies. ➔ Better focus on research and analysis.
	Disadvantages ➔ Limited availability of ecosystemic-scale data (especially, socio-economic data) ➔ Political difficulties due to including in the same analysis resources from different administrations.
Limits set by the jurisdiction	**Advantages** ➔ More uniform regulations. ➔ Ease of access to data. ➔ Direct relationship to administrative policies.
	Disadvantages ➔ Less specific and significant interpretations of ecosystem-health relationships (dividing the total into segments may distort the analysis of the results). ➔ Difficulties in identifying and monitoring ecosystemic impacts of different policies in a single functional unit.

Source: UNEP, 2007. Module 5. Modified.

alternatively, they may call on an independent agency to assume that responsibility (for example, an academic group or NGO).

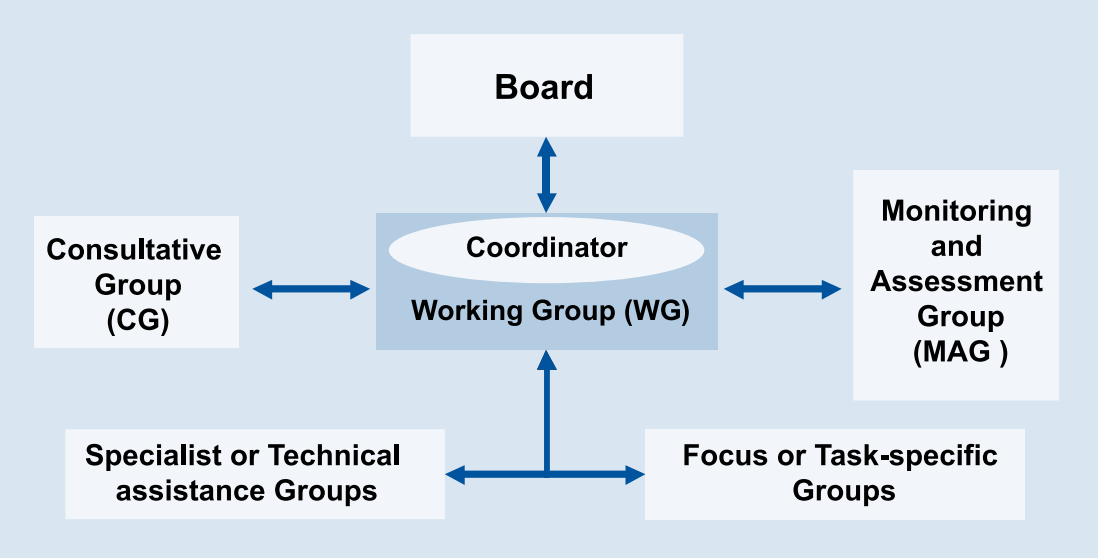
In principle, the first option – government agency/ies – has the advantage of a better official dialogue and more likelihood of having access to data and information. However, this does not always guarantee political independence as they tend to be more conservative and less creative than independent agencies, which is the second option; these, however, tend to find it more difficult to establish networks and access data and information directly from the source. Financing is also relevant when selecting members of the board, and in this respect, to formalize their commitment to the process, it is important that all members contribute to the budget.

After defining the institutional agreements, the stakeholders must be identified and invited to join the responsible Working Group (WG). It is also important to form a Consultative Group (CG) of participating social stakeholders who, however, are not authorized to assume responsibility for implementing the process.

To implement the process stages Focus or Task-specific groups will need to be created for training activities and those planned for participatory research. Similarly, it will be necessary to train Specialists or Technical Assistance Groups, including experts (epidemiologists, statisticians, geographers, etc.) who have access to data sources. We recommend selecting a Coordinator (based on capacity, experience, credibility and impartiality) to manage the process. A coordination plan for administering the GEO Health process is laid out in Figure 9.

Finally, it is highly recommended that Monitoring and Assessment Group – MAG – be created to assist in developing the process and to observe not only technical aspects but also, and in particular, the efficiency of the communications and coordination channels.

Figure 9: Coordination Plan



Assuming inter-sectorial involvement,periodic meetings of the MAG will be the most appropriate space to channel and resolve potential internal conflicts.

Depending on its political-institutional involvement and on the availability of financial resources, the MAG may also be suggested for a possible post-process role, planning periodic meetings to assess progress and impacts reached up to a determined date (e.g. 3, 6, 12 months after launching the report). We recommend that the meeting schedule include an item on the timely considering of the following issues:

- Public, political and academic repercussions of the report
- Strengthening technical and human skills
- Strengthening the local information systems
- Including the recommendations in public policies
- Helping to meet the Millennium Development Goals

The make-up of these groups must, as far as possible, respect the criteria of inter-disciplinarity, inter-sectoriality and participation. They must take into consideration that, in principle, the problem of environment and health involves the following social stakeholders:

- Those whose well-being, values and/or interests are affected by the degradation / loss of ecosystemic services;
- Those responsible for making decisions that affect environmental conditions in respect of human welfare;
- Those who have useful information, resources or skills for making public policies and their implementation strategies; intervene
- Those who are involved in and/or control how public policy strategies are designed and implemented.

The GEO Health methodology conceptual base allows social participants to be classified as follows:

- Providers: Persons who control and manage public or ecosystemic services.
- Users: Persons who use public or ecosystemic services and who are directly affected by material, symbolic or quality of life losses.
- Stakeholders: Persons indirectly affected.
- Experts: Persons having specific knowledge on affected public or ecosystemic services.
- Excluded parties: People who for some reason have no access to the services in question but wish to have, or should be able to have such access.

In turn, these collectivities[8] add to and form networks, organizations and/or institutions, becoming involved social collectivities. To form the WGs, CGs and MAGs a democratic participatory procedure should be used. In the GEO Health process, when identifying social

9 Denomination that will be used to distinguish them from individual stakeholders, that is, from the subjects.

stakeholders their roles, skills and interests should be taken into account (Figure 10). It is important that local processes can count on the participation of the following stakeholders:

Local authorities.

- The scientific–academic community (researchers; universities; centres of investigation).
- The educational community (teachers, students).
- The religious community (leaders, groups).
- Social communicators.
- Political leaders.
- NGOs and social movements (including ethnic and cultural minority groups; youth groups, women, aboriginal populations).
- Civil society organizations (groups, associations, professional councils, trade unions).
- Representatives of political forces.
- Representatives of national and/or local public agencies (ministries, secretariats, councils, institutes).
- Representatives of the productive and commercial sectors.

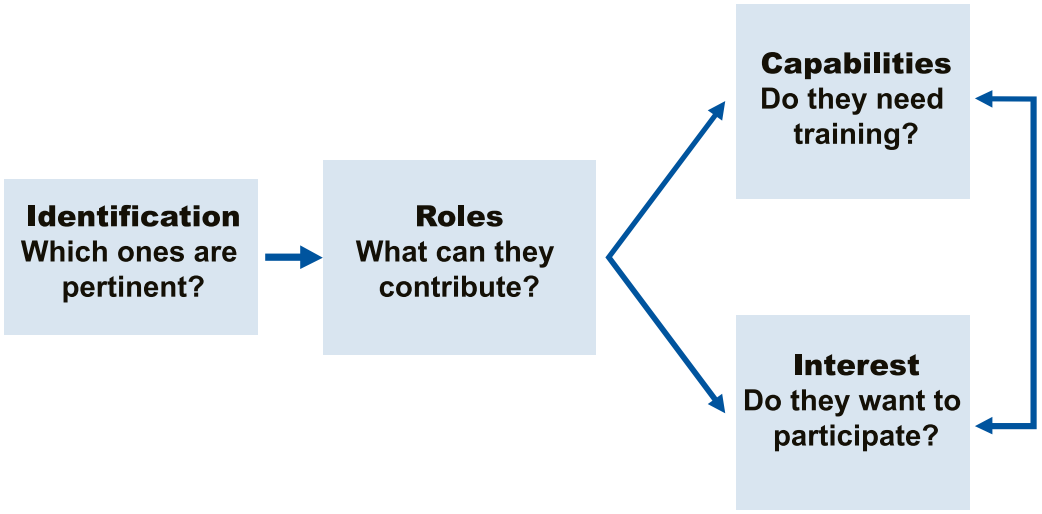
The participation of certain types of stakeholders may be very important to the GEO Health process, even though they have little influence (Table 4).

Table 4: Social skateholders, according to their influence and interest in the GEO Health process

	Little influence	Great influence
Little interest	Social stakeholders with limited capacity to contribute to the process	Social stakeholders who define economic, political or institutional matters
Great interest	Social stakeholders who need empowerment (e.g. Aboriginal populations living in critical ecosystems)	Key social stakeholders (those who draft and execute public policies on environmental and health problems)

Source: UNEP, 2007. Module 2. Modified.

Figure 10: Identification of social stakeholders, their roles, skills and interests



Civil society's commitment to a GEO Health assessment is essential, not only to ensure that individuals join in making a participatory analysis of the problem, but also to guarantee that society adopts the process's objectives and goals. Close collaboration with civil society organizations is also essential to increase society's support and consensus, especially of those who represent groups normally absent from political dialogue (women, the indigenous population, among others).

The best way to ensure that their observations and recommendations influence public policy making is to involve social stakeholders who must make these decisions and are affected by the results.

There are no valid excuses for not involving the largest possible number of (collective) social stakeholders. Involving them may delay the process, but it is essential for creating a firmer social awareness and building a large coalition in favour of developing and promoting healthy environments. However, it is important that the number of (individual) participants be limited to make proper administration of the process possible.

It is essential that the social stakeholders involved (collective and individual) are aware of the GEO Health methodological tool (its scope and limitations) before setting the goals of the process to be implemented. In any case, we cannot lose sight of the fact that the objective of the report is to increase knowledge about how society, environment and health are linked, and to encourage changes that promote healthier environments for all.

From the outset, it is important to clarify the uncertainties and premises associated with preparing an integrated assessment with these characteristics, in a way groups with different interests can participate and cooperate throughout the process, although this may present the participants with serious challenges.

SWOT analysis - Strengths / Weaknesses / Opportunities / Threats - is a very suitable tool to use in making an analysis of the socio-political and institutional climate when it comes to implementing the GEO Health process. A SWOT analysis consists of listing the internal positive aspects (government and/or civil society support, the members of the team, installed technical capacities, etc.) and the unfavourable internal aspects (lack of data, history of conflicts among sectors, mistrust, apathy, etc.), as well as listing the positive and negative external aspects. Figure 11 shows the general scheme of the SWOT analysis (a), together with the main results of this analysis applied to installing the GEO Health process in the City of Sao Paulo, Brazil, in 2007 (b).

Figure 11: SWOT Analysis Scheme

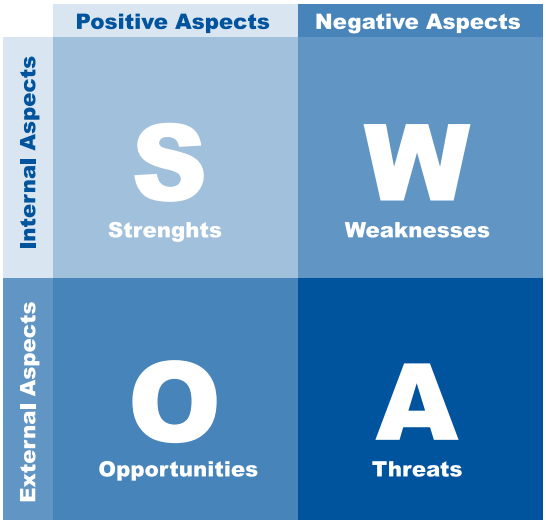


Table 5: Principle results of the SWOT analysis, as applied to installing the GEO Health process Sao Paulo, Brazil, in 2007

	Positive Aspects	Negative Aspects
External Aspects	• Effective establishment of inter-sectorial and inter-disciplinary working groups • Optimal openness and great inclination to participation by the communities involved. • Very good availability of technical capacities, infrastructure and consolidated secondary data.	• Difficulties in guaranteeing dialogue, decision-making and resolving conflicts among different partners in the process. • Problems among community teams to meet the time-line
Internal Aspects	• Excellent political conditions and dialogue with the local authorities	• Extremely high degree of socio-political, health and environmental complexity in the City of Sao Paulo

4-2 Definition of a basic agenda

Once the social stakeholders, who are to be partners in the GEO Health process, have been identified and the composition of the Board and the WG, CG and MAG groups have been defined, it becomes necessary to allocate the responsibilities that each partner must assume in the process; as basic agenda should also be established, to include:

(1) Drafting terms of reference and commitment.

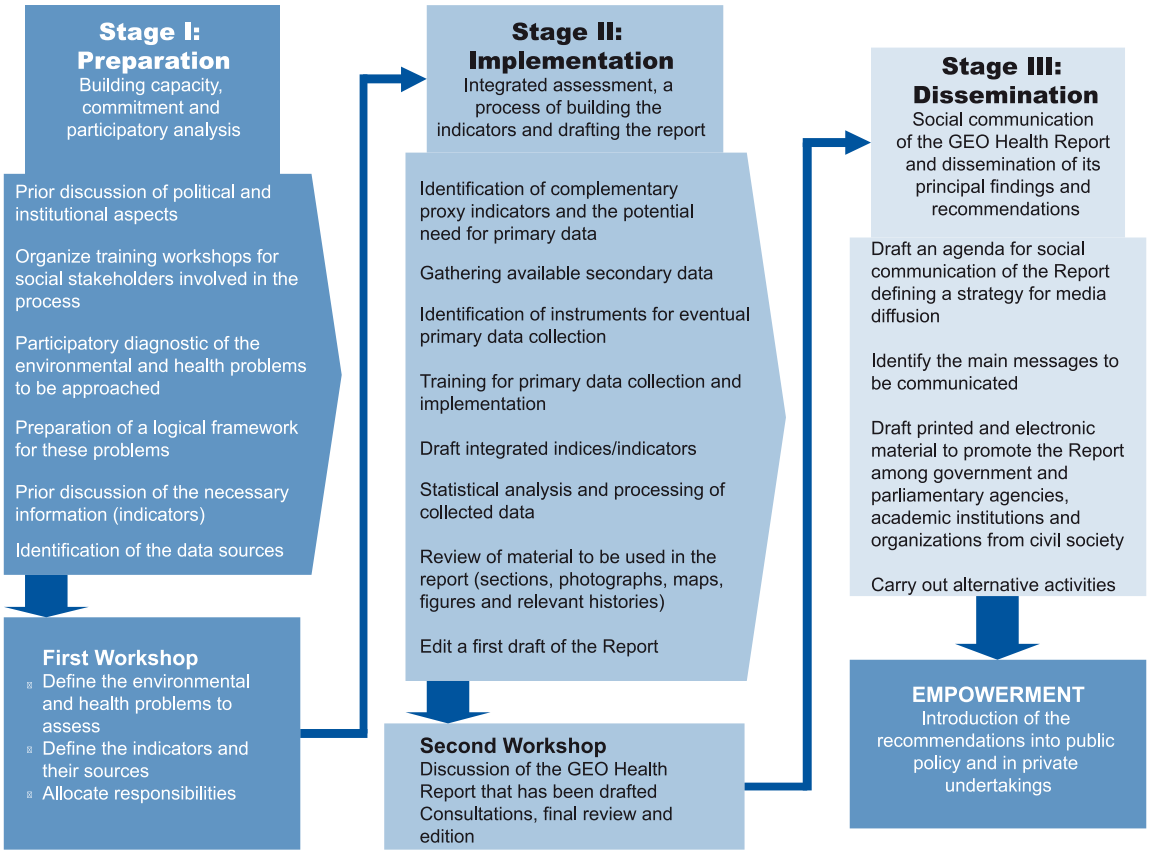
These terms include:

a) Activities to be carried out together (work plan to complete the three methodological stages of the GEO Health process).
b) The role to be played by each partner, including the specific activities to be developed and the information to be provided.
c) A definition of the model to be used when carrying out strategic consultations during the process.
d) Rules regarding information and communications (including terms of confidentiality).
e) Policy making procedures (it is suggested the anticipated conflict resolution opportunities be indicated).

(2) Definition of goals and preparation of a schedule of activities.

It is advisable to set goals in stages, the final goal being to achieve the process's objectives. It is also advisable to delegate intermediate goals to small, specific focus groups, while maintaining overall coordination of the process; defining the goals with precision helps the process and avoids having to disperse the work.

Figure 12: Stages in producing the GEO Health Report



Programming helps to plan tasks and is necessary to follow up on and assess how the process is advancing. It includes all the stages and indicates the type and content of the activities with their respective tasks and the time needed to carry them out. It is important to define the time required as precisely as possible.

Once all these steps have been taken, the WG will be able to initiate an integrated process on environment and health assessment that will result in producing and disseminating a report on "Environment and Health Outlook". This phase consists of three stages: preparing, producing and disseminating the report, as shown in Figure 12.

4-3. Stages in the GEO Health Assessment

First Stage: Preparation

After finishing the institutional implementation stage it becomes necessary to prepare the involved stakeholders and to give an accurate description of the problems related to the environment and health of which a holistic assessment will be made to draft the report.

To produce an "Environment and Health Outlook" report, the appropriate data must be gathered and analysed and integrated recommendations proposed to deal with environment and health that have been detected.

The first stage of producing the Report– Preparation –depends on meeting the following goals:

1. Organize training activities for the stakeholders involved in implementing the GEO Health process, to enable them to adopt the methodological tools and, at the same time, become aware of the need to build sustainable development for healthy environments by promoting health.
2. Develop, together with the stakeholders, a study on social perception of the problem under consideration – participatory diagnosis (PD). The PD will offer relevant qualitative information for dealing with the local problem and establishing priorities.
3. Establish criteria for setting priorities, using the results of the socio-political and institutional situation analysis (SWOT) and of the social perception study (PD).

Figure 13: Framework for Drafting GEO Health

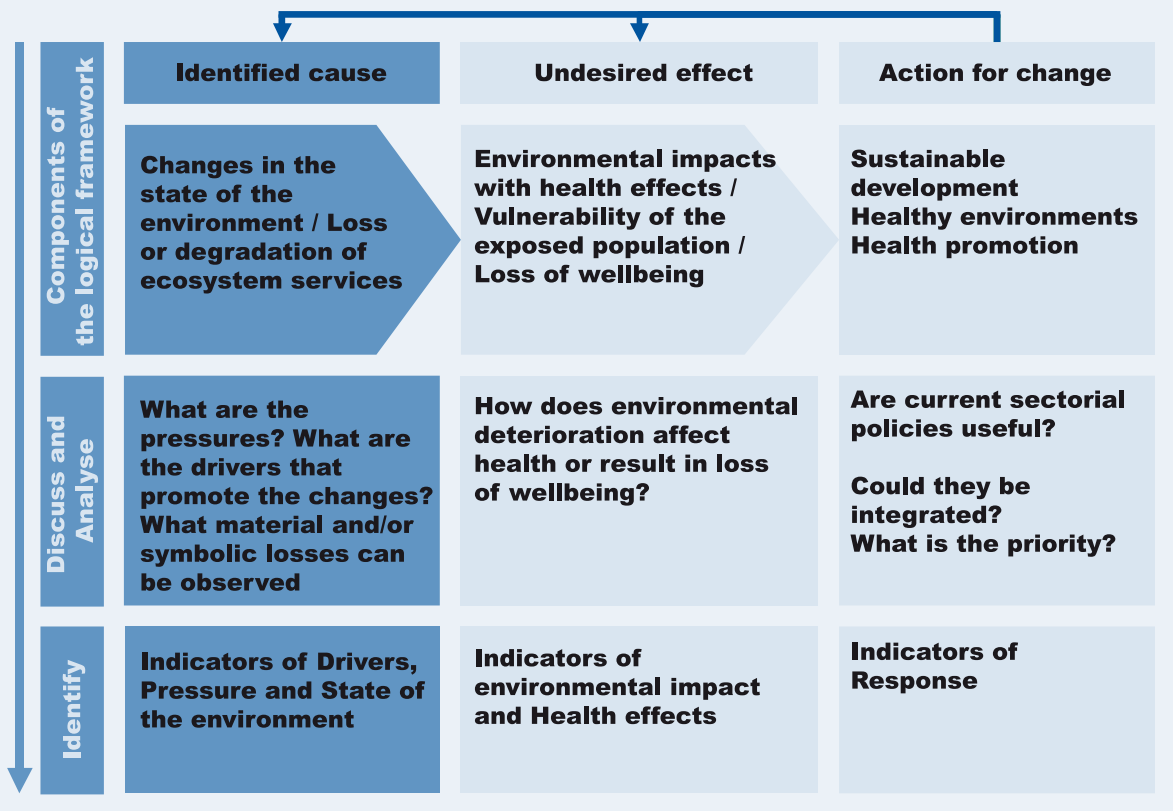


Table 6: Goals and Instruments for the Preparation Stage

Goals	Instruments
Train and raise awareness among stakeholders involved in the process	Workshops or Focus groups for training and raising awareness / GEO Health teaching material
Assess social perception	Surveys or Rapid Participatory Diagnostics (RPD)
Establish criteria for setting priorities	Analyse results from SWOT and RPD or Surveys
Draft statements about the problem; characterize the spatial units and / or social groups considered priorities	Framework for drafting
Discuss possible priority lines of action for change	
Identify basic GEO Health indicators to be included in the Report	Framework for drafting and list of indicators
Identify and qualify the data sources; analyse the suitability of available data for proposed basic GEO Health indicators	Group of specialists in close collaboration with local offices for statistical and geographic data

4. Describe the problems using the GEO Health process formulation framework (cause / effect / action) (Figure 13).
5. Identify, on the GEO Health indicator list (Annex 1), what, from the outset, should be part of the integrated environment and health assessment. The selected indicators will be considered to be the process's "basic" indicators.
6. Identify and qualify the data sources to be consulted.

The logical sequence of the actions linked to each stage could be performed relatively independently and, depending on local circumstances, in another sequence that would allow for activities to be initiated in the most appropriate way possible, bearing in mind the situation in which the GEO Health process is being implemented.

GEO Health methodology offers a series of tools to enable these goals to be met (Table 6) that may (and should) be adopted, adapted and, if necessary, replaced by others with the same purpose.

Once the goals have been met, the WG will draft a discussion document – together with the MAG assessment report – in a workshop attended by members of the Consultative Group and involved stakeholders, and expected to bring the first methodological stage to a close.

The expected product from the first stage is a partial report in which the activities undertaken are described and the results achieved communicated for each goal proposed for this stage, in view of the requirements of the following stage.

Training and building awareness of social stakeholders

GEO Health methodology requires a learning period to understand and apply it to an integrated assessment of environment and health. All the social stakeholders involved should have effective access to the information and be duly committed to the process.

An inter-disciplinary and inter-sectorial group is, by definition, heterogeneous in its knowledge and experience. The function of training is to provide a horizontal and participatory milieu to countenance concepts and learning by doing.

The basic objectives of this goal are to:

(a) Handle the GEO Health methodology: training on using the process tools, including analysing social indicators on environment and health.
(b) Handle data collection and analyse integrated assessment techniques.
(c) Prepare intersectorial actions.
(d) Do more groundwork on sustainable development of healthy environments and on health promotion.

Training and raising awareness may be done by organizing workshops or focal groups. It is recommended that teaching materials be made available, produced so that they can be used later on by the same social stakeholders to improve training within their organizations and/or communities. That is to say, in addition to being informative they should contain teaching recommendations.

There are no restrictions regarding the methods and techniques to be used in the workshops or by the focal groups; the only recommendation is to create a space with freedom of expression, diversity and tolerance in which participants' creativity is stimulated and they can apply their intellectual and working capacity.

Included among the skills that must be strengthened by training are:

- The capacity to deal with different qualitative and quantitative information.
- The methodology's inter-disciplinarity, recognizing that the fragmented knowledge model has run its course.
- Methodological inter-sectoriality, recognition of the need for integrated intervention in respect of complex problems that have multiple determining factors.
- Awareness of gender, ethnic, cultural and social differences.
- The capacity to deal with uncertainties and conflicts.

It is advisable that a documentary record be kept – written, photographic, and if possible filmed – of the training and awareness building activities for the social stakeholders. Images, stories and expressions produced in these spaces tend to complement and notably enrich the technical assessment process for environment and health.

Training social stakeholders should be an integral part of the GEO Health process, in such a way that the "learning by doing" scheme can serve to clear up doubts, errors

and disagreements concerning the process, allowing them to be discussed and, by so doing, to make a more realistic assessment.

A practical measure to ensure ample and full participation of social stakeholders during the entire process is, from the outset, to make as explicit as possible the strategy on how they should participate. If this is not done at an early stage, participation tends to end up as a delayed idea that often becomes a "fait accompli".

Should it become necessary to collect, process and analyse primary data – the second stage of the process – training involved stakeholders should create and/or strengthen their more specific capacities.

Participatory Diagnostic of the problem under study

Participatory Diagnostic (PD) – a technique based on the theory of research–action (Thiollent, 1996) – is a tool that allows the social perception of a specific environment and health problem to be determined.

The objective of PD is to provide elements to build the framework for preparing the process, thus helping to describe the problem and leading the search for socially acceptable responses. PD allows us to obtain qualitative social perception indicators by prioritizing the main social-environmental problems. PD, because of its participatory and inter-sectorial nature, is an important stage when participating social stakeholders may discuss, affirm, refute or formulate perspectives.

In cases where performance conditions are favourable (time, technical, human and financial resources), it is recommended a questionnaire be prepared on the perception of risk; it should take into consideration how environmental and health problems are characterized and how feasible it is to solve them from the point of view of community acceptance, as well as taking into account technological, financial and political aspects

For example, during the installation phase of preparing the pilot study in Chabás, a rural area in Argentina, the local social stakeholders suggested that, in principle, the social perception of risk in the community (fear of getting cancer due to the region's trans-genetic crops) did not correspond to the real risk (water and atmospheric pollution from massive use of agricultural pesticides). They considered, therefore, that preparing a questionnaire would be a much better way to show this contradiction and, by analysing the results, they would be able to prepare an agenda on awareness building and risk communication.

If, on the other hand, the conditions are not right for carrying out a survey, or the assessment is limited to the community level, proceeding with the RPD (Rapid Participatory Diagnostic) is recommended. The RPD consists of carrying out group activities where the environment and health problems that most concern a community can be described and, simultaneously, feasible action alternatives be identified to solve or mitigate them (Peres and others, 2005).

For local assessments, it is recommended that broad-based community participation in all the programmed participatory activities be promoted. However, for more comprehensive assessments (larger than community groups), it is advisable to carry out activities that numerically increase participation by relevant social stakeholders, in respect of the members of the WG.

In the GEO Health pilot study carried out in Sao Paulo, Brazil, the RPD was implemented with the participation of community health agents, educators and facilitators attending a training programme on environment and health (PAVS – Green and Healthy Environments Project) promoted by the municipal government through its environmental and health secretariats. This RPD consisted of two basic activities: (1) reconnaissance of the territory to be assessed with a photographic record and a debate on what was observed and (2) participatory description of the problems perceived as priority and identification of inter-sectorial involvement. The results of the RPD were very important when selecting process indicators.

If it is decided to investigate social perception by conducting surveys, the number of individuals to be interviewed will have to be defined (sampling), as well as the type of questionnaire (standardized or open response) and the method of analysing the data to be included.

Sampling depends, primordially, on the assessed population universe (number, diversity, complexity), and obeys statistical criteria. It also depends on the type of methodological instrument chosen for analysing the responses obtained, for example, to analyse collective discourse (Lefèvre and others, 2000), the number of individuals interviewed is not as critical for producing a

good result as in the case of quantitative methods[9]. If the goal is to quantify the frequency of repetition of a given response, a standardized questionnaire must be used on which the interviewer notes the responses (suggested or open) given by the interviewee for each question asked. In this case it is very important to be careful about the formal and methodological aspects of the questionnaire (rigorousness, precision, clarity and the order of the questions). However, if the goal is to analyse the contents of the interviewee's replies, the use of open-ended questionnaires is recommended, and the interviewer should participate as little as possible (Thiollent, 1987).

To conduct the PD, the Working Group must establish a task-specific group to draft questionnaires and analyse the results of the survey. It will probably be necessary to arrange a training programme to correctly manage these methodological instruments.

The procedure consists of holding workshops with a specific number of stakeholders who represent the community (it is avisable to establish several homogeneous groups). Active participation in Participatory Diagnostic workshops has three main objectives:

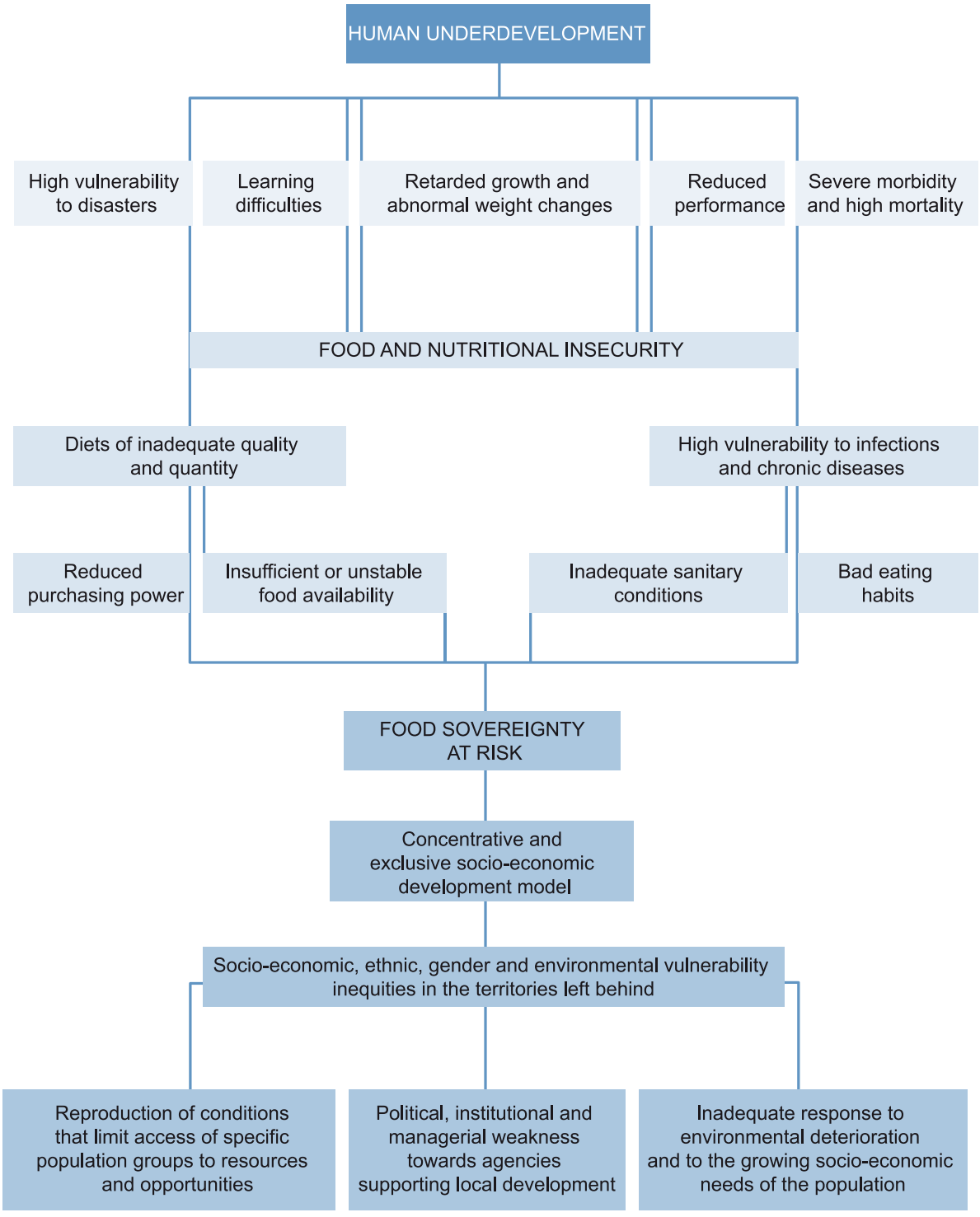
- To be aware (to obtain information, to share information and to seek advice).
- To express an opinion (to suggest, to debate, to evaluate, to plan).
- To decide (to choose representatives, to be a representative, to assign tasks, to perform tasks)

In Participatory Diagnostic workshops there is free discussion of the problem under consideration, without guidance from facilitators. It is suggested a group dynamics technique be used (Phillips 66; Simultaneous Dialogues, brainstorming) to organize the discussions and optimize the time spent at the workshops (Fraternitas Foundation, 2005). The result of this activity should be to reach a consensus about environment and health priority problems, associating environmental changes in the territory to the maximum possible extent with health problems that affect the population, and identifying vulnerabilities. The workshop participants should propose possible solutions or mitigation measures for each problem they consider to be a priority.

The problem tree is a very useful instrument for participants in PD workshops to identify and characterize problems. Figure 14 shows the results of a possible problem tree prepared about the loss of nutritional sovereignty, a very important environmental impact in LAC, identifying vulnerabilities and effects on health.

9 For example, the analysis of response frequency, a quantitative technique consisting of enumerating responses, repeated in closed questionnaires or those having the same discursive meaning in open interviews.

Figure 14: Problem tree for nutritional sovereignty risks



Source: Delgado and others, 1999.

The roots of the tree (dark blue boxes) represent the socio-environmental conditions that put nutritional sovereignty at risk, the branches (middle blue boxes) represent the conditions of nutritional uncertainty that are an adverse consequence (light blue boxes) of human development.

After the debate each participant should individually record the grade (1, 2 or 3) s/he assigns to each of the problems identified, considering the Frequency (F) of the problem; its Gravity (seriousness) (G); and the feasibility of finding Solutions (S). The grades are established according to the following table:

	Grade 1	Grade 2	Grade 3
Frequency (F)	Low	Medium	High
Gravity (G)	Little	Moderate	Accentuated
Solution (S)	Easy	Moderate	Difficult

So each problem detected receives a score, corresponding to the sum of the F, G and S grades as shown below:

Problem under consideration	F	G	S	Sum	Priority
A	3	3	3	9	Highest
N	1	3	2	6	Medium
Z	1	1	1	3	Lowest

The information on the perception held by a community regarding the frequency and gravity of the environmental and health problems, as well as the feasibility of solving them must be analysed by the Working Group and taken into account in the following steps of the process, especially when identifying conceptual framework's indicator components.

Identification of basic indicators with the GEO Health formulation framework

The GEO Health formulation framework is a methodological instrument designed to organize and simplify a series of complex data (or assumptions) in respect of environmental and health problems. The formulation framework should be built so that it is participatory and should consider the social perception results of the PD performed earlier.

The discussion may be begun by considering an environmental situation (cause), for example: poor urban solid waste disposal; use of agricultural pesticides; open pit mining, etc., and then the health problems (effects) that might be associated with them could be assessed. On the other hand, the discussion might start by describing the appearance or persistence of health problems, presumably associated with environmental exposure (diarrhoea, asthma, zoonosis, poisonings, dermatitis, among others.), to assess their probable socio-environmental determinants

So that the formulation framework prepared may become scientific knowledge, it must comply with the following causal criteria:

a) Sequence: Do the described causes precede the observed effect?
b) Theoretical grounds: Is there knowledge that explains the described cause–effect relationships?
c) Consistency: Were similar results found in studies carried out under comparable conditions?
d) Power of association: What is the relative risk between cause and effect?[10]
e) Dose / Response Relation: do alterations in the magnitude of exposure correspond to alterations in the magnitude of the effect?
f) Reversibility: Is it possible to reduce or eliminate the effect by reducing the cause?

As the scheme for the formulation framework shows (Figure 13), discussing and analysing each component should result in identifying the basic GEO Health indicators (see Annex 1 of this document) which, in principle, could be part of the assessment.

10 In epidemiology, measurements of association are indicators that measure the power with which a determined health event (effect) is associated statistically with a determined factor (the presumed cause). The power of association between the cause and the effect under study is calculated by comparing the incidence between exposures and non-exposures to the factor under consideration. One of the most frequently used indicators in this sense is the relative risk (RR). RR is calculated as a ratio between the incidence of the event in the group with the risk factor and that incidence in the reference group (that does not have the risk factor). RR is non-dimensional and it can oscillate between zero and infinity. A value equal to 1 indicates that there is no statistical association between the exposure (cause) and the event (effect), while a value, higher than 1 means that the exposure to the factor assessed does, in fact confer a greater risk for the occurrence of the event.

Discussing and analysing the possible causes should result in identifying the basic Driving Force (DF), Pressure (P) and State (S) indicators. By the same token, discussing and analysing possible effects should lead to identifying basic Environmental Impact (EI) and Health Effects (HE) indicators.

The PD will also allow conditions of vulnerability and situations of exposure to be identified that will aid when defining the most appropriate Vulnerability (V) and Environmental Exposure (EE) indicators.

Finally, by discussing and analysing possible lines of action it is intended to identify basic Response (R) indicators and, based on these, it will be necessary to discuss which actions should be continued, which strengthened and which adapted or discarded.

Identification and qualification of data sources

In the LAC countries the basic indicators are not available at all levels of geographic aggregation. However, listing them serves as a guide when preparing local "Environmental and Health Outlook" reports.

To conduct this activity it is advisable to establish a specialist team (statisticians, epidemiologists, geographers), capable of assessing the quality and statistical significance of the data available for the area being assessed. Ideally, this team would work in close collaboration with the local offices that handle statistical data (population censuses, environmental, health, socio-economic data, etc.) and geographic data (cartographic bases, maps).

Table 7 shows a grid that can be used as an assessment tool for indicators. A document will be prepared to report on the reliability of the available data and its appropriateness for building the process's basic indicators.

If necessary, the specialist team may also analyse available variables to create proxy indicators to replace the basic indicators[11]; in the absence of secondary data the team might suggest how to obtain primary data. When selecting GEO Health indicators, whether basic, proxy or primary data, it should be taken into account that they will go through a process to convert them into indices and later will be aggregated in order to make the integrated environment and health assessment. The specialized team established at this stage (preparation) will play an essential role in the following stage (drafting), at the time the data (whether primary or secondary) are collected, processed and analysed to write the report, as well as preparing indices / integrated indicators of the components it is anticipated will be needed for the process.

Table 7: Grid for Indicator Assessment

As the credibility of the GEO Health report will depend on the use of reliable and updated information, we suggest using the following grid as an instrument to assess the available information:

Component	Indicators and Information Sources	Last year and Responsible Institution	Periodicity	Coverage	Disaggregated Data (sex, region, etc.)	Use in Policy Design*	Data Quality
Driving Force							
Pressure							
State of the environment							
Environmental Impact							
Vulnerability							
Environmental Exposure							
Health Effects							
Response							

* Indicate whether the situation is "strong", "appropriate", or "weak". This decision will inevitably be subjective, but the main purpose is to give an idea of the relative use of the information in defining policies and the reliability of the data, so that the interventions for constructing statistical capacity will be organised according to priorities.

11 Proxy or substitute indicators are being used in initiatives such as assessments of Millennium Development Goals (MDG) to replace and complement the planned indicators in the methodology that have drawbacks when making local-level calculations. For example, when the national MDG report was drafted in Argentina the following proxy indicator was included: "Percentage of children below the poverty line" to compensate for the lack of information on "Prevalence of child malnutrition" (Alvarez 2007). http://www.eclac.org/deype/noticias/noticias/3/29203/cea4_ODM_argentinaPPT.pdf

Second Stage: Implementation

The principal objective of the implementation stage is to draft a preliminary version of the "Environmental and Health Outlook" report and to provide a GEO Health conceptual framework (Figure 6) as the primary methodological instrument.

The GEO Health process has reached this point thanks to the report from the drafting stage that was discussed by the participants of the First Workshop. Therefore, the environmental and health problems to be assessed will already be identified, priorities will be established and, finally, the interdisciplinary actions needed to make the change will already have been discussed.

All this prior debate will bring a concrete proposal to the second stage by identifying the indicators to be included in the assessment. Also available will be a technical analysis indicating the quality of existing data that allows viability to be assessed at the levels of geographic aggregation being used to prepare the process.

However, it is probable that, for reasons of analysis, in some of the GEO Health processes the need will arise for other indicators, different from those basic to the process. In that case, the proposal will be feasible provided there are appropriate sources. Furthermore, if the data from such indicators are more reliable or better demonstrate the associations they are intended to show, they may be used as proxy indicators for the component of the conceptual framework to which they correspond.

It may also happen that the available data sources fail to satisfy the demand for secondary data in respect of quality at all the territorial levels assessed and so, as a result, it becomes necessary to resort to collecting primary data. If this indeed becomes necessary, a training strategy must be established for the stakeholders involved in collecting those data.

The WG should establish a working agenda to draft the report and to review the schedule originally agreed, considering there now might be a need to take the following steps:

1. Collect secondary data available from identified sources to report about the components of the GEO Health conceptual framework (basic indicators) selected during the first stage.
2. Identify and select other required, non-basic, and/or proxy indicators, instead of basic indicators not available from the data sources.
3. Select instruments that may be able to collect now unavailable primary data.
4. Train the stakeholders involved to collect, process and make an integrated analysis of primary data on environment and health.
5. Collect all data (secondary and/or primary) to be included in the report.

The selection of new indicators, proxy indicators or primary data must rigorously obey the methodological criteria demanded of a good indicator. Table 8 presents some of these criteria – known by the acronym "SMART"— for determining whether an indicator has been designed correctly. These criteria emphasize the importance of setting realistic and pertinent objectives (agreed upon by the principal stakeholders) and that can be achieved by the time the project concludes. Collecting primary data demands choosing the appropriate methodological instruments and training local stakeholders who will take part in the activity.

Figure 15 schematizes the critical path in this second stage, according to the availability of high quality secondary data at every territorial level assessed. In each of the steps, the process coordinator should assign responsibilities to small drafting groups to be formed to concentrate on a determined goal, without losing an integrated perception of the process.

Data Collection

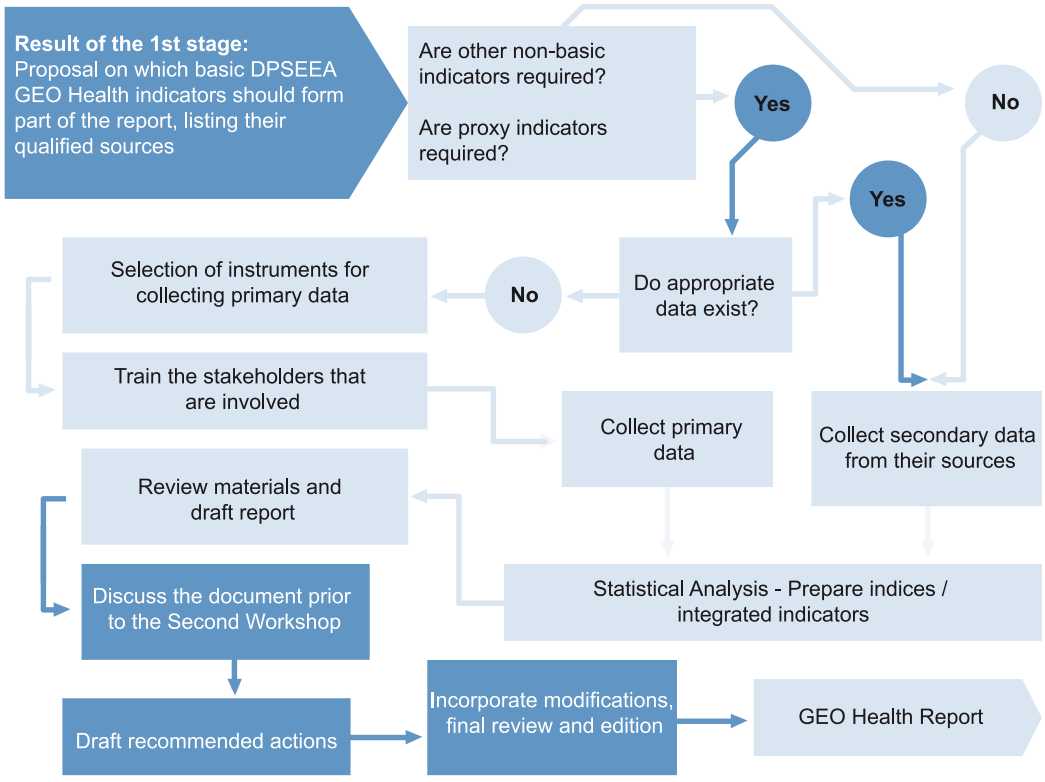
Use of secondary data

As far as possible the "Environmental and Health Outlook" reports should be drafted from the list of GEO Health indicators in Annex 1, based on secondary data produced by official sources. However, faced with the lack of quality data for these indicators at any level of geographic aggregation, the first option is to replace the basic indicators with proxy indicators sought from the same types of sources. It should be kept in mind that it is not a goal of the GEO Health process to establish a parallel process for compiling and analysing data. To ensure that stakeholders from the local / national area in which the assessment is being performed consider

Table 8: Criteria for choosing SMART indicators

	COMPONENT	EXPLANATION
S	Specific	Must reflect only those changes that are to be assessed, without ambiguity and avoiding measurement of variations associated with other factors
M	Measurable	Must provide certainty that the necessary information can be measured, analysed and compared with existing means.
A	Achievable	Must be available within an acceptable period, with the best possible cost-benefit relationship in respect of other similar indicators.
R	Relevant	Must be pertinent in respect of the precise objective that it is linked to, so that the effort to obtain the information is not in vain.
T	Time-framed	Must be limited in time, assessing in a precise manner the changes observed within the time period analysed.

Figure 15: Schematic for Second Stage: Implementation



the GEO Health process as being independent and pertinent, it is highly recommended that national and local data sources be used, rather than data sources from outside the locality or administrative district being assessed.

It is also essential to consider that, as the report being drafted is a public information tool, it cannot jeopardize the quality of the information. Only bona fide and concrete estimates should be used. The credibility of the report depends, to a great extent, on the reliability of the data, and therefore the sources must always be mentioned. If all possibilities of using secondary data have been exhausted, the last resort would be to collect primary at the local level. These data will be used to build the basic indicators chosen from among the GEO Health indicators listed in the Annex I [12]. The selection of which indicator from this list to choose as being basic

for a specific component of the conceptual framework should be governed by statistical criteria (power of association, significance) in combination with pragmatic criteria (availability of technical and human resources, reliability of available data, among other things).

The possibility should be considered that a determined country or locality has an information system based on similar indicators that could replace the GEO Health indicators (proxy indicators) and, in that case, it may be more convenient to use that information for the process.

Finally, a local environment and health assessment may require very specific information that is not measured by any of the GEO Health indicators. In that case, local indicators may be used, as long as they respect the required criteria of appropriateness.

In summary, there are three categories of functional indicators in the GEO Health process:

- Basic: Indispensable for the integrated analysis of environment and health.
- Proxy: Substitutes for unavailable basic indicators.
- Local: Necessary to understand the unique characteristics of each locality.

For the GEO Health process, it is crucial that the indicators can always be geographically referenced. Identifying a territorial reference must be the first step toward defining the indicators. The spatial unit used must, preferably, be recognised by the local population, given that this recognition encourages the community to accept environment and health information.

However, the selection of secondary health data at the local level, should consider (when it exists) that how it is constructed tends to respond to criteria or needs for managing the health sector. If added to this is the frequent paucity of environmental data, it makes it very difficult to adopt an ecosystemic focus that establishes associations between environmental changes and their effects on health. It is because of such difficulties that – in contrast to other GEO assessments – the GEO Health methodology considers the possibility of building indicators from primary data whenever it becomes necessary.

Collection of primary data and community participation

The indicators built from collecting local primary data should be agreed upon with the social stakeholders involved, and should comply with the requirements of independence, objectivity, simplicity, sensitivity, timeliness, territoriality and significance that the GEO Health methodology requires of all of its indicators.

Activities to collect primary data should provide an opportunity to mobilize the local community to promote healthy environments that lead to better health and quality of life. For this reason, the process should meet the goals of strengthening local skills and training new stakeholders who will make social empowerment strategies continuous and independent, and will use historic data to consolidate local databases.

It is recommended that the communities involved in local studies be included in the scheduled activities for the third stage of the process (dissemination), and this should be considered when estimating the process costs. It should be stressed that involving a community in the GEO Health process assumes a strong commitment in terms of its response. That is to say, the process's products must return to the community, and the members of the community should recognize themselves in those products to be able to make their own commendations, discuss their implications and, by being so empowered, be able to effectively apply the products.

When making contact with the local communities, no very ambitious or unrealistic promises should be made that would encourage them to have expectations that are difficult to fulfil or are simply not feasible. Disappointing the community leads to discouragement and the loss of credibility – a condition that is difficult to reverse; therefore, no activities involving the community should be initiated without being sure they can be concluded successfully. This, besides being a methodological recommendation, is an ethical mandate that must be respected.

Instruments for collecting primary data

When the secondary data are unavailable or fail to comply with the necessary conditions, primary data must be collected.
In principle, these data fall into one of the following data categories:

12 The GEO Health indicators in Annex 1 were selected from among indicators used previously by:
• GEO process reports, Millennium Ecosystem Assessment reports, Millennium Development Goal follow-up reports
• Information systems on environment and health of LAC countries, in municipalities with Local Agenda 21 and in regional initiatives like the Latin American and Caribbean Sustainable Development Initiative (ILAC)
• Indicators used by agencies of international cooperation such as CEPAL, World Bank, PAHO–WHO, and others.

- A social, economic or demographic context.
- Characteristic of the ecosystem and the state of the environment.
- Basic healthcare services and infrastructure.
- Aspects of human well-being.
- Environmental exposure.
- Availability, access, use of health services.
- Morbidity, disability and mortality.

The selection of priority data may be guided by the following questions:

- What ecosystemic services are available and what is the distributive profile for having access to such services (social and environmental characteristics of the territory assessed)?
- In which spatial units are effects on health observed that are of presumably environmental origin?
- Is there a theory to explain the association between the effects on health and the lack of access and/or the degradation of those ecosystemic services?
- Should that be the case: what are the characteristics of environmental exposure (dose, route of entry)?
- What are the social determinants of health and risk factors (individual and collective) that are characteristic of the affected groups' vulnerability?

Due to the varied nature of these data, the instruments that facilitate collection will also be diverse (clinical, microbiological, documentary analysis; chemical, biological determinations; surveys; focus groups; atmospheric and biophysical measurements, etc.). However, whatever instrument is used, there are three general restrictions that must be strictly observed:

- Primary data must be framed in the conceptual framework of GEO Health and their collection must have a theoretical justification, based on evidence (sociological, toxicological, epidemiological, ecosystemic, and others).
- The primary data must be collected within a system of geographic references, through procedures of sampling and must be applied to indicate associations that have statistical significance.
- The primary data chosen for collection must present the best possible cost / benefit ratio.

Training on collecting, processing and making an integrated analysis of primary data

Training stakeholders has to be vertical as well as horizontal, that is to say, it must include specialists and non-specialists in the same space causing a feedback process based on the "learning by doing" modality. In general terms, training activities must have a solid theoretical foundation, be adaptable to different political and socio-cultural compositions, and be sensitive to unique situations.

The training programme may take place as workshops or training groups, using the directed discussion modality and taking advantage of didactic support materials. The following are among the skills that should be strengthened by the training activities:

- Knowledge of current legislation and norms on environment and health.
- Basic notions of the ecosystemic focus.
- Command of geographic reference systems that allow epidemiological patterns to be visualized.
- An understanding of health and illness, the social determinants of health and individual and collective risk factors.
- Basic notions of bio-statistics and epidemiology.
- How to consult bibliographies and databases.
- Independence as to how skills should be reproduced and multiplied.

It is recommended that all stakeholders involved in the GEO Health process be included in the programmed training activities.

Preparation of the GEO Health conceptual framework integrated indices / indicators

Upon concluding data collection, the process will continue with the statistical analysis intended to use the components to create integrated environmental and health indices / indicators. This procedure is one of the specific objectives of the GEO Health process, since it is through these instruments that the integrated environmental and health assessment becomes effective. Integrating conceptual framework components is what makes the GEO Health process methodology unique compared to other methodologies for assessing environmental health. In fact, the GEO Health process is not merely limited to presenting environmental and health indicators together, but it also advances the construction of integrated indices / indicators. Thus, it best characterizes the relationship between the state of the environment and health conditions, while at the same time defining the territories and/or social groups most vulnerable to environmental exposures that affect human health.

From a technical point of view, the integrated indices / indicators combine very different indicators that -

upon aggregation - may demonstrate how to hide the relevant differences and, therefore, very great care must be taken when calculating them. In order to meet this goal, the participation of the team of specialists (epidemiologists, statisticians, geographers), designated in the first (preparatory) stage is extremely important, as is the close collaboration of local agencies that handle the statistics and geographical resources.

The selection of the basic indicators to be integrated must have theoretical backing and statistical significance, that is, they must faithfully indicate associations between environmental exposure and effects on health corresponding to a cause–effect framework. Should there be more than one indicator for a single component of the conceptual framework, it would be wise to select for aggregation that which indicates the greatest negative distinction between the spatial units (e.g. cities, neighbourhoods, geographic areas) and/or social groups (age, gender, occupation, ethnics) assessed.

It is important to convert the indicators into indices (a standard measure between 0 and 1, without units) by means of the formula:
Index = (maximum value – observed value) / (maximum value – minimum value)

Thus, the spatial units (or social groups) that obtain an index closest to zero present the worst results for that indicator, while those that approximate one, have the best results. A multiple linear regression analysis should be carried out, taking a component of health (V, EE or HE) as the dependent variable and the socio-environmental components (DF, P, S, EI) as independent variables. The result of the multiple linear regressions expresses the statistical significance and the coefficient of determination among variables.

For each spatial unit (or social collective), the integrated indicators of two or more components are obtained by adding the respective indices and dividing by the number of components added. Likewise, integrated indicators, in turn, may give way to other aggregations. By aggregating integrated indicators of socio-environmental components with the health components, we obtain the integrated indicators for environment and health.

One immediate application of these integrated environment and health indicators is the establishment of priority criteria, dividing the spatial units (or social groups) assessed according to the best or worst results obtained, guiding actions directed at the most relevant socio-environmental components in respect of their effects on health.

A possible instrument for establishing criteria for prioritisation is the categorization of the results by quartiles, or, the identification of the ¼ that displays the worst results (25% closest to zero) of the total units (territorial, socio-economic) assessed.

In conclusion, it is by making an integrated analysis of the components of the conceptual framework that the GEO Health method is able to reach a better scientific understanding of the associations between environmental risks as well as social vulnerability to environmental exposure with health effects, and to identify the most vulnerable territories and/or social groups. This information, together with the results of the PD prepared in the first phase, is fundamental for recommending actions.

Box 9: integrated environmental and health indicators for water borne diseases GEO Health Pilot Study in São Paulo, Brazil

Sao Paulo, The great Brazilian metropolis, has an estimated population of 11 million persons, distributed heterogeneously over a territory of 1,509 km², at a mean altitude of 760 MASL; almost on the line of the Tropic of Capricorn, in the hydrographical basin of Rio Tiete, in an Atlantic Tropical Forest region.

The city, one of the largest in the world, is divided into 96 administrative districts (DA). As a function of the good availability and quality of secondary data on health at this level of geographic aggregation, the Sao Paulo DA was adopted as a spatial unit for analysis.

As expected in a huge Latin American urban environment, Sao Paulo has a whole series of different environmental impacts (visual, sound, atmospheric and water contamination, irregular urbanisation, loss of vegetal coverage and biodiversity; irregular waste disposal, micro-climatic alterations, floods and landslides to mention a few), as shown in the "Urban Environment Outlook" report (UNEP, PMSP, IPT, 2004). The GEO Health process, implemented in 2007 and 2008 as a pilot study, was concentrated on the effects on health associated with water pollution (UNEP, PAVS, FIOCRUZ, 2008). One of the main challenges to the pilot study performed in Sao Paulo, was putting to the test the procedure for integrating the indicators of GEO Health conceptual framework components. By way of example, we will describe the procedure applied to integrate indicators, corresponding to social-environmental components (DF; P and S) and health components (HE) related to water-borne diseases:

First Step: Selection or the indicators to be integrated

To identify the DA most vulnerable to water-borne diseases associated with water pollution in the city of Sao Paulo, the following indicators, corresponding to the components of the conceptual framework of the methodology, were integrated:

- ➔ DF: Percentage of heads of household lacking instruction / Source: IBGE*
- ➔ P: Percentage of population living in favelas / Source: SVMA**
- ➔ S: Percentage of dwellings without sewage networks / Source: IBGE
- ➔ HE (i): Mean Infant Mortality Rate / Source: DATASUS – SMS***
- ➔ HE (ii): Mean hospitalisation rate for water-borne diseases among children under 5 years of age / Source: DATASUS - SMS

Among all the indicators contained in the matrix of the Sao Paulo GEO Health Report [13], those chosen turned out to be the ones with greater statistical significance and force of association in the multiple regression tests performed (taking the HE indicators as the dependent variable and the DF, P and S indicators as independent variables).

Second Step: converting the selected indicators into standardized indices

The value of each selected indicator, for each of city's 96 DA was standardized into indices [index = (maximum value – observed value) / (maximum value – minimum value)], obtaining a value of 0 to 1 without units. The indices closest to 1 express better conditions (social-environmental or health) than those closest to zero (contrary to the indicator from which they are derived, in which the lesser value corresponds to the best result).

13 Matrix of indicators from the São Paulo GEO Health Report:

DF: (1) Percentage of heads of household who did not attend school; (2) Percentage of heads of household earning less than the minimum wage. Source: IBGE

P: (1) Percentage of population living in favelas; (2) Percentage of population living in illegal settlement areas; (3) Percentage of population living in invaded areas. Source: SVMA

S: (1) Percentage of housing units not connected to sewage networks; (2) Percentage of dwellings supplied by water wells; (3) Percentage of dwellings lacking bathrooms; (4) Percentage of dwellings with waste collection service in community rubbish dumps. Source: IBGE; (5) Number of flooded areas. Source: SVMA

EE: (1) Index of rodent infestation of dwellings. Source: SMS; (2) Percentage of dwellings supplied with a water network up to its property. Source: IBGE.

HE: (1) Mean Infant Mortality Rate; (2) Mean hospitalisation rate for water-borne diseases among children under 5 years of age; (3) Mean mortality rate from water-borne diseases; (4) Rate of mortality from infectious and parasitic diseases (Cap. I CID-10). Source: DATASUS - SMS; (5) Mean incidence of leptospirosis. Source: Sistema de Informação de Agravos de Notificação (SINAN)

Third Step: integration of indicators

To obtain the integrated indicators, the following formulas are applied:

- ➔ DF_P= (index DF + index P) / 2
- ➔ DF_S = (index DF + index S) / 2
- ➔ DF_P_S = (DF_P + DF_S) / 2
- ➔ DF_P_S_HE(i) = (DF_P_S + HE(i) index) / 2
- ➔ DF_P_S_HE(ii) = (DF_P_S + HE(ii) index) / 2

Fourth Step: Identification of the priority areas

The 96 administrative districts, into which the city of Sao Paulo is divided, were placed in descending order according to the two integrated indicators DF_P_S_HE.

- ➔ The 25% closest to zero are considered the quartile with as the "worst" situation.
- ➔ The following 25%, the quartile with a "bad" situation.
- ➔ The following 25%, the quartile with a "good" situation.
- ➔ The last 25%, closest to one, the quartile with a "very good" situation.

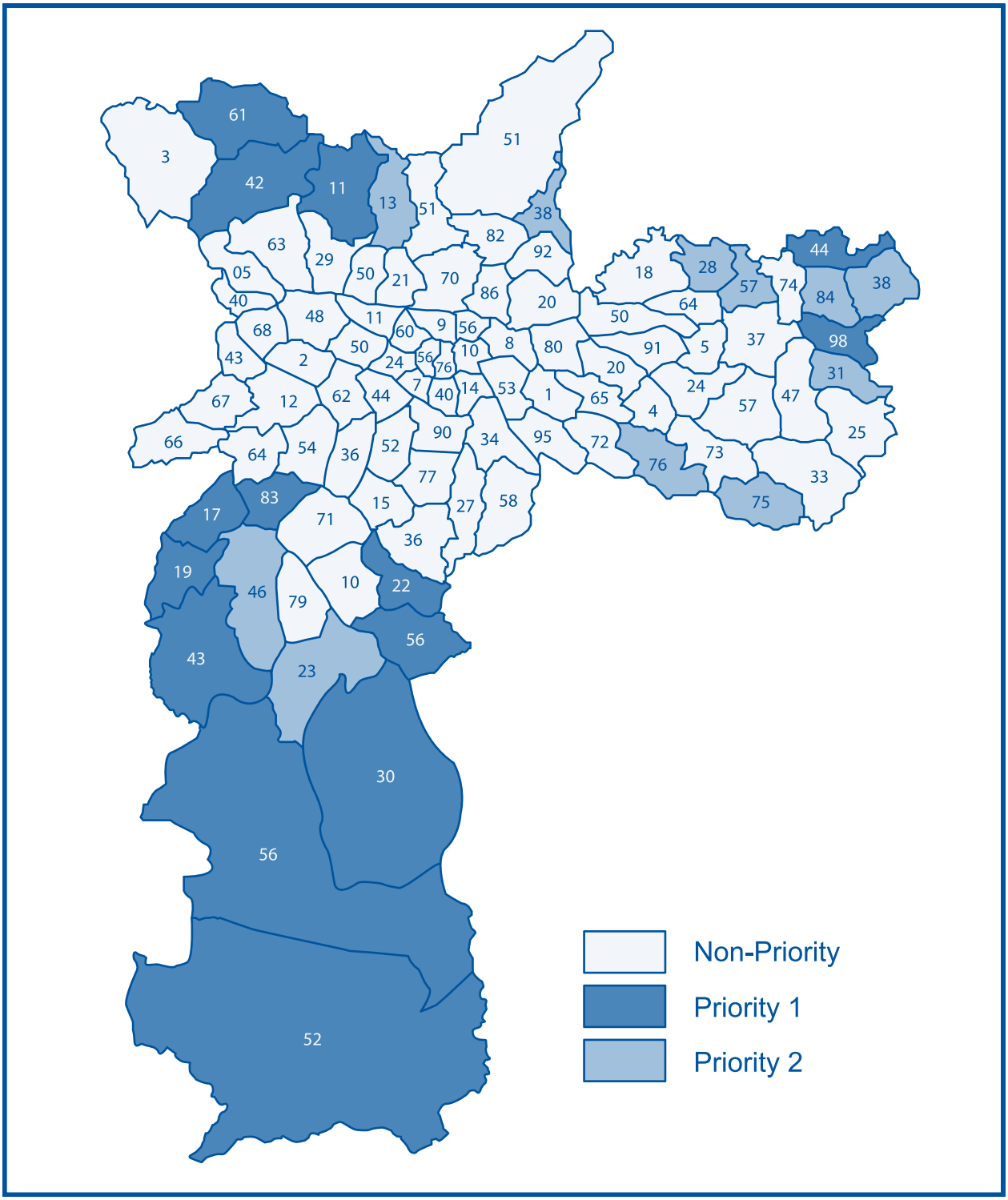
The DAs that presented "worst" results for two integrated indicators were considered "priority 1", those with a "worst" result in at least one of the two indicators was considered "priority 2", finally those having no "worst" result, were considered "non-priority".

In this way the analysis of the integrated indicators allows us to know that the effects of health from water-borne diseases, assessed in relation to the environment, are concentrated in 14 of the city's 96 DA, in which 25% of the population lives. These DA (Priority 1) show the "worst" results for the two integrated indicators. Furthermore, there are 7 DAs - with 17.6% of the population – that have "worst" results for one of the two (Priority 2). We can definitely conclude that the inter-sectorial interventions to resolve / mitigate this environmental impact could help to improve the health conditions of 42.6% of the population of São Paulo.

Figure 16 is the map of São Paulo, divided into DAs, classified according to the priority of intervention for water-borne diseases related to environmental deterioration of the water in the municipal territory.

* IBGE: Instituto Brasileiro de Geografia e Estatísticas (Brazilian Institute of Geography and Statistics)
** SVMA: Secretaria do Verde e do Meio Ambiente – Prefeitura de São Paulo (Green Secretariat of the Environment – Prefecture of São Paulo
*** DATASUS: database of SUS (Sistema Único de Salud) – SMS (Secretaria Municipal de Saúde) [Single Health System – Municipal Secretariat of Health]

Figure 16: Environment and health integrated indicators for water-borne diseases and infant mortality – Priority Areas for inter-sectorial intervention for environment and health - Sao Paulo, Brazil. 2007



Source: UNEP, PAVS, FIOCRUZ, 2008.

Box 10: ENVIRONMENTAL HEALTH INDEX (EHI), Proposal of a Tool to assess the human health risks due to local environmental conditions

GEO Health Pilot Study in Argentina

Environmental health is the result of the material and social conditions that characterize the state of the environment in which people live and influences the health of the population.

Developing an Environmental Health Index (EHI) may be a means of systematizing the different variables that cause its effects, providing information that not only is easily understood by technicians and administrators but, and more important, by the population at large, allowing individuals to help extend recognition of the situation in order to change it.

These indicators are combined by using an integration process, expressed mathematically by a polynomial intended to establish a hierarchy for the whole set and an overview of the processes. EHI is a project to organize variables – with their corresponding indicators – that are representative of their constituent aspects, with the added value of integrating them into a matrix that attempts to reflect the complexity of each scenario, adding referenced geographical information to the individual value of each segment.

Component Aspects of EHI

BASIC ENVIRONMENTAL HYGIENE
- Water Supply
- Sewer drainage
- Urban solid waste and
- urban drainage

HOUSING CONDITIONS, and SOCIAL FACTORS
- Socioeconomic level of the population
- Property ownership of housing unit/land
- Overcrowding
- Household solid waste treatment
- Animals kept in the dwelling
- Wash basins in the dwelling
- Educational level of the head of household
- Length of residence in the dwelling and
- Water treatment in the dwelling unit

HEALTH ASPECTS RELATED TO THE ABOVE-MENTIONED VARIABLES

The following matrix for preparing the EHI is built from these dimensions, with the respective weighting (W) by component, the sum total being equal to one. Each component, on its own could be made up of several selected indicators with SMART criteria:

CONDITION 1: SOCIAL

Socioeconomic, cultural and educational components and labour activity (W=0.1)
Environmental health (W=0.2)
Individual and family health (W=0.1)

CONDITION 2: HOUSEHOLD ENVIRONMENT

Conditions of the dwelling (W=0.15)
Water supply (W=0.15)
Sewer drainage (W=0.15)
Solid Waste (W=0.1)
Urban Drainage (W=0.05)

The value of the EHI will vary between 0 and 100, representing four different situations of environmental health.

Thus, an attempt is made to combine a set of indicators that can be converted into an integrated index that facilitates assessment of environmental risks to health and may be used by public powers and society at large to define policies that will improve these conditions.

Environmental Health Situation	Points
Excessive Risk	0 to 25
Some Risk	26 to 50
Minimal Risk	51 to 75
Acceptable Risk	76 to 100

Building proposals, recommendations and conclusions

An analysis of the data and information collected must meet three main objectives:

- To prepare an assessment of the state of the local environmental, identifying the pressures on it and the driving forces that move it.
- To identify the environmental impacts that have an effect on human health, characterizing the most vulnerable territories and/or social collectives.
- To discuss resolution or mitigation opportunities.

Once these objectives have been met, the Working Group will be ready to prepare conclusions and recommendations to guide policy-makers.

The report must offer social stakeholders a list of environmental and health policy proposals, aimed at changing the conditions affecting the territory that has been assessed. These proposals will establish objectives, goals, actions, instruments, and institutional and financial resources necessary to implement the policies presented in the report.

The proposed policies must show they are directly connected to the analysis included in the report, indicating how implementing it will help to improve the quality of the environment and resolve / mitigate the impact on ecosystems and on human well-being. An indication must always be given of the driving forces, pressure factors, environmental conditions and impacts about which it is intended that responses be given.

Recommendations must also be made about how to facilitate or create institutional, financial, social, political and cultural conditions suitable for applying the policies suggested. These recommendations may include:

- The need to provide better technical training for the different social stakeholders.
- Where the local governments' social-environmental and health budget resources should be spent.
- Creating specific agencies for inter-sectorial intervention on matters concerning the environment and health.
- Institutionalizing public policy making social participation channels.
- The need for interchanges with national or international bodies and institutions to expand the local government's intervention capacity.

The conclusions will present a summary of the view of the set of causal origins and of the nature of the city's environmental problems, their impacts, as well as the responses received and the policies proposed to deal with them. The conclusions should:

- Identify the main pressures on ecosystems and the most significant aspects of the state of the local environment.
- Associate ecosystem and ecosystemic service degradation with a worsening of the components of human well-being.
- Relate environmental impacts to the resulting effects on health and the responses received about mitigating / adapting to the problems detected.
- Evaluate the conditions that will enhance or hinder the technical and political effectiveness of the formulated responses.
- Present the principal proposals to the policy-makers.

The conclusions may be organised, following the sequence of report's chapters or based on the set of tasks.

Once all of the material from the report has been processed, the WG will establish an editorial team and follow-up on the following activities:

(1) Draft and review materials to be used in the report, including sections, maps, figures, photographs and relevant stories.
(2) Conduct the second process workshop, to discuss the preliminary report.
(3) Include the changes suggested, final review and edition.

It is advisable that the editorial teams to be established maintain the principles of inter-disciplinarity, inter-sectoriality and participation in the GEO Health process, should also be mindful of gender equity.

The MAG will draft an assessment report for each of the activities to be discussed at the closing workshop for the second stage, before discussing the rough draft of the final report on the process that has been drafted by the WG.

All the relevant observations and/or corrections suggested in the second workshop and consultation rounds should be incorporated.

The final modified document will then be submitted for quality control and technical revision for publication, including:

(a) revision of content and style coherency;
(b) qualitative and quantitative revision of the sections and their messages;
(c) verification of data and statistics, including complete references;
(d) technical edition, printing and publication.

The product of the second stage, that is to say, the "Environment and Health Outlook" report is the raw material for the next stage in which the GEO Health process organizes the procedures to be followed to disseminate and communicate contents.

Third Stage: Dissemination, communication and empowerment

Designing and implementing the media strategy

A plan is needed to disseminate the results of the GEO Health assessment that confirms the social and political legitimacy of the analyses and proposals. This legitimization will increase the possibilities that decisions based on those results will be successful (UNEP and Consorcio Parceria 21, 2003). In this respect, it is important that copies of the report (if possible, accompanied by an Executive Summary) be given – in addition to the policy formulators – to key multiplier sectors, such as schools, colleges, academic and research centres in related scientific areas; directors and editors of the media, and others.

However, dissemination and communication of the results of the GEO Health assessment must not be restricted to the report and its summary. A carefully articulated media strategy must also be used.

As in the other stages, meetings that provide guidance on how to establish agreements with the stakeholders involved in the process are of the utmost importance. The first consensus to be achieved at this stage is about defining an agenda of dissemination and communication activities.

In principle, there are three basic activities to be considered:

(1) Preparing dissemination material to publicize the results among government agencies, policy-makers, parliamentarians, civil society organizations, academic institutions and other stakeholders.
(2) Engaging in information activities about the results and debating the action the report recommends should be taken.
(3) Launching the report through the communications media and with a statement of policy positions.

Both the dissemination materials and the proposed activities should: be suited to the characteristics of the target public; be visually attractive; and be assessed prior to mass distribution. Thus, for example, it is important to prepare summaries for policy-makers and press releases for the general public.

The material for dissemination need not be restricted to the press. Not to be forgotten are alternative media, such as expositions, fairs, interviews in the local news media, the production of audio-visual materials, theatre groups, and others.

Communications activities present a challenge for the process, given that, traditionally, communicating information is still a phase that is not yet a full part of the process of researching and discussing social-environmental problems. In fact, international support for national statistical production has focused on producing information, while little attention has been given to distributing and disseminating data and their use by the public.

Thus, it becomes necessary to optimize all the strengths (consensus and soundness) and the opportunities (allegiances). For example, including high-level officials from the government, parliamentarians, NGOs, the private sector, civil and popular organizations in the media launch, as well as opinion leaders, will help to capture the attention of the media regarding the results of the GEO Health assessment. By the same token, ample dialogue and a broad process of consultation regarding the findings of the integrated assessment process will serve to expand participation and increase appreciation for action required to be taken in the national and sub-national or regional LAC environments.

Box 11: The strategy of "Change" (Actual Impact/Outreach) for consideration:

Characteristics of the message depending on the target audience

- ➔ **Policy-makers:** concise, specific content based on evidence and consisting of the most relevant information.
- ➔ **Social Communicators[14]:** concise content consisting of information of media interest, issues that can be easily related to current news or that explain problems on the social debate agenda. Easily communicated images and graphics may be attractive.
- ➔ **Students, militants from social movements:** well explained content, in simple language.
- ➔ **Scientists and the academic community:** contents rigorously based on updated evidence. Technical language.

Options for the media strategy

- ➔ **Options for Discourse:** include visits, interviews, expositions, workshops, and group dynamics.
- ➔ **Printed Options:** include newspaper articles, reports, flyers, letters, posters, "Op-Ed" columns, special supplements, reports.
- ➔ **Visual Options:** include television messages, videos, and documentaries.
- ➔ **Digital Options:** include internet tools (forum, chat, email, blogs, on-line conferences), CD-Rom, PC-demos.

Source: UNEP, 2007. Module 7. Modified.

The layout of the media strategy must be practical for social empowerment of the GEO Health assessment, that is to say, it must not only be effective in disseminating the results simply as information, but must be directed at raising awareness among the message's target audiences (policy-makers, scientists, academics, the general public, and others) and suggesting, for each person receiving the message, ways to make positive changes regarding the problems of environment and health. In other words, it is expected that the communicative component of GEO Health not only informs but also encourages attitudes that support building healthier environments in the context of a more ecosystemic culture.

Empowerment: The culmination of the GEO Health Process

The GEO Health process concludes by including the report's proposals and recommendations in the local government's public policies. Generally, this task will be beyond the responsibility of the WGs that draft the report, unless their government policies determine otherwise. For this reason, from the very beginning of the GEO Health assessment process, a strategy for collaboration must be firmly established with the persons responsible for public policies (or perhaps business people), who determine the environmental and health conditions to be assessed. This approximation may encourage fruitful exchange between decision-makers and the stakeholders who can help to resolve / mitigate socio-environmental and health problems, broadening the scope of the proposals (these possibilities clearly depend on the local political – institutional context and situation) (UNEP and Consorcio Parceria 21, 2003).

Whatever the attitude adopted by policy-makers may be, it must be stressed that simply preparing the GEO Health process is, in and of itself, an activity that promotes the empowerment of society. In fact, the results of the process are not limited to preparing a report, but also are an opportunity to train social stakeholders, promote democratic debate and exercise citizenship through the collective construction of a healthier environment.

With this outlook, the GEO Health process seeks to launch the methodological foundations of a permanent environment and health assessment process. The purpose is to follow the logic of producing periodic

14 In the group of social communicators we include journalists, reporters, chronicle writers, columnists, advertisers, copywriters among other opinion makers.

reports. By doing so, the GEO Health Report may become a stimulus for changing the attitudes of policy-makers and of society towards health problems associated with the degradation of ecosystemic services.

Continuing the process will make it easier to establish a tradition of making local assessments of the environment and health, thereby permitting an analysis to be made of the relevance of the responses received, and to consolidate favourable cultural attitudes towards promoting health and healthy environments, as well as protecting the integrity of ecosystems.

5

FINAL REMARKS

FINAL REMARKS

5

The GEO Health methodological proposal for an integrated assessment of the environment and human health in LAC has some distinguishing characteristics.

First of all, GEO Health adopts a territorial unit of analysis to make a participatory and integrated assessment of the environment and health, identifying ecosystemic level environmental impacts and discriminating against vulnerable social collectives. This delineation makes it easier to establishment more specific cause-effect relationships among all the possible links of environmental and health determinants. Thus, GEO Health represents an advance over merely territorial environmental assessment methods that tend to generalize health determinants, and over health hazard assessment methods that tend to generalize environmental determinants.

Secondly, GEO Health contemplates the possible acquisition of local indicators based on primary data in cases where there are insufficient or unsatisfactory secondary data at the level of aggregation analysis. This differentiates the GEO Health process from other GEO processes promoted by UNEP and prepared solely on the basis of secondary data.

Furthermore, GEO Health promotes constructing and/or using integrated environment and health indices and indicators. These may be prepared from a statistical analysis of the indicators selected for the assessment (as was the case in the pilot tests described above), or they may be prepared on the basis of other consolidated methodological instruments, such as the determination of the Environmental Burden of Disease (EBD) by means of the indices of DALY (Disability Adjusted Life Years), PYLL (Potential Years of Life Lost to premature death) and YLD (Years Lived with Disability).

Finally, GEO Health broadens the focus of environmental health by exploring the interactions between degradation or loss of ecosystemic services and the effects on the human population's conditions and quality of life. As a consequence health, in effect, is interpreted to mean not simply the absence of disease, but as a state of abundant physical, psychic and social wellbeing.

The result of these characteristics is GEO Health, a participatory, interdisciplinary and intersectorial methodological instrument thought out and designed to help social empowerment, to formulate and apply policies that promote more sustainable life styles and to contribute both to constructing healthier environments and protecting ecosystemic integrity in LAC.

ANNEX

ANNEX

ANNEX I: LIST OF GEO HEALTH BASIC INDICATORS

Indicators	References
1 - INDICATORS OF DRIVING FORCE	
1-1 DEMOGRAPHIC DATA	
Life expectancy at birth, by sex	Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. www.un.org/esa/population/ordering.htm
Population structure by age group	
Population by urban and rural area, by sex	
Annual growth rate of the population	
Fertility rate	
1-2 ECONOMICS, POVERTY AND INEQUALITY	
Poverty and extreme poverty coefficient gap	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Distribution of personal income by quintiles (or deciles)	
Households and population in poverty or extreme poverty	
Human Development Index (HDI)	UNDP – United Nations Development Programme. http://hdr.undp.org/en/reports/
Population living on less than $1 dollar (or $2 dollars) per day, purchasing power parity (PPP) values	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
Percent of persons in extreme poverty	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Ratio of mean income per household inhabitant decile 10 / deciles 1 to 4 (or quintile 5 / quintile 1)	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
External debt service as a percentage of exports	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
Mean size of urban households, by income quintile	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Annual rates of variation in GDP at constant market prices	
Value of external debt and a percentage of GDP	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
1-3 EDUCATION AND INFORMATION	
Radios per 1,000 inhabitants	International Telecommunication Union (ITU) http://www.itu.int/ITU-D/ict/publications/world/world.html
Percentage of students beginning first grade and completing the last grade of primary education	UNESCO-UIS – Institute for Statistics of the United Nations Educational, Scientific and Cultural Organization. http://stats.uis.unesco.org/
Mean years of study of the adult population	System of Sociodemographic Indicators for Indigenous Peoples and Populations of Latin America (SISPPI). http://www.sisppi.org/redatam/PRYESP/SISPPI/
Net school registration by level of education	UNESCO-UIS – Institute for Statistics of the United Nations Educational, Scientific and Cultural Organization. http://stats.uis.unesco.org/
Illiteracy rate	
Internet and mobile telephony users per 1,000 inhabitants	International Telecommunication Union (ITU) http://www.itu.int/ITU-D/ict/publications/world/world.html

1-4 EMPLOYMENT AND PRODUCTION	
Food exports as a percentage of all exports	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
Percentage contribution of each sector to GDP: agriculture, industry and services	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
Distribution of the economically active population by sector of activity	ILO – Internacional Labour Organization. LABORSTA http://laborsta.ilo.org/default_S.html
Structure of the total employed population by major sectors of activity	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Grains and cereals for animal feed as percentage of total consumption	United States Department of Agriculture (USDA) Foreign Agricultural Service (FAS). http://www.fas.usda.gov/psdonline/
Number of micro, small and medium-sized enterprises (MSME) per 1,000 inhabitants	Small and Medium Enterprise Department, International Finance Corporation (IFC). http://www.ifc.org/ifcext/sme.nsf/Content/Resources
Persons employed in low productivity sectors (informal sector)	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Production and importation of fertilizers and PESTICIDES	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT http://apps.fao.org
Un-processed agricultural product exports	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
"Most contaminating" industrial sectors in respect of the value of environmental production	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Unemployment rate (by sex, by years of schooling)	
Physical volume of production of the manufacturing and mining sectors	National System for Environmental and Natural Resources Information (SNIARN) - Mexico. http://www.semarnat.gob.mx
1-5 ENERGY AND CONSUMPTION	
Access to electricity	International Energy Agency (IEA) Statistics Division. http://data.iea.org/ieastore/default.asp
Electricity consumption per inhabitant	
Energy consumption from petroleum derivatives	
Energy consumption derived from solid biomass	
Household energy consumption by inhabitant	
Gasoline (petrol) consumption per inhabitant	
Ozone depleting substance consumption	Ozone Secretariat of the United Nations Environment Programme – UNEP. http://ozone.unep.org/spanish/
Paper and paperboard consumption per inhabitant	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT http://apps.fao.org
Carbon dioxide emissions per dollar of GDP, purchasing power parity (PPP) value	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
Ecological footprint index	Global Footprint Network. http://www.footprintnetwork.org/en/index.php/GFN/page/methodology/
1-6 GENDER AND INEQUALITY	
Human Opportunity Index (HOI)	World Bank – Latin America and the Caribbean. Human Opportunity Index. http://go.worldbank.org/MV7OH8XOH0
Population between 15 and 24 years of age with ample and correct knowledge of HIV/AIDS, by sex	UNSD – United Nations Statistics Division - . Database of Millennium Development Goals indicators – http://mdgs.un.org/unsd/mdg/Data.aspx
Percentage of households with a female head of household	System of Sociodemographic Indicators for Indigenous Peoples and Populations of Latin America (SISPPI). http://www.sisppi.org/redatam/PRYESP/SISPPI/
Proportion of women among the salaried employees in the agricultural sector	UNSD - United Nations Statistics Division. . Database of Millennium Development Goals indicators – http://mdgs.un.org/unsd/mdg/Data.aspx
Ratio of urban wages between the sexes, by completed years of education	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Ratio of the number of girls to boys by level of education	UNESCO-UIS – Institute for Statistics of the United Nations Educational, Scientific and Cultural Organization. http://stats.uis.unesco.org/
Ratio of illiterate women to men	
Ratio of school attendance by orphaned children to non-orphaned children between 10 to 14 years of age	UNSD - United Nations Statistics Division. . Database of Millennium Development Goals indicators – http://mdgs.un.org/ /mdg/Data.aspx
Prevalence rate for contraceptive use in married women between 15 and 49 years of age	

2 - INDICATORS OF PRESSURE	
2-1 URBAN AND BUILT-UP ENVIRONMENTS	
Changes in motor vehicle fleet density	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
Urban density and compactness	Malaga. Urban Indicators System Agenda 21, 2008. http://www.omau-malaga.com/docs/metodologia_y_significado.pdf
Growth in the road network	National System for Environmental and Natural Resources Information (SNIARN) - Mexico. http://www.semarnat.gob.mx
Number of automotive vehicles and passengers in automotive vehicles per 1,000 inhabitants	International Road Federation (IRF). World Road Statistics http://www.irfnet.org/wrs.asp
Sewage discharged into storm water drains	Ministry of Health, Brazil - PAHO/WHO. Avaliação de impacto na saúde das ações de saneamento: marco conceitual e estratégia metodológica. (Assessment of health impacts of sanitation interventions: conceptual and methodological strategy) Brasília, 2004. http://www.opas.org.br/sistema/arquivos/Mnl_Impac.pdf
Receptive tourism	
Population in the main metropolitan area	World Development Indicators Online. Washington, DC: The World Bank. http://go.worldbank.org/3JU2HA60D0
Migration rate	CELADE. Latin American and Caribbean Democratic Centre, Population Division, ECLAC. http://www.eclac.cl/celade/proyecciones/basedatos_BD.htm
2-2 EMISSIONS AND CONTAMINANT GENERATION	
Sewage discharge (municipal and non-municipal)	National System for Environmental and Natural Resources Information (SNIARN) - Mexico. http://www.semarnat.gob.mx
Greenhouse gas emissions: carbon dioxide, fluorinated gases, methane and nitrous oxide	Intergovernmental Panel on Climate Change (IPCC): http://www.ipcc-nggip.iges.or.jp United National Framework Convention on Climate Change (UNFCCC): http://unfccc.int/2860.php
Carbon monoxide, sulphur dioxide, nitrogen oxides, troposphere ozone and non-methane volatile organic compound emissions	The Netherlands National Institute for Public Health and the Environment/The Netherlands Environmental Assessment Agency (RIVM/MNP) and the Netherlands Organization for Applied Scientific Research (TNO). http://www.mnp.nl/edgar/
Stratospheric ozone depleting substance emissions (CFC-11, CFC-12 and CFC-113)	Carbon Dioxide Information Analysis Centre (CDIAC), Environmental Sciences Division, Oak Ridge National Laboratory. 2007. ALE / GAGE / AGAGE Network Data on Concentrations of Greenhouse and Ozone-depleting Gases. http://cdiac.ornl.gov/ftp/ale_gage_Agage/
Solid waste generation	Virtual Library on Sustainable Development and Environmental Health of the Pan-American Health Organization (PAHO): http://www.cepis.ops-oms.org/metaiah/search.php ECLAC - Economic Commission for Latin America and the Caribbean. http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Hazardous waste generation	Environmental Toxicology Laboratory, Faculty of Medicine, Autonomous University of San Luis Potosí. http://ambiental.uaslp.mx/docs/FDB-ResPeligrosos.pdf Ministry of the Environment and Natural Resources. Mexico. http://www.semarnat.gob.mx/GESTIONAMBIENTAL/MATERIALESYACTIVIDADESRIESGOSAS/Pages/residuospeligrosos.aspx
2-3 NATURAL RESOURCE EXTRACTION AND USE OF EXTERNAL FACTORS	
Annual water extraction per inhabitant	Food and Agriculture Organization of the United Nations (FAO) Land and Water Development Division. 2005. AQUASTAT http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/dbase/index.stm
Water extraction as a percentage of all domestic water resources	
Livestock, fisheries and forestry production	Agricultural statistics system (SIAGRO) - ECLAC - Economic Commission for Latin America and the Caribbean. http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Intensive water usage in agriculture	Food and Agriculture Organization of the United Nations (FAO) Land and Water Development Division. 2005. AQUASTAT http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/dbase/index.stm
Intensive use and consumption of fertilizers and pesticides	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT http://apps.fao.org
Agricultural machinery usage	
Changes in soil usage	Agricultural statistics system (SIAGRO) - ECLAC - Economic Commission for Latin America and the Caribbean. http://websie.eclac.cl/sisgen/Consultaintegrada.asp

3 - INDICATORS OF THE STATE OF THE ENVIRONMENT	
3-1 URBAN AND BUILT-UP ENVIRONMENTS	
Final disposal of urban solid waste	National System for Environmental and Natural Resources Information (SNIARN) - Mexico. http://www.semarnat.gob.mx
Evolution of the fragmentation of landscape, ecosystem or habitat units	Department of the Environment and Land Use. Eusko Jaurlaritza. http://www.ingurumena.ejgv.euskadi.net/r49-579/es/ European Landscape Convention http://www.mma.es/portal/secciones/desarrollo_territorial/paisaje_dt/convenio_paisaje/
Magnetic field sources as a hazard to public health	World Health Organization - WHO http://www.who.int/mediacentre/factsheets/fs299/es/index.html
Population with access to improved sanitation services by urban and rural areas	WHO/UNICEF - World Health Organization and United Nations Children's Fund. Joint Monitoring Programme for Water Supply and Sanitation. http://www.wssinfo.org/en/welcome.html
Percentage of households with adequate kitchen ventilation, lighting and installations	National Hygiene, Epidemiology and Microbiology Institute (INHEM). Havana, Cuba http://www.bvsde.paho.org/bvsacd/conven/raisa.pdf
Percentage of households with solid waste collection services	Virtual Library on Sustainable Development and Environmental Health of the Pan-American Health Organization (PAHO): http://www.cepis.ops-oms.org/metaiah/search.php ECLAC - Economic Commission for Latin America and the Caribbean. http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Volume of public transport	International Energy Agency (IEA) Statistics Division. http://data.iea.org/ieastore/default.asp
3-2 WATER, ATMOSPHERE AND SOIL	
Suitability of beaches for bathing	Environmental Health and Technology Company – São Paulo. Ministry of State for the Environment. http://www.cetesb.sp.gov.br/Agua/praias/balneabilidade.asp
Concentration of phosphorated and nitrogenated compounds in surface and subterranean waters	National System for Environmental and Natural Resources Information (SNIARN) – Mexico. http://www.semarnat.gob.mx
Concentration of chemical contaminants in bodies of water or soil: Arsenic, Beryllium, Cadmium, Chromium, Mercury and Lead	WHO – World Health Organization - Inter-Organization Programme for the Sound Management of Chemicals (IOMC). http://www.who.int/iomc/en/index.html European Environment and Health Information System. http://www.enhis.org/object_binary/o2800_Guidelines_indicator_methodology_V3_uneditedVersion.pdf Environmental Toxicology Laboratory, Faculty of Medicine, Autonomous University of San Luis Potosí... http://ambiental.uaslp.mx/docs/FDB-ResPeligrosos.pdf
Concentration of carbon monoxide, sulphur dioxide, nitrogen oxides, troposphere ozone and particulate matter in airborne suspension (PM10 y PM2.5)	Virtual Library on Sustainable Development and Environmental Health of the Pan-American Health Organization (PAHO): http://www.cepis.ops-oms.org/metaiah/search.php
Chemical and biochemical demand for oxygen	ECLAC - Economic Commission for Latin America and the Caribbean. http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Analytical incidence of thermostable coliforms outside the norm	Ministry of Health, Brazil - OPAS/OMS. Avaliação de impacto na saúde das ações de saneamento: marco conceitual e estratégia metodológica. (Assessment of health impacts of sanitation interventions: conceptual and methodological strategy)Brasília, 2004. http://www.opas.org.br/sistema/arquivos/Mnl_Impac.pdf
UV radiation index	National ultraviolet medicine network – Physics Department of the University of Santiago, Chile. http://www.indiceuv.cl/home.htm

3-3 BIODIVERSITY, ECOSYSTEMS AND NATURAL RESOURCES	
Forestry coverage as a percentage of total surface area (forests, tree farming and reforestation)	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT http://apps.fao.org
Bodies of water	Global Land Cover Characteristics Database (GLCCD) http://edcdaac.usgs.gov/glcc/globdoc2_0.html
Animal species (amphibians, birds, mammals, fish and reptiles)	World Conservation Monitoring Centre of the United Nations Environment Programme (UNEP-WCMC). Species Data. http://www.unep-wcmc.org The Inter-American Biodiversity Information Network (IABIN) http://www.iabin.net/es/
Vegetal species (trees, cycadaceae, conifers, flowers, ferns and vascular plants)	
Index of food production per inhabitant	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT http://apps.fao.org
Renewable hydrological resources per inhabitant	Food and Agriculture Organization of the United Nations (FAO) Land and Water Development Division. 2005. AQUASTAT http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/dbase/index.stm
Surface area with permanent pastures and grasslands	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT http://apps.fao.org
Surface harvested by type of crop	Agricultural statistics system (SIAGRO) - ECLAC - Economic Commission for Latin America and the Caribbean. http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Surface covered with snow or ice	Global Land Cover Characteristics Database (GLCCD) http://edcdaac.usgs.gov/glcc/globdoc2_0.html
Surface dedicated to mining production (metallurgical and non-metallurgical)	Preparation of environmental indicators for the Andean Community of Nations. www.comunidadandina.org/normativa/dec/d699.htm
Surface in savannahs, wetlands and permanently flooded areas	Global Land Cover Characteristics Database (GLCCD) http://edcdaac.usgs.gov/glcc/globdoc2_0.html
Built-up urban surface area	Global Land Cover database. European Commission, Joint Research Centre http://www-gvm.jrc.it/glc2000/
Surface in irrigated lands	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT http://apps.fao.org
Surface in dry lands	The Global Assessment of Human Induced Soil Degradation (GLASOD) Digital Database from UNEP/GRID-Geneva http://gcmd.nasa.gov/records/GCMD_GNV00018_171.html
3-4 CLIMATE	
Stratospheric ozone concentration	NASA. Total Ozone Mapping Spectrometer. October, 2003. http://toms.gsfc.nasa.gov
Relative air humidity	Preparation of environmental indicators for the Andean Community of Nations. www.comunidadandina.org/normativa/dec/d699.htm
Mean precipitation (monthly, seasonally and annually)	World Bioclimate Classification System. www.ucm.es/info/cif
Mean global temperature	Goddard Institute for Space Studies (GISS). 2006. NASA GISS Surface Temperature Analysis (GISTEMP). New York: GISS. http://data.giss.nasa.gov/gistemp/
Maximum, mean and minimum temperatures	Preparation of environmental indicators for the Andean Community of Nations www.comunidadandina.org/normativa/dec/d699.htm
3-5 URBAN GREEN ZONES	
Urban shade	Malaga. Urban indicators system Agenda 21, 2008. http://www.omau-malaga.com/docs/metodologia_y_significado.pdf
Useable urban green area per inhabitant	
Number of trees per inhabitant	
Percentage of autochthonous species in urban vegetation	

4 – INDICATORS OF ENVIRONMENTAL IMPACT	
Over-exploited aquifers with saline intrusion and/or that suffer a soil salinization process or brackish subterranean waters	National System for Environmental and Natural Resources Information (SNIARN) - Mexico. http://www.semarnat.gob.mx
Endangered and extinct animal species (amphibians, birds, mammals, fish and reptiles)	NaInternational Union for Conservation of Nature and Natural Resources (IUCN). 2007. 2007 IUCN Red List of Threatened Species. Gland, Switzerland: IUCN. http://www.redlist.org/info/tables/table5 http://www.wcmc.org.uk/
Endangered and extinct tree and plant species	Numbers given for endangered and extinct species of trees are from the Tree Conservation Database, World Conservation Monitoring Centre (WCMC). http://www.wcmc.org.uk/trees/Background/country_stats.htm
Invasive species	National System for Environmental and Natural Resources Information (SNIARN) - Mexico. http://www.semarnat.gob.mx
Forest and grassland fires (annual number and affected surface area)	
Index of water stress	Natural Environment Research Council, Centre for Ecology and Hydrology. 2002. The Water Poverty Index: International Comparisons. Wallingford: Centre for Ecology and Hydrology. http://www.nerc-wallingford.ac.uk/research/WPI/images/wdpaper.pdf
Number of extreme hydro-meteorological events	IPCC - Intergovernmental Panel on Climate Change. http://www.ipcc.ch/
Number of days in which the maximum permitted concentration of the following substances is exceeded: carbon monoxide, sulphur dioxide, nitrogen dioxides, troposphere ozone and particulate substances less than PM10.	Virtual Library on Sustainable Development and Environmental Health of the Pan-American Health Organization (PAHO): http://www.cepis.ops-oms.org/metaiah/search.php ECLAC - Economic Commission for Latin America and the Caribbean. http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Number of days in which the UV index records high and extreme values	National ultraviolet medicine network – Physics Department of the University of Santiago, Chile. http://www.indiceuv.cl/home.htm
Record of abnormal temperatures and precipitation	World Meteorological Organization (WMO). World Climate Data and Monitoring Programme (WCDMP) http://www.wmo.int/pages/index_en.html
Surface affected by soil degradation	National System for Environmental and Natural Resources Information (SNIARN) - Mexico. http://www.semarnat.gob.mx
Surface affected by forest pests	
Surface affected by overgrazing	
Deforested surface	ECLAC - Economic Commission for Latin America and the Caribbean. http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Variation in global temperature	Goddard Institute for Space Studies (GISS). 2006. NASA GISS Surface Temperature Analysis (GISTEMP). New York: GISS. http://data.giss.nasa.gov/gistemp/

5 - INDICATORS OF VULNERABILITY AND ENVIRONMENTAL EXPOSURE	
Availability of calories (total and animal origin) per inhabitant and percentage of the population below the minimum necessary caloric intake	Food and Agriculture Organization of the United Nations (FAO), FAOSTAT http://apps.fao.org
Hygienic customs	Ministry of Health, Brazil - OPAS/OMS. Avaliação de impacto na saúde das ações de saneamento: marco conceitual e estratégia metodológica. Brasilia, 2004. http://www.opas.org.br/sistema/arquivos/Mnl_Impac.pdf
Index of household infestation by cockroaches, mosquitoes and rodents	National Hygiene, Epidemiology and Microbiology Institute (INHEM)., Havana, Cuba http://www.bvsde.paho.org/bvsacd/conven/raisa.pdf
Population at risk for malaria	PAHO - Pan-American Health Organization. Health Analysis and Statistics Unit (HA), Regional Basic Health Data Initiative. http://www.paho.org/Spanish/SHA/glossary.htm#D
Population with sustainable access to improved sources of supply for potable water, by urban and rural areas	WHO/UNICEF – World Health Organization and United Nations Children's Fund. . Joint Monitoring Programme for Water Supply and Sanitation... http://www.wssinfo.org/en/welcome.html
Population living with HIV/AIDS (adults and children) and anti-retroviral therapy coverage	Joint United Nations Programme on HIV/AIDS (UNAIDS). 2006. Report on the global AIDS epidemic. Geneva: UNAIDS. Available online at http://www.unaids.org/en/HIV_data/2006GlobalReport/default.asp
Population living in slums	UNSD - United Nations Statistics Division. Database of Millennium Development Goals indicators – http://mdgs.un.org/unsd/mdg/Data.aspx
Percent of the indigenous population speaking only an indigenous language	System of Sociodemographic Indicators for Indigenous Peoples and Populations of Latin America (SISPPI). http://www.sisppi.org/redatam/PRYESP/SISPPI/
Children under 5 years of age with below normal height	UNICEF – United Nations Children's Fund. Childinfo: Monitoring the situation of children and women http://www.childinfo.org/
Children under 5 years of age moderately or severely undernourished	PAHO - Pan-American Health Organization. Health Analysis and Statistics Unit (HA), Regional Basic Health Data Initiative... http://www.paho.org/Spanish/SHA/glossary.htm#D
Prevalence of obesity in the adult population	
Percent of low birth weights	
Percent of deaths certified with poorly defined or unknown cause of death	
Percent of the population under 1 year of immunized age	
Percent of the population under 15 or 60 years or over	
Dependency ratio	
Coverage rate of social security for children	PAHO - PILO – Internacional Labour Organization, Regional Office for Central America, Haiti, Panama, and the Dominican Republic. Decent Work Indicators. Child Labour. http://www.oit.or.cr/estad/td/infantil_indic.php
School attendance rate for employed children	
Child labour (hours worked per week, by sex, age, activity and hazardousness of the workplace)	The ILO's International Programme on the Elimination of Child Labour (IPEC). Database. http://www.ilo.org/ipec/ChildlabourstatisticsSIMPOC/lang--en/index.htm
Use of alcohol, illegal drugs and tobacco (adolescents and adults by sex)	WHO – World Health Organization. WHO Global Infobase http://www.who.int/infobase/report.aspx?rid=112&ind=ALC US National Centre for Education Statistics http://nces.ed.gov/programs/youthindicators/Indicators.asp?PubPageNumber=48
Domestic use of solid fuels	World Health Organization (WHO). 2006. Global Health Atlas: World Health Statistics. Geneva: WHO. http://www.who.int/GlobalAtlas/
Overcrowded dwellings	System of Sociodemographic Indicators for Indigenous Peoples and Populations of Latin America (SISPPI). http://www.sisppi.org/redatam/PRYESP/SISPPI/

6 - INDICATORS OF HEALTH EFFECTS	
6-1 ENVIRONMENTAL DISEASE BURDEN	
Years of life lost due to disabilities caused by water-borne diseases	WHO - World Health Organization – World morbidity burden. http://www.who.int/topics/global_burden_of_disease/es/
Years of life lost due to disabilities caused by respiratory diseases	
Years of life lost due to disabilities caused by transmissible diseases	
Years of life lost due to disabilities caused by poisoning	
Years of life lost due to disabilities caused by neoplasias	
Healthy life expectancy	
6-2 MORBIDITY	
Serum and/or urine concentration of chemical contaminant substances or their metabolites (Arsenic, Beryllium, Cadmium, Chromium, Lead, Mercury, among others)	WHO – World Health Organization - Inter-Organization Programme for the Sound Management of Chemicals (IOMC). http://www.who.int/iomc/en/index.html European Environment and Health Information System. http://www.enhis.org/object_binary/o2800_Guidelines_indicatormethodology_V3_uneditedVersion.pdf Environmental Toxicology Laboratory, Faculty of Medicine, Autonomous University of San Luis Potosí. http://ambiental.uaslp.mx/docs/FDB-ResPeligrosos.pdf
Incidence of tuberculosis detected by positive bacilloscopy (BK+)	PAHO - Pan-American Health Organization. Health Analysis and Statistics Unit (HA), Regional Basic Health Data Initiative... http://www.paho.org/Spanish/SHA/glossary.htm#D
Index of teeth with caries, lost teeth and obstructed teeth at 12 years of age	
Annual number of notified cases of vector-transmitted diseases (Chagas disease, dengue fever, haemorrhagic fevers, hantavirosis, Leishmaniasis, leptospirosis, malaria, among others)	International Classification of Diseases (ICD) http://www.who.int/classifications/icd/en/ International Classification of Functioning, Disability and Health http://www.who.int/classifications/icfbrowser/ International Classification of Health Interventions (ICHI) http://www.who.int/classifications/ichi/en/ WHO Statistical Information System (WHOSIS): National statistics http://www.who.int/whosis/en/index.html WHO Global InfoBase Online: Data on chronic diseases and their risk factors for all WHO Member States http://www.who.int/infobase/report.aspx Global Health Atlas: Standardized data and statistics for infectious diseases at country, regional, and global levels http://www.who.int/globalatlas/
Annual number of notified cases of obligatory report diseases with environmental exposure or unhealthy environments (hansenosis, hepatitis A, meningococcal meningitis, intestinal parasites, skin diseases, among others)	
Annual number of persons affected by natural disasters	
Annual number of persons that received health care due to working accidents	
Annual number of persons receiving health care due to traffic accidents	
Annual number of persons receiving health care due to accidents with poisonous animals	Regional statistics: Statistical information from WHO Regional Offices
Annual number of persons receiving health care due to chemical poisoning events	
Percentage of adults aged 65 or over receiving health care due to acute or chronic respiratory disease	ILO – CISDOC – Occupational safety and health database. http://www.ilo.org/global/What we do/Statistics/lang--es/index.htm
Percentage of children under 5 years of age receiving health care due to acute respiratory infection, asthma or allergies	PAHO - Pan-American Health Organization. Health Analysis and Statistics Unit (HA), Regional Basic Health Data Initiative. http://www.paho.org/Spanish/SHA/glossary.htm#D
Percentage of children under 5 years of age receiving oral rehydration treatment for diarrhoeas	
Percentage of children under 5 year of age and adults 65 years or over diagnosed with anaemia.	

6-3 MORTALITY	
Annual proportion of deaths recorded for adults over 65 years of age due to acute or chronic respiratory diseases	International Classification of Diseases (ICD) http://www.who.int/classifications/icd/en/ International Classification of Functioning, Disability and Health http://www.who.int/classifications/icfbrowser/ International Classification of Health Interventions (ICHI) http://www.who.int/classifications/ichi/en/ WHO Statistical Information System (WHOSIS): National statistics htt://www.who.int/whosis/en/index.html WHO Global InfoBase Online: Data on chronic diseases and their risk factors for all WHO Member States http://www.who.int/infobase/report.aspx Global Health Atlas: Standardized data and statistics for infectious diseases at country, regional, and global levels http://www.who.int/globalatlas/ Regional statistics: Statistical information from WHO Regional Offices http://www.who.int/healthinfo/statistics/regions/en/index.html ILO - CISDOC - base de datos de seguridad y salud en el trabajo http://www.ilo.org/global/What_we_do/Statistics/lang--es/index.htm OPS – Organización Panamericana de la Salud. Unidad de Análisis de Salud y Estadísticas (HA). Iniciativa Regional de Datos Básicos en Salud. http://www.paho.org/Spanish/SHA/glossary.htm#D
Annual proportion of deaths recorded for children under 5 years of age due to infectious intestinal diseases	
Annual proportion of deaths recorded for children under 5 years of age due to acute respiratory infections	
Annual proportion of deaths due to reportable vector-transmitted diseases (haemorrhagic dengue fever, malaria, among others),	
Annual proportion of deaths due to reportable diseases related to environmental exposure (meningococcal meningitis, tuberculosis among others)	
Annual number of lives lost due to natural disasters (landslips, floods, droughts, among others)	
Annual number of lives lost due to disasters related to urban or household dangers (fires, collapses, among others)	
Estimated infant mortality rate and mother and child mortality	
Estimated age-adjusted mortality rate due to external causes	
Estimated age-adjusted mortality rate due to neoplasias	
Estimated mortality rate due to suicide and self-inflicted lesions	
6.4 VIOLENCE, MALAISE, PSYCHOLOGICAL SUFFERING	
Happiness index	EUR - Erasmus University Rotterdam, Netherlands. http://www2.eur.nl/fsw/research/happiness/index.htm
Population in a situation of displacement or forced migration	Refugee Studies Centre. Oxford Department of International Development - Oxford University. http://www.rsc.ox.ac.uk/ Joint United Nations Programme on HIV/AIDS ONUSIDA Colombia - http://www.onusida.org.co/desplaz.htm
Annual number of children, adolescents and adults that received health care due to events of family violence.	WHO – World Health Organization – Gender Department, Women and Health. http://www.who.int/gender/en/
Annual number of lives lost or disability caused by conflicts resulting from landholding	PAHO – Pan-American Health Organization Emergency Preparedness and Disaster Relief Programme – Health and Displacement. http://www.disaster-info.net/
Estimated rate of mortality from homicide, by rural and urban areas	PAHO - Pan-American Health Organization. Health Analysis and Statistics Unit (HA), Regional Basic Health Data Initiative... http://www.paho.org/Spanish/SHA/glossary.htm#D

7 - INDICATORS OF RESPONSES	
7-1 COVERAGE OF HEALTH SERVICES AND STRATEGIC PUBLIC SPENDING*	
Existence of emergency, mitigation and health care plans in the face of disasters	PAHO – Pan–American Health Organization. Virtual Library on Health and Disasters. http://helid.desastres.net/
Existence of programmes for strengthening health information and communication	PAHO – Pan-American Health Organization. .Strengthening Health Systems http://new.paho.org/hq/index.php?option=com_content&task=view&id=62&Itemid=259
Existence of a consolidated Primary Health Care Network	PAHO – Pan-American Health Organization. APS strategic guidelines and future programmes http://www.paho.org/spanish/ad/ths/os/APS-orientation.htm
Number of establishments for ambulatory care	PAHO - Pan-American Health Organization. Health Analysis and Statistics Unit (HA), Regional Basic Health Data Initiative... http://www.paho.org/Spanish/SHA/glossary.htm#D
Health professional ratio (physicians, registered nurses)	
Public expenditure in education as a percentage of GDP	UNESCO-UIS – Institute for Statistics of the United Nations Educational, Scientific and Cultural Organization http://stats.uis.unesco.org/
Public expenditure in research, science and technology as a percentage of GDP	OECD – Organization for Economic Co-operation and Development. Main Science and Technology Indicators http://www.esds.ac.uk/international/support/user_guides/oecd/sti_manual.pdf
Public expenditure in health as a percentage of GDP and per capita	PAHO - Pan-American Health Organization. Health Analysis and Statistics Unit (HA), Regional Basic Health Data Initiative... http://www.paho.org/Spanish/SHA/glossary.htm#D
Public social expenditure as a percentage of GDP and per capita	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
7-2 ENVIRONMENTAL MANAGEMENT AND LEGISLATION	
Adhesion, signatory or ratification of multilateral environmental accords	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Local Agenda 21: number of municipal committees formalised	ICLEI - International Council for Local Environmental Initiatives. http://www.iclei.org/index.php?id=global-programs
Sewage treatment	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Traffic control and vehicular restriction in critical urban areas	Transit Control Operational Unit (UOCT) – Ministry of Planning and Cooperation. Chile. http://www.uoct.cl/uoct/inicio.ns.jsp Directorate of Atmosphere Monitoring. Ministry of the Environment, Mexico DF. http://www.sma.df.gob.mx/simat2/
Existence of national emergency commissions or immediate response teams for disasters	ILAC - Latin America and Caribbean Initiative for Sustainable Development. http://www.geodatos.org/geodatos/ILAC_es.html
Existence of National Sustainable Development Councils	
Existence of national laws related to access to genetic resources and benefit sharing	Convention on Biological Diversity (CND) - www.biodiv.org/
Existence of Environmental Statistical Systems and reports on the state of the environment	ILAC - Latin America and Caribbean Initiative for Sustainable Development. http://www.geodatos.org/geodatos/ILAC_es.html
Number of firms with ISO 14001 certification	ECLAC – Economic Commission for Latin America and the Caribbean. CEPALSTAT http://websie.eclac.cl/sisgen/Consultaintegrada.asp
Number of fishery species with exploitation restrictions	
Percentage of drainage areas being managed	Food and Agriculture Organization of the United Nations FAO-AQUASTAT http://www.fao.org/ag/agl/aglw/aquastat/main/index.stm
Percentage of protected environmental areas in respect of the total territory	ILAC - Latin America and Caribbean Initiative for Sustainable Development http://www.geodatos.org/geodatos/ILAC_es.html
Percentage of marine-coastal areas protected in respect of the total marine-coastal area	
Percentage of municipalities with land use management plans being implemented	
7-3 INTER-SECTORIAL MANAGEMENT OF THE ENVIRONMENT AND HEALTH	
Existence of national or local directives for an inter-sectorial public policy on environment and health	UNEP (United Nations Environment Programme); PAHO (Pan-American Health Organization) and FIOCRUZ (Fundação Oswaldo Cruz) – GEO Health São Paulo. Summary and Lessons Learnt. 2007.
Existence of legislation promoting healthy environments (anti-tobacco laws, noise reduction laws, visual contamination laws, among others)	
Existence of strengthened organisms for environmental, epidemiological and sanitary oversight in health	
Existence of environmental education and education for health promotion programmes within the educational system	

• The name of the indicator "Public Spending" does not necessarily imply that the public funds for education, research, science and technology, health and social security must be understood as "spending" in the commercial sense of the term. In the best of cases, public spending in a specific sector may be conceived as the amount of funds destined to finance national development within the framework of a planned project.

ANNEX II: EXAMPLES OF THE APPLICATION OF THE METHODOLOGY
CASE 1:

Teachers in a suburban school began to notice that some of their students were having attention problems during classes. The children mentioned felt weak, their mouths were dry and their eyes irritated, some had stomach aches and others had headaches. In a few days their classroom performance dropped, and they began to refuse their school snack, saying they were not hungry. On some days their condition improved, but afterwards they again showed the same signs and symptoms.

As the educational community suspected food poisoning, the director of the school immediately got in touch with the company responsible for the snack service and described the problem. The company responded in writing to say it strictly obeyed the contractual clauses and that, if the problem was with the food all the students would have clinical symptoms, which was not the case.

Upon receiving this response, the director contacted the local health authorities who said no similar cases had been reported in the school system and that they would begin a study to discover what was causing the problem. A health technician visited the school installations and a doctor examined the affected children. An expert report was issued indicating that evidence of poisoning had been found, dismissing food exposure as a cause, but suggesting that the problem might lie in the misuse of pediculosis remedies (home or commercial). The report suggested no possible environmental exposure.

In view of these facts, the school called a meeting with the persons responsible for caring for the students. A paediatrician explained the correct way to deal with external parasites in children. Many parents recognized that, because they did not know otherwise, they had been misusing the remedies.

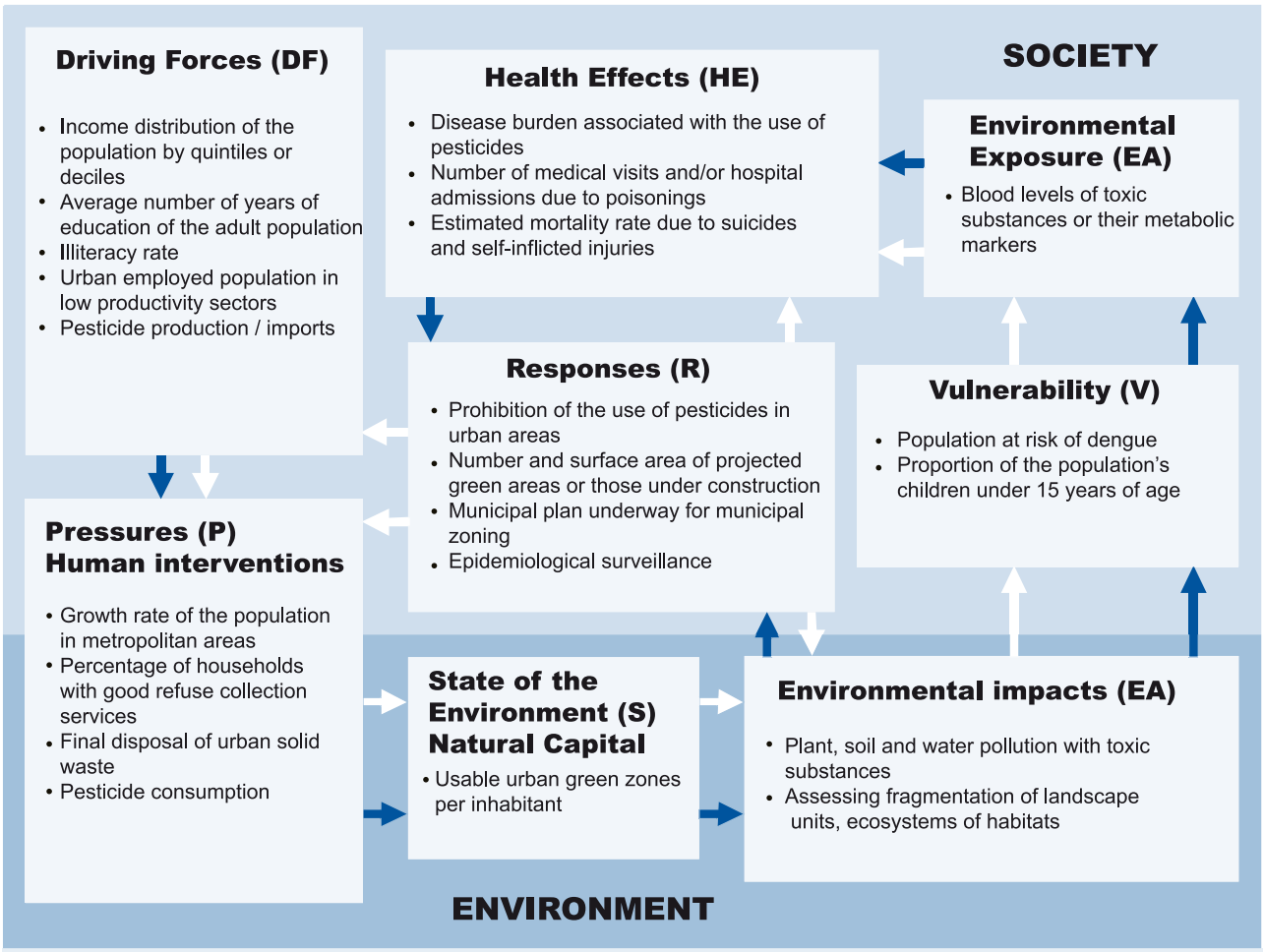
Railroad tracks cross the neighbourhood where they all live and where the school is located. The neighbours use the railroad land as an open-air trash dump into which they throw all types of waste and where the neighbourhood children had improvised a playground. Refuse collection services in this part of the city are very poor; there are no green spaces for recreation and both formal educational levels and family incomes are far below the national average.

Shortly afterwards, the father of one of the students committed suicide. He was a 25-year-old farm worker, who had worked since he was a teenager applying methyl parathion pesticide (Folidol) to tomato crops. He migrated to the city seeking better living conditions and, thanks to his fumigating experience, he was employed by a company that provides services to the railroad to keep the grounds weed-free. He poisoned himself by drinking the herbicide Paraquat – Diquat that he used for his work: he died of acute pancreatitis, complicated by internal bleeding. A few days after the death of her father, his daughter was hospitalized with fever, myalgia and bleeding diarrhoea. The diagnosis presumed the cause to be dengue fever (perhaps the hemorrhagic type), since several neighbours had come down with that disease; however, the clinical analysis results showed that was not the cause and concluded that the girl had washed a Folidol container, brought home by her father, to be reused.

After these two cases occurred in the same family, professionals from the health secretariat suggested that the health effects they had observed were environmental and caused by pesticide fumigation – toxic to humans – in urban areas.

The graph below shows the components of the GEO Health conceptual framework – with their respective (possible) indicators – that were applied to assess this hypothetical case.

Figure 1: The components of the GEO Health conceptual framework applied to assessing (hypothetical) vector-borne diseases with effects on human health.



The light blue background spans the social components, while the dark blue background contains the environmental components. The blue arrows link the potential interactions (that may be mutual or not) between the components without mediating the responses. The white arrows indicate potential interactions among the components and the responses by society to mitigate or adapt to environmental and health problems.

Sources consulted:

BAYER S.A. Treatment of poisoning by herbicides *http://www.bayer.com.mx/bayer/cropscience/bcsmexico.nsf/id/As_TratHerb_BCS*

BINASSS (Library of the Social Security Institute of Costa Rica. Intoxicación por plaguicidas. *http://www.binasss.sa.cr/poblacion/plaguicidas.htm*

CRÍTICA DE LA ARGENTINA. Fumigan con un peligroso agroquímico *http://www.criticadigital.com/impresa/index.php?secc=nota&nid=21566*

MEYER, Tufi Neder; CAMARGOS RESENDE, Ione Lamounier; ABREU. Juscélio Clemente de. Incidência de suicídios e uso de agrotóxicos por trabalhadores rurais em Luz (MG), Brazil. Rev. bras. Saúde ocup., São Paulo, 32 (116): 24-30, 2007. *www.fundacentro.gov.br/rbso/BancoAnexos/RBSO%20116%20Suicídios%20e%20agrotóxicos.pdf*

MSPAS (Ministerio de Salud Pública y Asistencia Social, El Salvador) Intoxicaciones por plaguicidas. Guía de atención de los principales problemas de salud de adolescentes. Capítulo 16. *http://www.mspas.gob.sv/regulacion/pdf/guia/Guia%20patalog_FH10_6_Adolescentes.pdf*

CASE 2:

The recent expansion of the agricultural and livestock frontier in sub-tropical areas, including clearing large tracts of forest, has made significant changes in the ecosystem and in the way of life of the population.

Groups of environmentalists have attempted to use the media to promote action to reverse this trend but without achieving the hoped-for political results. For their part, indigenous organizations initiated legal action to have an area designated as an environmental preserve, and this is still being dealt with in the courts. In the Region's municipalities, previously passed over, land use changes were accompanied by significant financial movements and a concentration of economic prosperity.

One of the most visible changes for the population was the marked increase in truck traffic. Crop growers, cattle ranchers and transportation companies put pressure on the local government to invest in infrastructure to help them move their merchandise. The authorities announced the river port terminal would be expanded and modernized and a new highway built. In view of the public's positive opinion and acceptance of these announcements about the infrastructure, there was no problem in obtaining the respective environmental licences.

Months after work began on building the highway, including dividing a forested area into segments, the Region experienced one of the hottest and rainiest summer seasons within living memory. Floods even affected the new urbanized areas, especially areas of unstable urbanization occupied by migrants attracted because jobs were available.

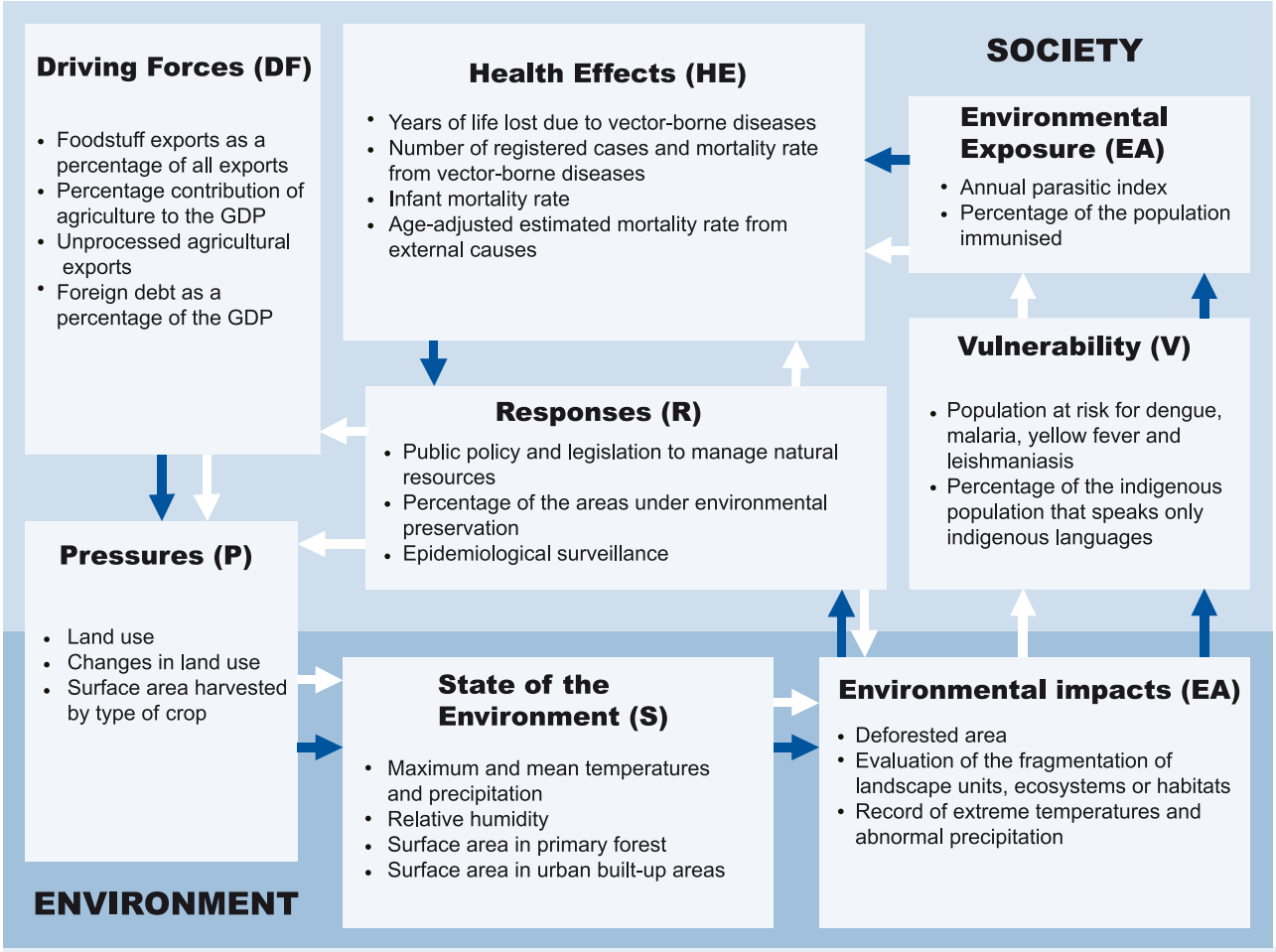
During this period a farm labourer reported to the authorities the discovery of two dead monkeys near his house. Never before had so many cases been reported of wild animals being killed on the highways or had so many animals been seen outside their natural habitat.

Specialists concluded that climate change and deforestation, together with prolonged high temperatures and humidity, increased the probability of outbreaks of diseases, especially those transmitted by vectors. In fact, heat and stagnant water favour the proliferation of mosquitoes that transmit these diseases, and the destruction of their natural habitat causes parasite-harbouring wild animals to move into areas inhabited by humans.

During that season, in fact, four of the region's municipalities reported cases of dengue fever, yellow fever and leishmaniasis. The health authorities are now concerned about the possible reappearance of malaria and the hantavirosis emergency.

The following figure shows the components of the GEO Health conceptual framework – with its respective (possible) indicators – applied to the assessment of this hypothetical case.

Figure 2: The components of the GEO Health conceptual framework applied to assessing (hypothetical) vector-borne diseases.



The light blue background spans the social components, while the dark blue background contains the environmental components. The blue arrows link the potential interactions (that may be mutual or not) between the components without mediating the responses. The white arrows indicate potential interactions among the components and the responses by society to mitigate or adapt to environmental and health problems.

Sources consulted:

BARRAGÁN G, Artemio; LOAIZA B, Maria Haydeé ; FLORES S, Adriana; de la GARZA O Filiberto; ALCOCER G, Juan Manuel; FERNÁNDEZ S, Idelfonso. Hantavirus: un problema latente de salud pública en México. Ciencia UANL, vol.V, no. 2, Abril-Junio 2002.

CERDA L, Jaime; VALDIVIA C, Gonzalo; VALENZUELA B, M. Teresa e VENEGAS L, Jairo. Cambio climático y enfermedades infecciosas: Un nuevo escenario epidemiológico. Rev. chil. infectol. 2008, vol. 25, no. 6.

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SOCIEDADE BRASILEIRA DE ANÁLISIS CLÍNICAS. ¿El desequilibrio ambiental genera fiebre amarilla, dengue y leishmaniasis en Misiones? - *http://www.sbac.org.br/pt/conteudos/qualinews/noticias/noticias2008_2/11059.html*

CASE 3:

Farmers interested in producing organic coffee discovered the lands they intended to cultivate did not qualify for certification of organic products for export. The main problem in meeting international requirements was with the quality of the Region's irrigation water. A report prepared by consultants from the certifying body indicated that both the surface waterways and the subterranean springs were polluted with arsenic, chromium and lead. The report also warned that concentrations of nitrates were above the values considered safe for human consumption.

In earlier decades coffee had been intensively cultivated in the territory in question. Due to repeated pest infestations and a loss of competitiveness, the coffee farms were replaced by farms raising dairy cattle and, to a lesser degree, beef cattle. Introducing livestock into this mountainous region resulted in maize and sugarcane being planted for forage, as well as tanning activities.

The municipality includes a small urban centre with relatively good infrastructure in terms of access to electric power, telephone service, drinking water supply, sewage disposal and treatment networks; however, none of these services is available to the rural population

In rural dwellings water is pumped and consumed directly from shallow wells; wastewater is disposed of in cesspools or surface streams and household solid waste is buried, burnt or disposed of in open dumps. In most of these dwellings biomass is used for cooking (wood, combustible residues and even manure).

Since access to the electric power grid is very uncertain, the population uses batteries to run their domestic and farm equipment; the batteries are recharged or recycled in several workshops in rural areas. The workshops' residues and effluents, with a high lead content, are disposed of in the same way as waste and rainwater.

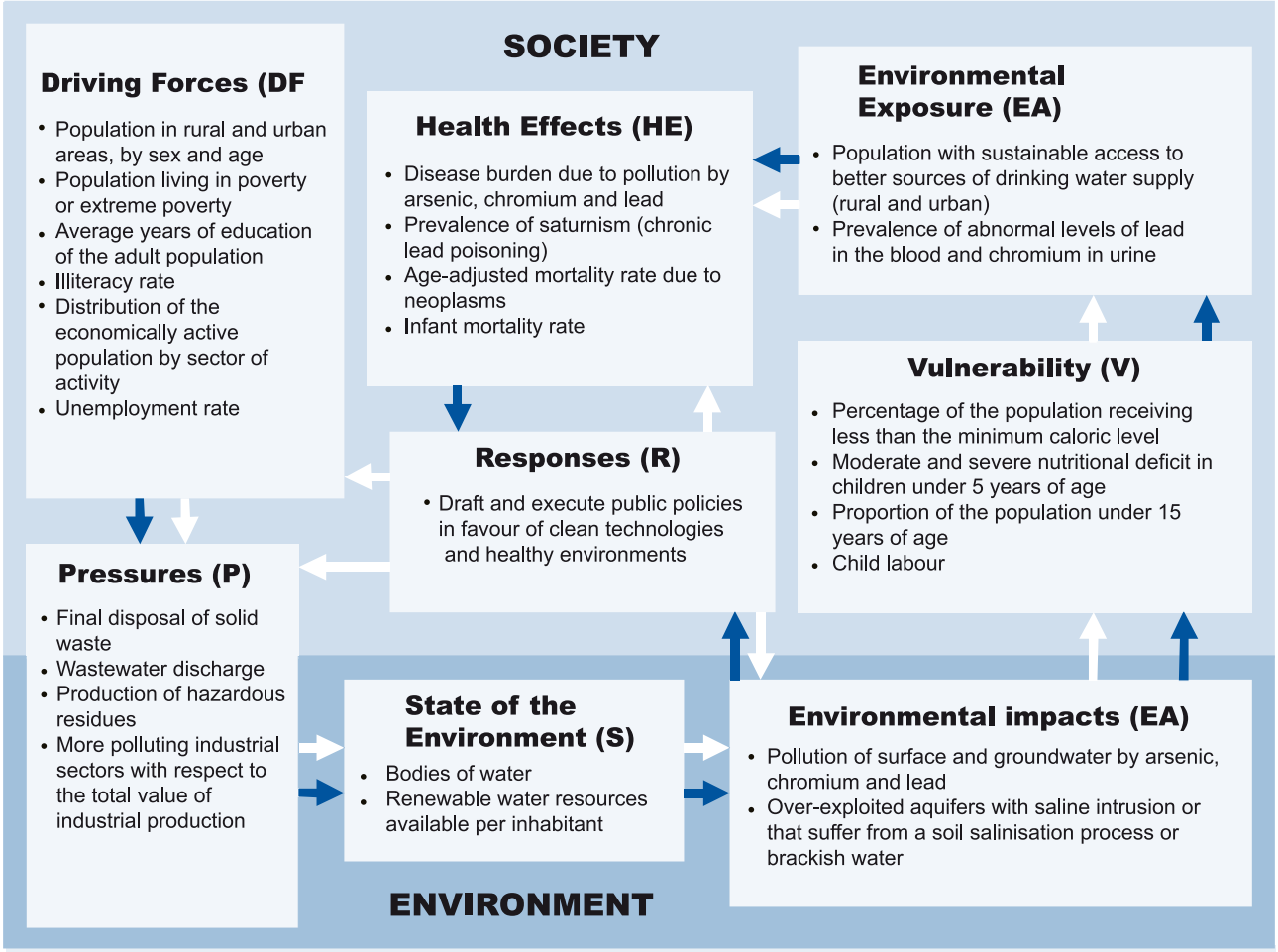
In addition to receiving most of the polluted water, the main river in the region also receives effluents from the two duly registered tanneries, and many other artisanal tanneries operating informally in the region. This is the most likely source of the arsenic and chromium pollution.

On the other hand, the principal sources of nitrate-based water pollution seem to be the intensive use of fertilizers for maize and sugarcane plantations, together with the lack of basic sanitation and the huge volume of manure produced by livestock.

The report requested by the organic coffee farmers was, in fact, the first assessment of water quality to be conducted in the municipality, without any knowledge of the magnitude of environmental exposure and its consequences on human health. The municipality epidemiological record is very poor and it has few health statistics however, the few data available show a marked difference in the rates of infant mortality, especially in neonatal mortality, as well as in cases of diarrhoea and intestinal parasitosis in children under 5 years of age in the rural population compared to the urban population. In the winter months the primary rural health care centre attends to children and the elderly with symptoms of acute respiratory diseases, probably the result of greater exposure to gases and suspended particulate matter that pollute the air inside their dwellings, where biomass is used as a source of energy.

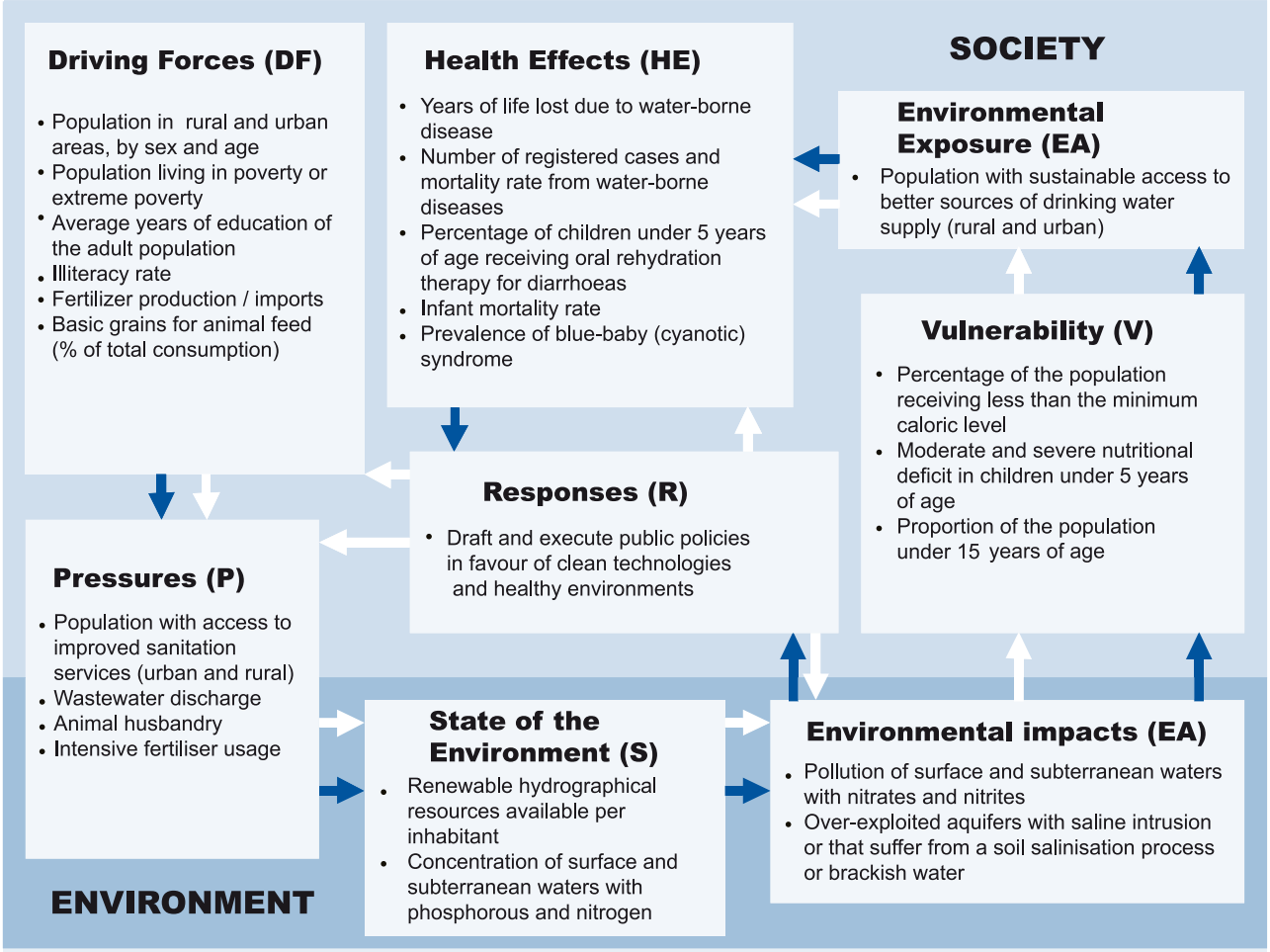
The first of the following figures shows the components of the GEO Health conceptual framework – with its respective (possible) indicators – applied to assessing the (hypothetical) chemical pollution (arsenic, chromium and lead) that affects human health. The second figure shows water pollution from nitrates and organic material. Finally, the third figure shows the indicators by component associated with exposure to gases from combustion and suspended particulate matter inside dwellings and their effects on health.

Figure 3: The components of the GEO Health conceptual framework applied to assessing (hypothetical) chemical pollution (arsenic, chromium and lead).



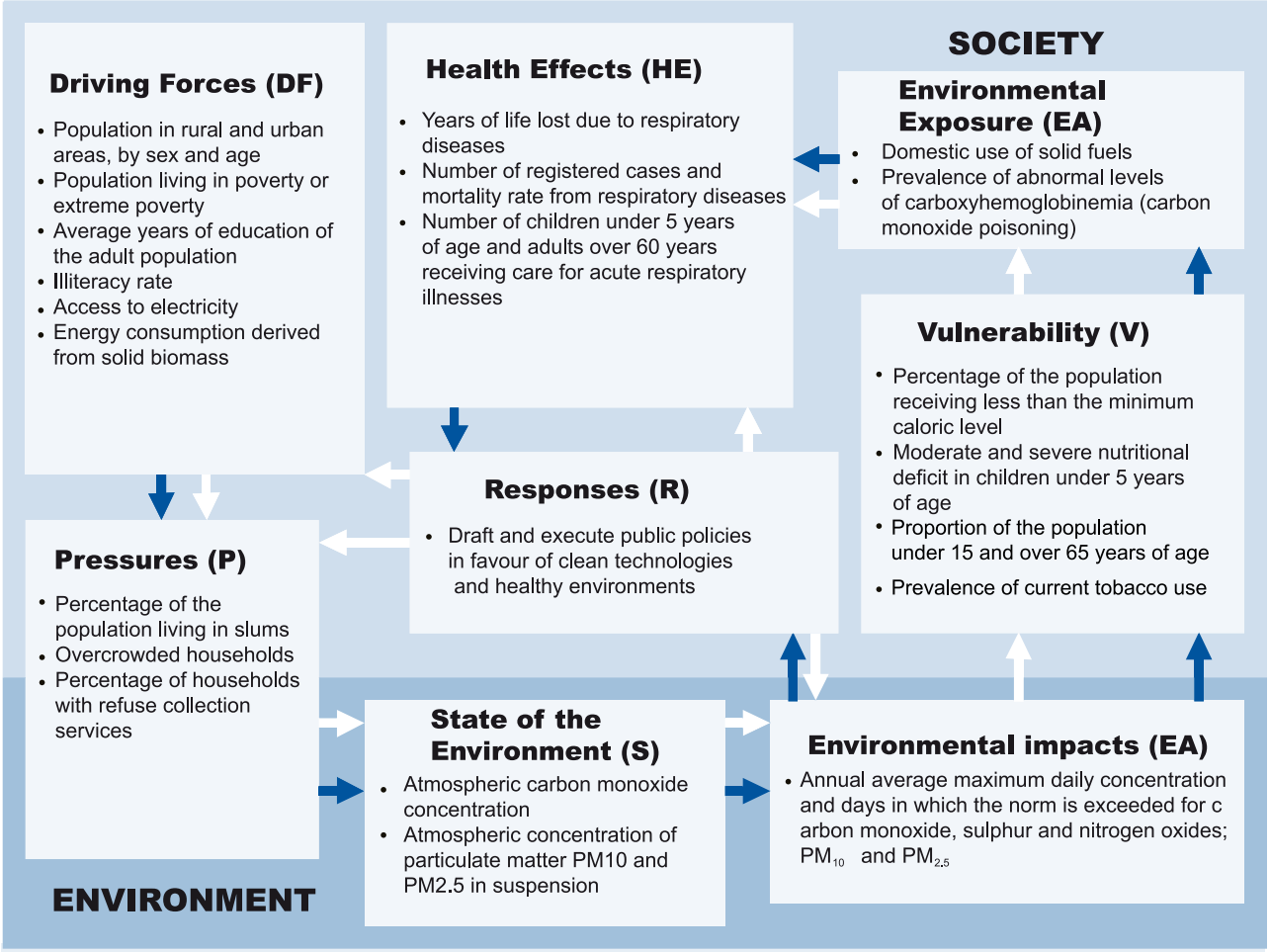
The light blue background spans the social components, while the dark blue background contains the environmental components. The blue arrows link the potential interactions (that may be mutual or not) between the components without mediating the responses. The white arrows indicate potential interactions among the components and the responses by society to mitigate or adapt to environmental and health problems.

Figure 4: Component of the GEO Health conceptual framework applied to a hypothetical case of water pollution from nitrates and organic matter.



The light blue background spans the social components, while the dark blue background contains the environmental components. The blue arrows link the potential interactions (that may be mutual or not) between the components without mediating the responses. The white arrows indicate potential interactions among the components and the responses by society to mitigate or adapt to environmental and health problems.

Figure 5: Component of the GEO Health conceptual framework showing the indicators by components for a hypothetical case associated with exposure to combustion gases and suspended particulate matter dwellings and their health effects.



The light blue background spans the social components, while the dark blue background contains the environmental components. The blue arrows link the potential interactions (that may be mutual or not) between the components without mediating the responses. The white arrows indicate potential interactions among the components and the responses by society to mitigate or adapt to environmental and health problems.

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