GEO Cities Manual/Guidelines for Integrated Environmental Assessment of Urban Areas

Working Manual
Arab Region

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

PREFACE

GEO Cities Manual/Guidelines for Integrated Environmental Assessment of Urban Areas for Arab Region is an integral part of the Global Environment Outlook process of the United Nations Environment Programme (UNEP). It aims to build capacities in the Arab Region for integrated environmental assessment and reporting at city and local levels.

At the global level, the GEO process, which incorporates different activities including capacity building and production of a report series and other materials, aims to:

- Track yearly environmental issues and developments, and thus highlight for policymakers and other stakeholders in the GEO Year Book report series developments as well emerging issues and technology advances.
- Undertake, once every five years, a comprehensive and policy relevant assessment of the state of the global environment, analyzing environmental trends, their driving forces, current policies and emerging issues. The GEO reports also assess the impacts of the changing environment on people and ecosystems.

The fundamental objective of the GEO Cities project is to promote better understanding of the interaction between urban development and the environment, providing the region's local governments, scientists, policy-makers and the public with reliable and up-to-date information to help them improve urban environmental planning and management. The GEO Cities project publishes assessments that provide information on the state of the environment, the main factors for change, and the policies affecting the environment and emerging themes.

The Arab region faces four major environmental problems. The first concerns the scarcity of fresh water. Available fresh water resources in the Arab world are extremely strained. The origins of most of the major rivers in the Arab world, such as the Nile, Tigris and Euphrates, are located outside the Arab world. This could threaten the sustainable flow of fresh water to Egypt, Sudan, Iraq and Syria. The per capita share of available renewable water resources is almost 16.3 per cent of his/her peer on the global scale, which illustrates the extent of water poverty the Arab people experience. The second problem is fast trend of urbanization that associates with degraded quality of the urban environment. Facets of degraded urban environment in Arab cities are numerous including, but not limited to, degraded air quality, accumulated municipal wastes, visual blight in the form of eye-soars, etc. resulting from traffic congestion, and lack of proper urban planning and management. The third problem refers to depleting and destructing natural resources, such as forests and biodiversity thus negatively affecting the survival of many communities. Finally, the fourth problem is the possible adverse impact of climate change on human settlements, where the populations of Arab settlements are vulnerable to extreme events. As populations in urban areas in the Arab world are constantly increasing, as is their vulnerability to natural disasters, there is a need for greater understanding of the interaction between urbanization, urban policies on one hand, and the quality of the environment, and means to be prepared for adaptation to minimize the impacts of climate change on the other.

The GEO Cities report is a response to international agendas and conventions including Millennium Development Goals (MDGs), Agenda 21, and World Summit on Sustainable Development (WSSD), 2002. Furthermore, the GEO Cities project responds to decisions of the Arab Ministers for Environment within the overall framework of the League of Arab States (LAS)

INTRODUCTION

> "The future will be predominantly urban, and the immediate environmental concerns of most people will be urban ones"
>
> *World Commission on Environment and Development (WCED) 1987*

The Arab region has an extended history of urbanization. Morocco, Saudi Arabia, Egypt, Iraq and Yemen, for example, have sets of cities that have well connections to the global economy, such as Casablanca, Aden and Cairo. Trade is the major reason for the location of many of these cities. Coastal cities, such as Jeddah, Casablanca and Aden, and in-land cities, such as Cairo, Damascus and Baghdad, are the outcome of complex trade networks, and served as nodes of these networks.[1]

The population of Arab countries is young. It is growing, and will continue to grow in the near future. Most of the dependent population is young members of the society who has not joined the labour force. They demand social services and physical infrastructures, such as education, health services, safe drinking water and proper schemes for safe drinking water, solid waste management, and wastewater collection and treatment. Definitely, they will need jobs, housing and other means to sustain their livelihoods in the near future. Most of the developments will be in the cities. Many studies in urban geography and regional sciences suggest that new comers will reside urban areas, particularly existing cities of the Arab world. This urban growth will be the outcome of both sustaining high rates of natural population growth and continuous rural-urban migration. This urban growth will require extending both physical infrastructures and social services.

Urbanization and environmental problems that associate with it are of major concern for the sustainable development of Arab societies. The aim of the work of UNEP on environmental assessment and early warning through GEO Cities project is to assist Arab countries and cities to undertake more precise assessments of the state of the environment, causes of environmental degradation and consequences of urban strategies, policies and plans. The exercise is important for decision-making based on human rights and assures good urban/metropolitan governance, thus making human development sustainable.

Global Environment Outlook (GEO),[2] UNEP's forerunner for assessing the state of the environment outlined in this manual, is the basis of the methodology applied to prepare environmental reports in cities of the Arab world. It is a response for pressing needs to guide and build capacities of central and local bodies to develop Integrated Environmental Assessments (IEAs), which is "the process of producing and communicating future-oriented, policy-relevant information on key interactions between the natural environment and human society."[3] This manual is a guide for local team on how to use information to assess the state of the environment, determine the forces that led to the current situation and prescribe necessary actions to assure the sustainable human development in Arab settlements. The local team responsible for GEO Cities report elaboration through this manual and capacity building workshops will should:

- Know what is IEAs, and how to use them;

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[1] Bonine, Michael E. "Cities of the Middle East and North Africa, in Cities of the World, World Regional Urban Development, Stanley D. Brunn and Jack F. Williams (editors), New York, NY: Harper & Row, Publishers, 1983.

[2] GEO is a consultative, participatory, capacity building process for global environmental assessment and reporting on the state of the environment, trends and outlooks. GEO is both a process involving stakeholders from across the globe, as well as a product for environmental decision-making. The GEO process aims to facilitate the interaction between science and policy-making. (Source: UNEP, "GEO Process," http://www.unep.org/geo/Docs/GEOProcessBrochure.pdf (accessed Tuesday, January 05, 2010)

[3] UNEP and IISD, GEO Resource Book: A training manual on integrated environmental assessment and reporting, 2007, http://www.iisd.org/pdf/2007/geo_resource.pdf (accessed Tuesday, January 05, 2010)

- Know what are the components and structure of IEAs in both theory and practice;
- Have the capacities to learn and practice how to organize and manage and assessment and reporting process
- Know and comprehend the tools for this assignment; and
- Disseminate information to initiate discourse on causes and responses

The manual places special emphasis on the DPSIR (Driving forces and Pressure; State; Impact; and Response) matrix. It enables the local team to organize the information to produce the report.

Planning and management for sustainable development require new needs for assessment and reporting. These requirements include how to recognize the links between environmental conditions and human activities especially those related to urban development; highlight the need for a long-term perspective; consider equity among and between generations; and encourage participation by all sectors of society in decision-making.

The GEO Cities manual and capacity-building workshops specifically aim to serve as guides for the local technical team to prepare the GEO Cities report. Both the manual and workshops aim to building local technical capacity for preparing a comprehensive assessment of the state of the environment. The manual and the workshops will encourage activities for monitoring the environment, and initiate processes for information generation and dissemination by directing the technical team in their search for scientific facts and data about the environment in cities, as well as to communicate with society about better management of the locality's natural resources. This will require building their capacities on assessing the impact of urban development on different ecosystems. The GEO process will support efforts to reach a consensus about the most critical environmental problems in each city, by holding a permanent dialogue between the different social stakeholders, including specialists on environmental subjects that involve the local government/administration and society. The manual is an input into training the technical team to assess the state of the local environment by analyzing the determining factors of urban development and their relationship with ecosystems and natural resources. This eventually will lead to establishing an urban-environmental database to permit continuous follow-up of the state of the environment, based on appropriate urban-environment indicators. One of the expected outcomes of this manual and capacity building workshops based on it, is making it possible to formulate preventive strategies and programmes to help cities deal with environmental risks.

These objectives and targets discussed above are the framework of this manual. At the end of the process, the local team will be able to assess the state of environment of their city, and point out how to solve problems highlighted in their report. The manual is a useful tool that will help to strengthen institutional capacity to prepare environmental assessments and comprehensive reports on cities in the Arab world. In the long term, such assessments will lead to better-informed decision making and enhanced environmental planning and management thus helping to improve the quality of life for the dwellers of the city and its region.

This manual consists of three different sections. Following this introduction is a section on cities. It presents the reader with basic information to what are cities, how they develop, and where. The section also emphasizes the rationale for planning and intervention. The next section presents the GEO Cities methodology and the IEA process. The last section is about how to prepare a GEO City report. It outlines the steps necessary to compile data, analyze them, and elaborate the report. It also suggests the various outputs of the GEO report

1. CITIES

REASONS FOR CITIES

A city is a relatively large and permanent settlement, particularly a large urban settlement. The different between urban and rural settlements stem from economic, social and administrative definitions. In cities, land uses are more intensive compared to that of rural areas. This is evident in the form of densities, i.e., number of persons per unit of land, and of course, the number of floors per parcel of built land. This manifests itself, as known in the economic theory, in the form of rent differential, where rent per unit of land for urban uses is often higher than that for agricultural and rural uses. Unlike rural population who engage in agricultural production activities, urban population are engaged in a wide range of manufacturing and service employment.

Cities are the localities of complex social and economic relations. Social values and norms differentiate between urban and rural residents. Levels and thresholds of services in urban areas differ than that of rural areas. For example, universities, as research centres and higher education institutions, with larger threshold, are often located in urban areas.

ECONOMIES OF SCALE

The prime reason for a city to develop at a specific location is the economies of scale, which is doubling the output because of doubling one input, such as labour, holding the other production input, in this case is capital, constant. In other words, Economies of scale are the cost advantages that a business obtains due to expansion. They are factors that cause a producer's average cost per unit to fall as scale is increased. It is a long run concept and refers to reductions in unit cost as the size of a facility, or scale, increases. Major cities develop only on sites and locations that have this privilege.

AGGLOMERATION OF ECONOMIES

The second reason for cities to emerge and continue growing is agglomeration of economies, which is a term that describes the benefits that establishments receive when locating near each other. This concept relates to network effects, when more firms in related industries cluster together, costs of production may decline significantly.[4] Even when multiple firms in the same sector[5] cluster, there may be advantages because that cluster attracts more suppliers and customers than a single firm could alone. Cities form and grow to exploit economies of agglomeration.

COMPARATIVE ADVANTAGE

Third, cities develop in specific location with certain comparative advantage, i.e., the ability of a city, region and/or nation to produce a particular good or service at a lower opportunity cost than another city, region and/or nation. Comparative advantage is central for trade that can develop value for cities, regions and nations, even when one can produce all goods with fewer resources than the other can.

EXPORT VERSUS SERVICE SECTORS

Based on the above, cities have two types of economic sectors: basic (export) sector that produces goods and services consumed outside the defined administrative boundaries; and non-basic (service) sector where the products are consumed within the city's defined boundaries. Export-led growth strategy calls for supporting basic sectors seeking benefits from trade; while others argue for

[4] firms have competing multiple suppliers, greater specialization and division of labour result
[5] competitors

supporting service sectors with backward and forward linkages, such as housing, to initiate economic growth. Often a combination of both approaches is the key to sustainable economic growth.

RATIONALE FOR PLANNING

MARKET IMPERFECTION

The *raision d'etre* of cities is economic. For markets to be competitive there are number of conditions that must exist. The first is a large number of buyers and sellers to avoid any monopolistic actions. Second, no collusion, i.e., avoid external pressures that affect the decision of the consumer. The third is free entry and exit from the market. In other words, Zero Entry/Exit Barriers – It is relatively easy to enter or exit as a business in a perfectly competitive market. The fourth condition is perfect information, where all consumers and producers should know prices and quality of products. The fifth condition is rational behaviour, where agents are utility maximizers when consuming; cost minimizers when producing, and in all cases seeking profits. The sixth condition is costless transactions, where buyers and sellers incur no costs in making an exchange. Finally, the characteristics of any given market good or service do not vary across suppliers.

The violation of one or more of these conditions results in a state of market imperfection, thus requiring government intervention. The Government, as a regulator, avails information, for example; and in several cases assures no monopolistic actions through, for instances, antitrust action.[6] Thus, the first rationale for planning is to mitigate for market imperfections.

PUBLIC GOOD

Market mechanisms cannot provide all sorts of commodities and services. Protecting the quality of air from harmful emissions is not the function of private sector companies. Solid waste management is another service that cannot be left to the private sector. These and similar goods are public good, which has two characteristics: 1) jointly consumed, where the consumption of one agent does not affect the level of satisfaction of another agent; and 2) it is extremely difficult to deprive an agent of the society from the service or the good. Examples of public goods include disaster risk reduction, TV and radio broadcasting, national defence, etc. Failing to provide public good is known as market failure.

EXTERNALITIES

The second market failure is externalities. It is the spill over or the impact of an economic activity of an agent on others. In urban planning zoning, which regulates land use, height of buildings, the footprint of a building, width of streets, ratio of open areas, etc. are means towards minimizing the impact of externalities. Environmental pollution is one of the physical manifestations of externalities.

DISTRIBUTIVE JUSTICE

Distributive justice is another market failure. It is about what constitutes to be socially just with respect to the allocation of goods in a society. Distributive justice extends beyond fair income distribution. It is about protecting the community from the adverse impacts of environmental pollution.

[6] Antitrust is about prohibiting agreements or practices that restrict free trading and competition between business. This includes in particular the repression of cartels. It is banning abusive behavior by a firm dominating a market, or anti-competitive practices that tend to lead to such a dominant position. Finally, it is supervising the mergers and acquisitions of large corporations, including some joint ventures. Transactions that are considered to threaten the competitive process can be prohibited altogether, or approved subject to "remedies" such as an obligation to divest part of the merged business or to offer licenses or access to facilities to enable other businesses to continue competing.

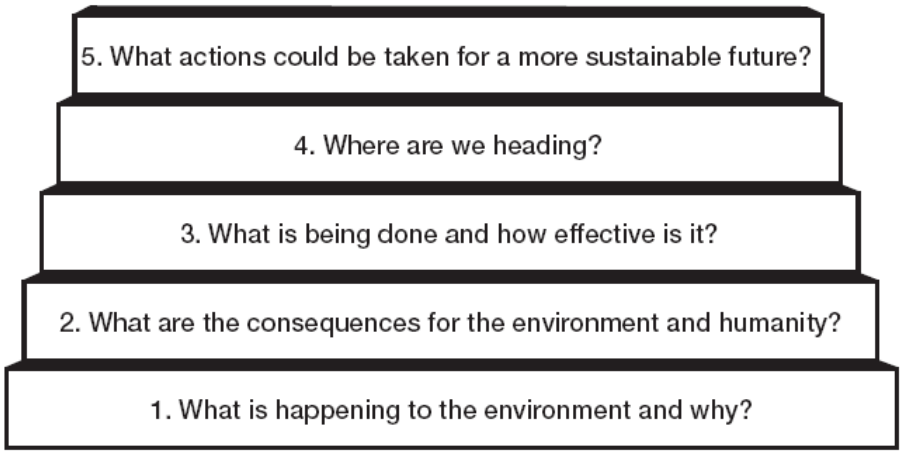
INSTITUTIONAL TRANSFORMATION

Issues and problems arise within an institutional framework. The aforementioned interventions stem from the economic theory. To sustain solutions, there is a need for institutional transformation to avoid returning to square one. Institutional transformation aims to setup framework for decision-making conducive to balancing economic gains without offsetting social stability and/or resulting environmental degradation. Means toward institutional transformation include, but are not limited to, training and capacity building; reforms in decision-making; empowerment and enabling other players, such as NGOs, private sector companies, etc.

2. GEO CITIES METHODOLOGY

The goal of the GEO process is to ensure that environmental problems and emerging issues of wide international significance receive appropriate, adequate and timely consideration by governments and other stakeholders. As an integrated environmental assessment, GEO provides answers to the five key questions illustrated in the step diagram below, Figure 1. Most "traditional" environmental assessments consider the first question; very few take an integrated perspective that considers all five questions.

FIGURE 1 KEY QUSOURCEESTIONS TO BE ANSWERED BY STATE OF THE ENVIRONMENT (SOE) ASSESSMENT AND POLICY



Source: Jäger, Jill and others, "GEO Resource Book:A training manual on integrated environmental assessment and reporting Training Module 1" *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

BOX 1 INTEGRATED ENVIRONMENTAL ASSESSMENT

Integrated Environmental Assessment provides a participatory, structured approach to linking knowledge and action. Over time, GEO has developed an increasingly integrated approach to environmental assessment, the use of indicators and reporting. The "integrated approach" to answering the questions illustrated in Figure 1 above is an umbrella term for:

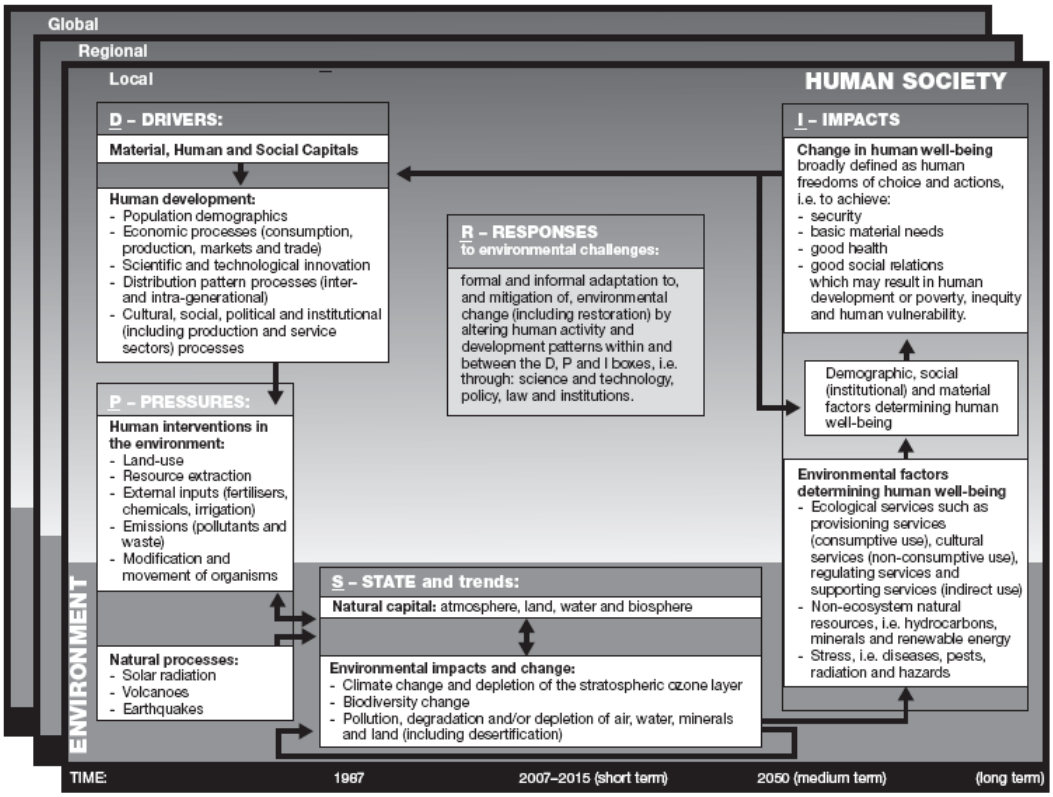
- Linking the analysis of environmental state and trends with the policy analysis;
- Incorporating global and sub-global perspectives;
- Incorporating historical and future perspectives;
- Covering a broad spectrum of issues and policies; and
- Integrating the consideration of environmental change and human well-being.

Source: Jäger, Jill and others, "GEO Resource Book: A training manual on integrated environmental assessment and reporting Training Module 1," *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

The GEO assessment uses the drivers-pressures-state-impacts-responses (DPSIR) framework in analysing the interaction between environmental changes. The concepts of human well-being and ecosystem services are central to the analysis. However, the report broadens its assessment from focusing exclusively on ecosystems to cover the entire environment and the interaction with society. The framework attempts to reflect the key components of the complex and multidimensional, spatial and temporal chain of cause-and-effect that characterizes the interactions between society and the environment. The GEO framework is generic and flexible, and recognizes that a specific thematic and geographic focus may require a specific and customized framework.

The GEO conceptual framework (Figure 2), therefore, contributes to society's enhanced understanding of the links between the environment and development, human wellbeing and vulnerability to environmental transformations. The framework places, together with the environment, the social issues and economic sectors in the 'impacts' category rather than just exclusively in the 'drivers' or 'pressures' categories.

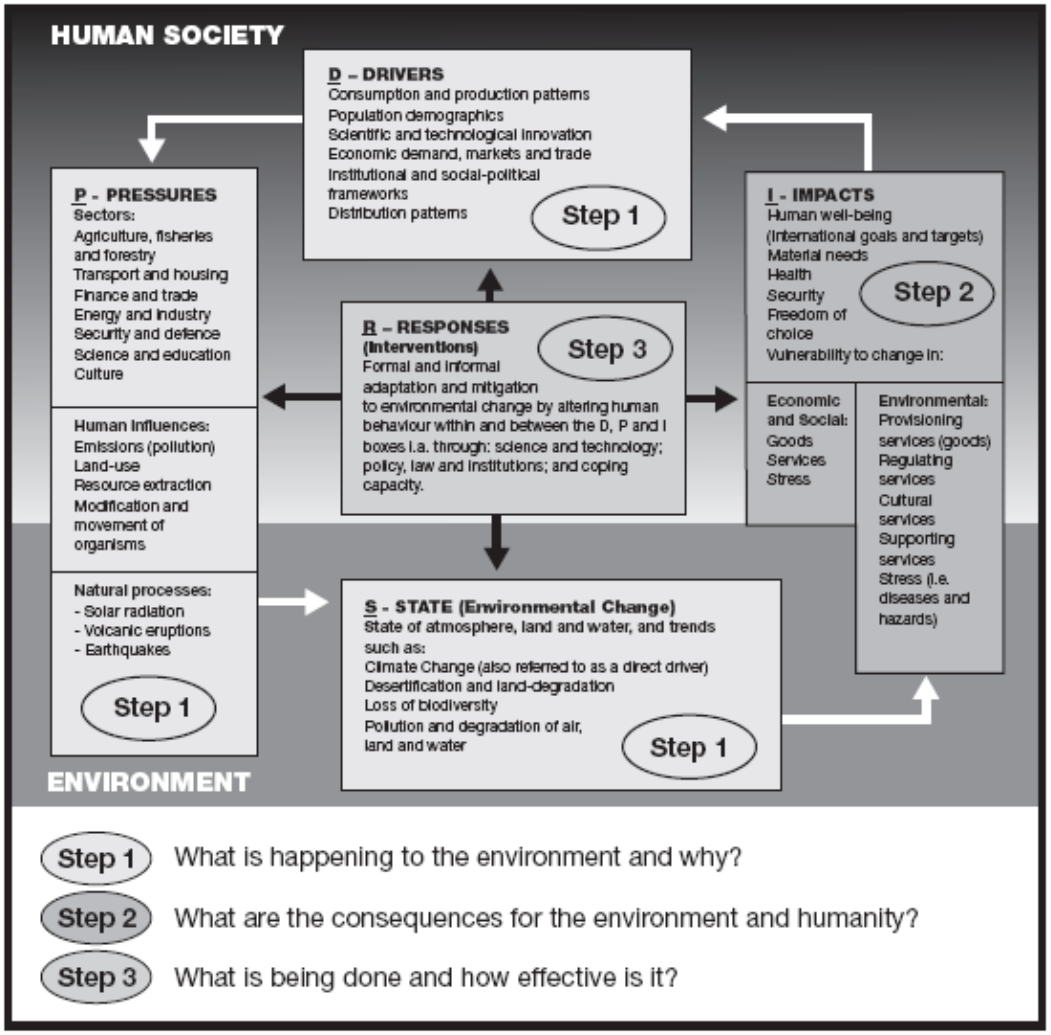
FIGURE 2 GEO CONCEPTUAL FRAMEWORK



Source: Jäger, Jill and others, "GEO Resource Book: A training manual on integrated environmental assessment and reporting Training Module 1," *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

The same basic elements—Drivers, Pressures, State, Impact and Responses—are illustrated in Figure 3. Since this manual focuses on Integrated Environmental Assessment primarily at the city level, it is less critical to show multiple levels, although the assessments would obviously reflect national level implications of global processes, and go into sub-national detail to the city level. Figure 3 also shows how the elements of the framework are linked to the questions illustrated in Figure 1.

FIGURE 3 SIMPLIFIED ANALYTIC FRAMEWORK FOR INTEGRATED ENVIRONMENTAL ASSESSMENT AND REPORTING



Source: Jäger, Jill and others, "GEO Resource Book: A training manual on integrated environmental assessment and reporting Training Module 1," *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

GEO[7] is a participatory process for environmental assessment; it aims to facilitate the interaction between science on the one hand and policy and decision making on the other. Each GEO assessment is multi-dimensional in scope, incorporating environmental, policy, geographic and temporal perspectives. Environmental dimensions include:

- Thematic (related to the state and trends of land, atmosphere, water and biodiversity);
- Functional (related to the provision of environmental goods and services);
- Sectoral (the relationships between the environment and activity areas such as energy use, industry, tourism, agriculture and trade);
- Cross-cutting (relating to issues such as production, consumption, gender, poverty, human security and vulnerability); and
- Interlinkages within and among all of the above.

FOCUS OF THE ANALYSIS

[7] The global GEO process is described on the website www.unep.org/geo .

A typical GEO Cities report focuses on the interaction between urban development and the environment, assessing it using the Driving force,[8] Pressure,[9] State,[10] Impact[11] and Response[12] (DPSIR) matrix. The analysis focuses on driving forces and on the pressures of urban development on one hand, and the resulting impact on the environment and the services it provides on the other. In elaborating the report, the local team has to consider the following:

- The city's main economic activities,
- Its social structure and equity
- The main occupations in the area, and
- The local institutional structure, the local team has to pay special attention must to public bodies that protect the environment, and to the degree the public is involved in the formulation of public policies, among others.

The report has to assess the impact of urbanization on the environment, especially on natural resources and local ecosystems. The report has to present clearly the state of the environment and the impact it has on the quality of life in cities. Considering that environmental degradation is an obstacle to development, the local team has to propose the responses for the local government/administration, and generally the society.

ANALYTICAL FRAMEWORK: DPSIR MATRIX

DPSIR is a general framework for organizing information about state of the environment. It tries to define and relate the group of factors that determine the characteristics influencing the environment at any territorial level (local, regional, national, global). The DPSIR matrix seeks to establish a logical link between its components to direct the assessment of the state and trend of the environment, from the factors that exert pressure on natural resources (and which may be understood as the "causes" of its present state), to each locality's responses as to how to deal with its own environmental problems.

[8] What has resulted in the pressures, should be presented, highlighting the origin of such forces
[9] Pressures are underlying economic and social forces such as population growth, consumption or poverty.
[10] It is the condition of the environment resulting from pressure
[11] It is the effect produced by the state of the environmental on aspects such as quality of life and human health, on the environment itself, on the built-up environment and on the local urban economy.
[12] Response is the component relating to collective or individual actions that lessen or prevent negative environmental impacts, correct damage caused to the environment, conserve natural resources or contribute to improving the quality of life of the local population. Responses include activities for monitoring the system and information generation and dissemination for proper decision-making, interventions in the form of preventive and corrective measures, and finally, supportive measures, such as capacity building, legislation, raising awareness, etc.

Social studies are the source of the idea of the framework, used for organizing systems of indicators in the context of environment and, later, sustainable development. The framework assumes cause - effect relationships between interacting components of social, economic, and environmental systems, which are

- Driving forces of environmental change (e.g. industrial production);
- Pressures on the environment (e.g. discharges of waste water);
- State of the environment (e.g. water quality in rivers and lakes);
- Impacts on population, economy, ecosystems (e.g. water unsuitable for drinking); and
- Response of the society (e.g. watershed protection)[13]

The components of the DPSIR matrix express forms of urban-environmental relationships and environmental attributes, as well as the quality of local life. These components aim to answer the following fundamental questions on any territorial scale:

1. What is happening to the environment and why? (driving force, state, pressure)
2. What are the consequences for the environment and humanity? (impact)
3. What is being done and how effective is it? (response)
4. Where are we heading? (future outlook)
5. What actions could be taken for more sustainable future? (policy options)

The components of the DPSIR matrix that correspond to the questions are:

1. **Driving forces** are human activities, processes and patterns that impact on sustainable development. In human settlements, there are three driving forces: population dynamics, economic activities and territorial basis.
2. **State** refers to the condition of the environment, resulting from pressure; for example, the level of atmospheric pollution, soil erosion or deforestation. The information on the state of the environment responds to the question: What is happening to the environment?
3. **Pressure** refers to underlying economic and social forces such as population growth, consumption or poverty. From the policy point of view, pressure is the starting point from which to confront environmental problems. Information on pressure tends to be more easily

BOX 2 DPSIR

Drivers (including demographic changes, economic and societal processes) lead to more specific pressures on the environment (including land use change, resource extraction, emissions of pollutants and waste, and modification and movement of organisms). These pressures lead to changes of the state of the environment, which are in addition to those that result from natural processes. The environmental changes include climate change, stratospheric ozone depletion, changes in biodiversity and pollution or degradation of air water and soils. These changes lead to changes of the services that the environment provides to humankind, such as the provision of clean air and water, food and protection from ultra-violet radiation. As a result of changes in services and mediated by demographic, social and material factors, there are impacts on human well-being (health, material assets, good social relations and security). Responses include both formal and informal attempts to either adapt to the changes in environmental services or to reduce the pressures on the environment.

Source: Jäger, Jill and others, "GEO Resource Book: A training manual on integrated environmental assessment and reporting Training Module 1," *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

[13] Cities Environment Reports on the Internet (CEROI) Programme, Urban Environment Gateway, "DPSIR Framework," UNEP, GRID Arendal, http://ceroi.net/reports/arendal/dpsir.htm (accessed Tuesday, January 05, 2010)

available because it comes from socio-economic databases. Awareness of pressure factors seeks to respond to the question: Why is it happening?

4. **Impact** refers to the effect produced by the state of the environmental on aspects such as quality of life and human health, on the environment itself, on the built-up environment and on the local urban economy. For example, an increase in soil erosion will produce one or several consequences: reduced food production, increased food imports, increased use of fertilizers and malnutrition.
5. **Response** relates to collective or individual actions that lessen or prevent negative environmental impacts, correct damage caused to the environment, conserve natural resources or contribute to improving the quality of life of the local population.

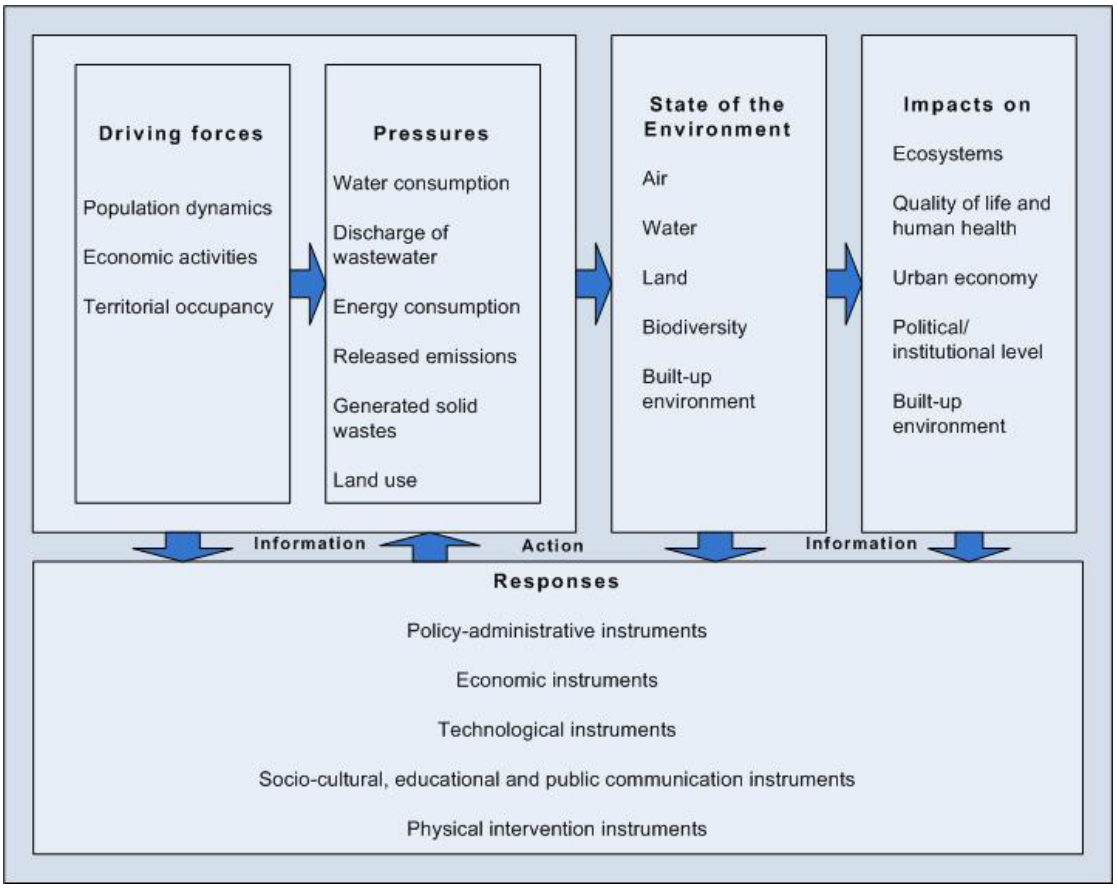
   Responses may include activities on regulation, environmental or research costs, public opinion and consumer preferences, changes in administrative strategies and providing information about the environment. Measuring how society responds requiress more work from the local team on analysis and interpretation. The instruments included in this category of the matrix attempt to answer the question: What are we doing?

   Responses to the question: What will happen if we do not act now? aim to direct the analysis of future outlooks on the local environment by assessing its present state. The underlying logic of the DPSIR matrix allows links to be established to project/forecast future manifestations/implications of present environmental conditions, encouraging analyses to be made of the possible consequences of present actions. This raises the possibility of strategic action being taken to change the direction of each locality's environmental problems.

Figure 4 shows the principal elements of each of the categories of the DPSIR matrix and the relationship between them. As may be seen, the matrix seeks to define possible relationship patterns between different human activities and the environment, in this specific case applied to urban-environmental relations. The simple PSR framework (Figure 2) merely states that human activities exert pressures (such as pollution emissions or land use changes) on the environment, which can induce changes in the state of the environment (for example, changes in ambient pollutant levels, habitat diversity, water flows, etc.). Society then responds to changes in pressures or state with environmental and economic policies and programs intended to prevent, reduce or mitigate pressures and/or environmental damage.[14]

[14] National Strategies for Sustainable Development (NSSD), "Pressure State Response Frameworks," www.nssd.net/references/SDInd/PSR.html (accessed on Tuesday, January 05, 2010)

FIGURE 4 INTERACTION OF DSPIR MATRIX URBAN/ENVIRONMENTAL COMPONENTS



"Driving force," as indicated in Figure 2, is a concept added to the above framework to accommodate more accurately the addition of social, economic, and institutional indicators. Furthermore, the use of the term "driving force" allows that the impact on sustainable development may be both positive and negative as it is often the case for social, economic, and institutional indicators. The DPSIR framework is actually a matrix that incorporates three types of indicators horizontally and the different dimensions of sustainable development vertically, namely social, economic, environmental, and institutional. [15]

The use of the state of the environment indicators in the DPSIR framework can bring scientific findings from the field and lab to the public and decision-makers. As a rule, for indicators to steer action they should have an explicit target group in the city, country or region. A set of indicators should not only give information on the development in specific environmental problem areas, but also give a general impression of the state of the environment. Ideally, a set of indicators is a means devised to reduce a large quantity of data to a simpler form, while retaining essential meaning for the question that are being asked of the data.

Table 1 is an example of logical integration of an indicator used in the state of environment. The table (part of a DPSIR matrix) shows how population, as a driving force, is putting pressures on the environment through releasing untreated wastewater. The low scores on the Water Quality Index (WQI) indicate degraded quality of fresh water resources; the logical outcome is increased number of

[15] National Strategies for Sustainable Development (NSSD), (Ref. Op. Cit.)

infected individuals. The response is to allocate investments for wastewater management (collection and treatment).

TABLE 1 EXAMPLE OF LOGICAL INTEGRATION OF THE INDICATORS

Element	DPSIR Dimension Indicators				
	Driving force	Pressure	State	Impact	Response
Water	Population	Total volume of untreated domestic sewage	Water Quality Index (WQI): BOD, COD, DO, count of E-Coli cells, etc.	Increase in water-borne diseases	Investment in drainage, collection, treatment and water distribution systems

IEA PROCESS

The IEA process consists of a number of activities including:[16]

1. ***Establish an institutional framework for collaboration and organization of the IEA***. Identify and enter into formal or informal cooperative agreements with different organizations with interest, capacity and/or mandate concerning the environment. Discuss and agree on objectives and roles to be adopted in the production of your IEA outputs.

2. ***Establish and maintain an information base*** (i.e., set up information system, gather and update the required data). The information-gathering process during the assessment provides an opportunity to analyze the quality and usefulness of information provided by monitoring systems. It is also an opportunity for improving data sharing and harmonisation mechanisms. Also, during this activity, it is possible to identify new themes and information needs, as well as data gaps. This step further allows identification of indicators of key environmental issues.

3. ***Discussion forum.*** An IEA represents an opportunity for discussions on topics such as common assessment methodologies, trends of the driving forces, pressures, and key environmental issues, policies, policy options and scenarios. These discussions may involve the public, private sectors and decision makers. Also, this provides an opportunity to analyze environmental policy and practice with involvement of different stakeholders.

4. ***Capacity-building.*** The IEA plays a capacity building role in two ways. First, the IEA process emphasizes a learning by doing approach based on interactive workshops and other non-workshop based interactions such as distance learning, Internet fora or technical and scientific collaboration. Second, the IEA can help identify capacity building needs and address them through targeted action, such as training, staff exchanges, the provision of data and technical equipment or through other means.

5. ***Define and implement a communication and impact strategy***. From the beginning of the process, it is necessary to understand who your various audiences are, so you can establish an efficient and effective communication and impact strategy. Strategies should include implementation plans as well as evaluation measures.

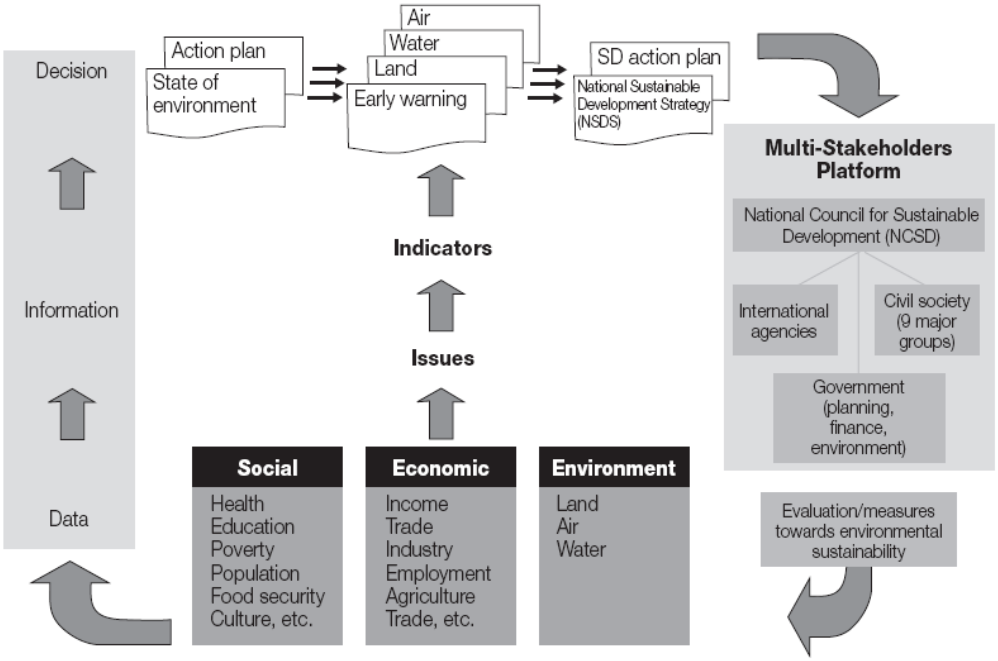
[16] Gómez, Rosario and others, "GEO Resource Book: A training manual on integrated environmental assessment and reporting Training Module 2," National IEA process, UNEP and IISD

MONITORING, DATA AND INDICATORS

A steady increase in reporting on environmental trends and performance during the past decade reflects a broad societal need for strengthening the evidence base for policymaking. At some point during the process of developing your integrated environmental assessment (IEA), you will need to collect, process and analyze data. As you begin, you will need to know essentials about data collection including selecting the most appropriate and reliable types and sources of data and how to collect, store and analyze your data Figure 5.

While "data" consists of detailed neutral facts, indicators and indices are selected and/or aggregated variables put in a policy context, connected to an issue identified in the IEA process and ideally also a policy target. A limited number of variables are selected from a wealth of observed or measured data sets, based on relevance of the variables to major issues and general trends. Indicators become signposts to inform policy actors and the public in a way that make thick volumes of detailed statistics and other data on the state and trends of the environment more accessible for decision making purposes.[17]

FIGURE 5 FRAMEWORK OF ENVIRONMENTAL DATA FLOWS



Source: van Woerden, Jaap and others, "GEO Resource Book: Monitoring, data and indicators Module 4," The GEO Approach to Integrated Environmental Assessment, UNEP and IISD

With data in hand, the next step will be to convert the data into a meaningful form that can be used during decision making processes. Indicators and indices help us package data into a form that speaks to a relevant policy issue.

Once you have developed indicators, you will need to derive meaning from them. What trends, correlations, or spatial relationships are revealed through the data? To answer these questions, you will need familiarity with various non-spatial and spatial analysis techniques.

[17] van Woerden, Jaap and others, "GEO Resource Book: Monitoring, data and indicators Module 4," The GEO Approach to Integrated Environmental Assessment, UNEP and IISD

A common theme running through data collection and indicator elaboration is the importance of participatory processes. A second theme is the importance of reliable data and well-chosen indicators. This is critical to the process, because poor information can lead to poor decisions. At the same time, information needs to speak to the intended audience in a relevant way; otherwise, the most well-developed indicators could have limited impact.

Structure of the GEO Cities Report

Using the DPSIR matrix as a guide to collecting, organizing and analyzing the information will allow the local team to construct, step-by-step, the report on the state of the environment. It is also important to define the structure of the report in accordance with the priorities and needs of each city and including analysis of the pressures, the present environmental state, the socio-environmental impact and the responses given. Below is a proposed structure for the report.

GEO Cities reports - proposed structure

Chapter 1 City Introduction

1.1. Key physical characteristics

- **1.1.1 Location**
- **1.1.2 Geography and topography**
- **1.1.3 Physical ecology and climate**

Chapter 2 Socio-economic and political context (PRESSURES)

2.1. Historic evolution of urbanization

- **2.1.1 Territorial occupation and land use over time**
- **2.1.2 Distribution of economic activities and their impact on the city's structure**
- **2.1.3 Growth and distribution of the population**
- **2.1.4 Structure of supply systems for water, sanitation, transport, telecommunications and energy**
- **2.1.5 Infrastructure and social services (health, education, culture and entertainment) and their spatial distribution**

2. Description of the local political-administrative structure

3. Analysis of local socio-economic factors

- **2.3.1 Dynamics of demographics**
- **2.3.2 Dynamics of Economics**
- **2.3.3 Territorial occupation**
- **2.3.4 Social inequity**
- **2.3.5 Energy consumption**
- **2.3.6 Water consumption**
- **2.3.7 Atmospheric emissions**
- **2.3.8 Waste production**
- **2.3.9 Sewage treatment**

Chapter 3 State of the Environment (STATE)

3.1. Local ecosystems

3.2. Analysis of ecosystem resources:

- **3.2.1 Air**
- **3.2.2 Water**
- **3.2.3 Land**
- **3.2.4 Biodiversity**
- **3.2.5 Built environment**
- **3.2.6 Solid waste**
- **3.2.7 Forests**

3. Summary of the state of the local environment

Chapter 4 Impact of the state of the environment (IMPACT)

4.1. Impact on ecosystems

4.2. Impact on quality of life and human health

4.3. Impact on urban economy

4.4. Impact on the built environment (urban vulnerability)

4.5. Impact at the policy-institutional level

4.6. Vulnerability to natural and technological disasters

URBAN-ENVIRONMENTAL COMPONENTS OF THE DPSIR MATRIX

The local team has to consider responding to two fundamental questions when preparing the GEO Cities Report:

- How urbanization puts pressure on the environment?
- What constitutes the environment, the quality of which is the subject of the GEO Cities report?

URBANIZATION COMPONENTS

Urbanization has three components:

- Demographics
- Economics
- Territorial occupation

These components are the main driving forces of urban development. Territorial basis helps to bring the other two together. Even when they should be classified as a central part of the interaction process with the environment, they are only presented indirectly in the proposed matrix, in which they are included by means of a series of selected indicators that will allow an assessment to be made of the local environment.

ENVIRONMENT COMPONENTS

Two components are used to analyze the environment:

- Natural resources, from a broader perspective that includes water, atmosphere, soil and biodiversity; and
- Ecosystems, the last named considered as how a territory appears as a result of the interaction of natural resources.

In the case of ecosystems, account must be taken of how each one is described locally as there are differences in the terminology and the concepts used to define what an ecosystem is, how many ecosystems there are and what they are in each locality. In any event, once the state of each of the above-mentioned natural resources is assessed, the information and analyses taken from the resources mentioned should also be used to make an evaluation of the state of local ecosystems. It is preferred that more attention be paid to the most relevant ecosystems in each city, according to their importance to the environment's equilibrium and the quality of life of the local population.

Applying the DPSIR matrix is only useful when accompanied by the urban/environmental indicators capable of expressing the behaviour of factors relevant to the preparation of the GEO Cities Report. The theme of the indicators will be dealt with in the chapter on providing information for the report.

The interaction between urban and environmental components is the key to preparing the GEO Cities reports. Urbanization has three main components: Demographics; Economics; Territorial occupation. These components are the main driving forces of urban development: population, economic activities and the territorial basis that helps to bring the other two together. Two components are used to analyze the environment: natural resources, from a broader perspective that includes water, atmosphere, soil and biodiversity; and ecosystems, considered as the way a territory appears as a result of the interaction of natural resources.

Applying the DPSIR matrix is only useful when accompanied by urban-environmental indicators showing trends over time. The theme of the indicators will be dealt with in the individual sections below.

Chapter 1 of the report on key physical characteristics will typically include information about location, geography and topography, physical ecology and climate, for instance. However, only information that is essential for understanding urban development and urban environment should be included. For example, the aspects of climate, which are important (such as rainfall patterns), can be described in one or two sentences.

PRESSURE: POLICY, SOCIAL AND ECONOMIC CONTEXT

To answer the question What affects the state of the local environment? The following subjects should be considered:

HISTORIC EVOLUTION OF LOCAL URBANIZATION

The following factors of urbanization should be examined:

- Occupation of the territory and land use over time.
- Distribution of economic activities in the urban area and their impact on the city's structure.
- Growth of population and its distribution in different areas of the city.
- Structure of supply systems for water, sanitation, transport, telecommunications and energy.
- Infrastructure and social services (health, education, culture and entertainment) and their spatial socio-economic distribution.

Details of these factors will depend on the availability of existing information for each city and the importance of each factor in relation to the urban world and the ecosystems that surround it.

It is important that users of the methodology make an analysis, which permits them to:

- Understand the driving forces, trends and problems involved in local urbanization.
- Use it as a reference when making decisions concerning the direction taken by the growth of cities, investing public resources and formulating public policy.

DESCRIPTION OF THE LOCAL POLITICAL-ADMINISTRATIVE STRUCTURE

Describing the local political-administrative structure is very important when formulating local government or administration regulatory action on standards and control of urban growth and the

Topics to describe the local political-institutional structure

a) The local government administrative structure highlighting the administrative bodies related to the question of the environment and urbanization: ministries, public bodies concerned with garbage collection, collection/distribution of water, environmental sanitation, preservation of the environment, and so on.
b) The existence of Master Urban Plans, induction/regulation instruments for local urban development with their desirable characteristics.
c) The existence and descriptions of the Environmental Management and Local Environmental Legislation Plans, as well as Environmental Protection Areas.
d) Funds available in municipal budgets for environmental preservation/protection projects.

protection of the environment. The growth of cities and their influence on local ecosystems determined by the characteristics, range, and constitution of local governments, as well as their capacity to act and their relationship with other social stakeholders (civil society and the market).

Important processes to include in the analysis are:

- Present use of natural resources
- Distribution of people and activities within the urban space.
- Characteristics of urban constructions.
- The definition of the population that benefits from these services, They are subject to the rules and regulations in the laws, standards, regulations, tax systems and control practices adopted by local government and, nowadays, by civil society.

For this reason, awareness of the local political-institutional structure will help to identify available instruments or those needed.

ANALYSIS OF LOCAL SOCIO-ECONOMIC FACTORS

The interaction between the dynamics of urbanization – demographics, the economy and territorial occupancy – is complex, with effects on the social structure at all levels that define its characteristics and determine much of the meaning and consequences of the urban-environmental relationship.[18]

To analyze the topicality of the pressures of urbanization, it is necessary to describe each element and relate it to its corresponding indicators.

DYNAMICS OF DEMOGRAPHICS

Indicators
a) Population growth
b) Population in human settlements

Population growth and the flow of population to a specific point in the territory are two of the most important factors in understanding how urbanization influences the growth of society and, as a consequence, to understand the urban-environment relationship. Some natural and social processes are particularly relevant.[19] The first, in relation to demographics, is the natural dimension of the birth rate and the death rate. In fact, the population's growth and natural renewal rest on how some central processes interact. With respect to the relationship between the number of live births (birth rate) and the number of deaths per year (death rate), there are objective elements (family income, structure of the health system and of infrastructure services; how women are integrated into the labour market; conditions of scientific medical knowledge). There are also subjective elements (educational level of families, religion, culture and local customs, the use of birth control, the activities of social movements that defend reproductive rights). These processes are not exclusively natural, but changes in the structure of contemporary society induce them. In societies or social groups organized around the most traditional cultural values, the situation is very different.

Population growth resulting from these natural variants, together with growth caused by migration (social process) will determine how demographics interact with the environment. Migration is an important factor in the growing urbanization of societies. Migratory movements generally associate with the concentration of economic activities in a given area. In 2000, urban Arab dwellers were 151,793 representing 53.38 per cent of the total population, and in 2030, would be 331,628

[18] Pintér, László and others, "GEO Resource Book: A training manual on Integrated analysis of environmental trends and policies Module 5," *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD
[19] Pintér, László and others, "GEO Resource Book: A training manual on Integrated analysis of environmental trends and policies Module 5," *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

representing 65.42 of the total population.[20] Approximately, 60 per cent of those dwellers will live in cities and will require infrastructures, such as drinking water; social services, such as educational and health facilities; and environmental amenities, such as parks, green areas, clean air, and so forth.

The two migration movements: emigration (people leaving) and immigration (people arriving) may be of the following types:

- Rural-urban migration
- Urban-urban migration
- Transient migration

Each has particular effects in urban terms and in terms of pressure on the environment. Infant mortality is a measure of the population's general health and quality of life, varying in accordance with income levels, educational standards and access to such essential urban services as water supply and drainage, as well as a public health system. It reflects, therefore, poverty and social inequity, environmental pollution, the lack of investment in public health, and the lack of sanitation services. In this sense, how the environment conditions the quality of life is another measurement of the impact. This information is readily available from national and regional statistics institutions and from public health services in each city or state.

Indicators

a) Gini Index (social inequality)
b) Atmospheric emissions
c) Energy consumption per capita
d) Solid waste production
e) Solid waste disposal
f) Emissions of acid rain-producing gases

DYNAMICS OF ECONOMICS

In most cases, the economy is the determining factor of urban development in a country, and places heavy pressure on the environment. Economic activities that affect the environment are:

- Consumption of raw materials.
- Use of land for production (agriculture, constructions, commercial, residential, recreational, highways and streets, storage, and others).
- The disposal of solid and liquid wastes.

In most cases, agriculture, industry, business and services make little attempt to adapt to the environment, with resulting destructive effects, such as pollution and extinction of flora and fauna. The ecological crisis is the result of such economic model of production. Consumption becomes increasingly unsustainable, due, in part, to the degradation it causes in the environment. The basis of the model is overexploiting natural resources, in particular non-renewable resources, or those with a very long-term replenishment cycle.

All the goods society consumes originate in nature, so the pressure of economic activity on the environment is inevitable. Hence, it is important to identify and assess the type and scale of different activities that use natural resources and have an impact on the environment, and to analyze how they interact with the urban environment. The prevailing model usually overexploits resources, degrades the environment or puts ecosystems at risk thus endangering biodiversity.

An activity sector is a group of organizations and people engaged in the same general economic activity; in other words, a category of development activity within the city. Each activity sector will include groups and organizations with broadly similar interests and needs, and a similar relationship with urban development and the urban environment.

[20] Economic and Social Commission for Western Asia (ESCWA), "Population and Development Report," First Issue, Water Scarcity in The Arab World, United Nations, New York, 2003
http://www.escwa.un.org/information/publications/edit/upload/sdd-03-12-e.pdf (accessed Tuesday, January 05, 2010)

There is no a fixed rule for identifying and categorizing activity sectors. The situation will be different in each city, and the list of activity sectors will reflect local circumstances. It is important to identify activities, which contribute understanding of the situation. Hence, the local team has to pay more attention to the activity sectors (mining, manufacturing, housing, transport, agriculture) with the biggest effect on urban environmental management.

The local team responsible for elaborating the report has to address each activity sector and describe it separately. Each description should concentrate on the sector as a whole without describing individual enterprises or subgroups. Sometimes, as in the manufacturing activity sector, it is useful to describe the most important sub sectors (e.g. chemicals, pharmaceuticals, steel), especially if these are the ones that have the most significant impact on environment resources. Keep descriptions concise. A small table of statistics is often the best way to convey key information. At least for the main activity sectors, a simple map should illustrate the geographic distribution of the activity. Once the team has satisfactorily identified the city's activity sectors, the following report should present the information for each activity sector separately in this order:

Challenges facing the development of renewable energy in Gulf States

Developing renewable energy in the Arab States of the Gulf is relatively low in spite of the large geographical potential for the use of these solutions. A combination of constraints, including but not limited to, the absence of relative legal and policy framework, the high initial capital costs and the lack of commercial skills and information are among the barriers that challenge this market. Even though these states have not been interested in these energy solutions for many years, recently, they started to show interest probably due, in part, to their accession to the Kyoto Protocol. The government, the private sector and the people started realizing the inevitability of putting climate change issues on the top of the list of priorities in the process of economic and social development. Some renewable energy investments seem to be more available and effective solutions in this part of the Arab region, because of specified conditions and requirements in remote and isolated areas.

Konstantinos D. Patlitzianas, Haris Doukasa and John Psarras, "Enhancing renewable energy in the Arab States of the Gulf: Constraints & efforts," Energy Policy, Volume 34, Issue 18, December 2006, Pages 3719-3726, http://www.sciencedirect.com/science/article/B6V2W-4H5DYM1-1/2/3114ccea55b450d2afe9b42ac7acf231 (accessed Thursday, 26 June 2008).

CHARACTERISTICS OF THE ACTIVITY SECTOR

Describe very briefly the nature and characteristics of the activity sector including, where appropriate, the following information:

- The general types of activities in the sector.
- An approximation of how many people work in the sector, separately where applicable for the formal and informal sub-sectors.
- Recent trends in the sector (and if applicable in sub-sectors) – growth or decline in activity, in employment, etc.
- Important linkages, if any, to other activity sectors.

Next, is to identify the groups, institutions, firms, individuals, ministries, sector representative bodies, etc. that are important for organizing how the sector operates. Then, describe any special arrangements that have been made to link the sector with environmental management activities in the city.

ANALYSIS OF THE STATE OF THE ENVIRONMENT'S NATURAL RESOURCES

Describe in general the use of environmental resources by this activity sector, in terms of both quantities and qualities:

- What specific resources are used (water, air, land, minerals, trees, etc.) that are essential to the activity itself?
- What is the approximate size (scale) of use of these resources?
- What are the recent trends in the consumption of resources by the sector – what are likely future consumption patterns?

There are differences in energy consumption, according to activity and the support needed, and the production industry is very greedy. In the Arab region, most energy for industrial use, and electric energy, comes from: fossil fuels (petroleum, natural gas and mineral carbon), thermo-electrical (based on fossil fuels and mineral carbon) and, to a lesser extent, from nuclear energy,[21] wind energy and solar energy, the last two considered to be clean energy sources.

Describe the availability of these environmental resources, for the sector:

- What are the main sources of supply of these resources – in particular, identify sources of supply that are in the city or its surrounding area? Have these sources changed in recent years?
- Are there specific shortages of certain resources – or are there problems in obtaining the quantity - or the quality – of resources needed?
- How readily available are the resources being used by the sector? What are the special measures that the society has taken to expand available supplies or to protect existing supplies?
- Does this sector compete directly with other activity sectors for supplies?
- Are there any particular initiatives underway in response to shortages?

THE ACTIVITY SECTOR'S IMPACT ON ENVIRONMENTAL RESOURCES

Describe in general terms the impact the activity sector has on different environmental resources – that is, degradation and/or depletion:

- What are the main pollution effects of the activity sector, and how do these affect various environmental resources?
- Does the activity sector's use of resources cause observable depletion of any environmental resources?
- Have any projects or programmes been undertaken specifically to alleviate the impact of this sector on various resources?

In urban centres, the civil construction and transport activities exert direct pressure on the environment: they demand urban space to expand, occupying and building in important ecosystem areas, threatening local biodiversity and freeing polluting chemical products.

Liquid and solid waste also causes pressure. Nowadays, indiscriminate dumping of industry's by-products: atmospheric emissions (gases and particles), liquid wastes/effluents (containing toxic or polluting chemical products, heavy metals) and industrial (solid) wastes dumped into rivers, lagoons and seas, is responsible for environmental pollution.

Analyzing industrial pressure on the environment

[21] In February 2007, Gulf Cooperation Council of the GCC announced that member countries are moving ahead with plans to explore development of their first nuclear energy plants, with representatives planning to seek help from the U.N. Source: International Herald Tribune, according to Associated Press, published on February 11, 2007, http://www.iht.com/articles/ap/2007/02/11/africa/ME-GEN-Gulf-Nuclear.php (accessed on Thursday, 26 June 2008). In September 2006, Egypt announced reviving her plans for civilian nuclear power program. Source: BBC News, "Egypt unveils nuclear power plan," http://news.bbc.co.uk/2/hi/middle_east/5376860.stm (accessed on Thursday, 26 June 2008).

- The characteristics of energy consumption (main sources of energy consumed, localization of industries, price of energy, shortage, population's access).
- Gas emissions that produce acid rain, cause the greenhouse effect and/or deplete the atmosphere's ozone layer (types, sources, volume); discharge of industrial waste/effluents into bodies of water (types, sources, volume); solid wastes (types, volume, final destination), industrial wastes (toxic, non-toxic and inert).

Agriculture

In urban centres, in particular near medium-size cities, agriculture has become less important than other activities. In cases where it is still significant its main features should be shown – number of people employed, types of products, destination of the products, area occupied, use of pesticides, growth of the area occupied, production techniques, rate of expansion of the municipal area used – to calculate its pressure on the environment. Attention must be paid to such matters as deforestation, which results from using new land for agriculture, soil and water pollution caused by the use of agricultural toxins, setting fires to clear land for cultivation and the threat to springs from deforestation and pollution.

Commerce and services

Commerce and services affect the environment; they demand the construction of buildings, shops and shopping centres, and so on, and produce solid and liquid wastes that pollute the soil, water and harm biodiversity. Some of these pose particular threats to the environment. They include pollution from the pathogenic agents in hospital waste, which release into the environment untreated biological and chemical vectors that can easily spread diseases and pollute both soil and water, threatening the environment and human health.

Tourism involves the hotel and other related sectors. It puts pressure on space for building hotels (perhaps intruding on to still-preserved environmental spaces), produces solid and liquid waste, and consumes energy.

TERRITORIAL OCCUPANCY

The occupation of territory is the material/environmental expression and result of interactions between demographics and economic activity. It is the progressive adaptation and inclusion of the territory's environmental resources into the expansion of the urban area, implying some degree of destruction and threat to the integrity of ecosystems.[22] Urbanization necessarily implies territorial occupancy, the physical basis for such urban activities as:

- Construction of housing;
- Opening streets and avenues;
- Building industrial plants;
- Deposits;
- Hotels and shops;

Indicators

a) Area covered by human
b) settlements, legal and illegal
c) - Total volume of untreated
d) domestic sewage
e) - Distribution model
f) - Motorization index
g) - Land use change from non-urban to urban
h) - Reduction in vegetation

[22] Pintér, László and others, "GEO Resource Book: A training manual on Integrated analysis of environmental trends and policies Module 5," *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

- Preparing land for agricultural production to meet the needs of urban consumers;
- Building places of worship and of entertainment;
- Health care and education;
- Building drainage, water, and energy supply infrastructure.

The determining factors of territorial occupancy are:

- The degree and characteristics of social inequity;
- The characteristics of the economy;
- How the local government is structured and acts;
- How civil society organizations act;
- The territory's physical-natural characteristics;
- Including the city in the international network of cities (i.e., global urban system).

In making the analysis, the local team has to highlight the following factors:

- Population distribution and activities within the territory;
- Occupation/production in vulnerable areas;
- Land use;
- Building and using the infrastructure;
- Water consumption (source, volume, socio-space distribution, uses);
- Access to drainage services (volume, socio-space distribution, types of treatment);
- Production of solid wastes (volume, type, final disposal, principal sources);
- Local energy consumption (main sources, origin of the energy, measuring consumption, and others).

SOCIAL INEQUITY

Indicators
a) Gini income inequality index

For the GEO Cities report, social inequality[23] goes beyond the income differences between social classes, although they are central to its classification. The access of inhabitants to the urban services essential for a good quality of life (such as supply of drinking water, drainage system and collection of domestic garbage) and good urban land for housing are among the measures of social inequity.

The lack of services provided to marginalized city dwellers a) puts pressure on the local environment, b) contributes to water and soil pollution and c) harms flora and fauna – environmental degradation often affect first plants, trees, different animals. Degradation of the environment often inflicts marginalized population. For example, the proliferation of malaria-transmitting mosquitoes (and diseases such as malaria) that has a serious impact on human health and quality of life usually associate with the residence of the poor.

The richest social groups contribute to the pressures on the environment by building, for example, condominiums on environmentally protected land. Civil construction industries and companies discharge polluting substances and advance on spaces that are natural breeding grounds for local fauna (such as mangroves and reefs in the case of coastal cities).

The report has to analyze following:

[23] There is a conceptual difference between equality and equity. The former means the state or quality of being equal; correspondence in quantity, degree, value, rank, or ability; while the latter means fair and just.

- The history of the local economy, with its diversification of activities that has influenced how the territory was occupied, how it attracted immigrants and transient migrants and their distribution within the urban zone.
- Local income distribution, specifying the way it affects where people live in the city.
- How social and territorial distribution of essential urban services is affected by local income distribution and the interaction between them.
- The social classes and areas that produce the worst environmental degradation and pollution, to establish the relationship between them and the provision of urban services.
- The main features of the local housing market.
- The relation between social inequality and the local transport system.
- The local population's access to education, specifying average years of study, the distribution of students in formal education, the number and frequency of school dropouts.

BOX 3 DEFINING CLIMATE CHANGE

The Earth's climate is a complex system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water, and living things. The atmospheric component of the climate system most obviously characterizes climate; climate is usually described in terms of the mean and variability of temperature, precipitation and wind over a period, ranging from months to millions of years (the classical period is 30 years).

Projecting changes in climate system is different from a weather forecast and in indeed a much more manageable issue. Based on the foundation of current climate models, there is considerable confidence that climate models provide credible quantitative estimates of future climate change. However, to be able to predict changing climate the results will not only depend on the interaction between characteristics of the climate, but also on the amount of GHGs resealed to the atmosphere. The amount of GHGs in the atmosphere is determined by released gases both from human and natural sources and by their removal as sinks that mainly includes photosynthesis of vegetations. Furthermore, the climate reacts over long periods to influences upon it; many GHGs remain in the atmosphere for thousands of years.

Source: IPCC, 2007 and UNEP, 2009

ENERGY CONSUMPTION

Urban energy consumption in Arab region associates with citizens' development, health and quality of life and has strong implications for the national and global environment. As energy production in these countries involves the use of land, it has an effect on environmental balance.

Across the Arab world, energy consumption increased in all countries with varying degrees during the period from 1980-1998. Countries that had long established industries like Egypt and Morocco showed increases in their consumption that were more than two fold, while countries with emerging industries like Syria and Jordan showed a threefold increase. The Gulf region, however, witnessed a sharp rise in consumption of energy and has become one of the highest per capita commercial energy consumers in the world.

There are indications that other sources - less clean from the point of view of climate change, will have to be used to satisfy the growing demand for energy over the short and medium term. The prospects for further strengthening renewable sources are promising and require large investments; in the coming decades, a source with great investment potential is methane gas (CH4) from landfills. In most cases; nevertheless, its controlled burning may provide energy to supply local networks (but not a large city). The practice would also help to reduce greenhouse effect emissions, in the spirit of the Kyoto Protocol; this encourages the use of alternative low impact energies.

The total primary energy consumption figures for the world for the year 2004 were, on average, 220 million barrels of oil equivalent per day, which, in terms of thermal watts become 14.5 terawatts (one barrel of oil 1,600 kWh Thermal). The Arab World countries' share in the above consumption was about 7.6 million barrels of oil equivalent per day, which is about 3.5 per cent of the total. Deserts and desert-like regions–where incidences of solar radiation are very high–are most suitable for capturing the solar energy and converting the same into thermal/electric energy. As per a UNEP estimate, the total deserts or desert-like regions over the earth stretch across 36 million km^2, which receive direct normal solar radiation of 2.4 TWh/km^2/year or 274 MW/km^2 from the sun. Of these total deserts on the earth, the deserts in the Arab World form a major part. Incidence of direct normal solar radiation on these desert surfaces ranges from 2.2-2.8 TWh/km^2/year, with the average being 2.5 TWh/km^2/year. This is well above the threshold value of 2.0 TWh/km^2/year for the technical and economical potentials of CSP Technology. Thus, Arabian deserts have huge potential for capturing solar energy and catering to the various energy needs of the Arab World whether thermal or electric.[24]

Wind is a form of solar energy. Uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth cause winds. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetation. The terms wind energy or wind power describes the process by which the wind is used to generate mechanical power or electricity.

Hydroelectric generation also has regional environmental impacts, with repercussions on urban areas. Flooding in areas where barriers are built affects local flora and fauna. Social impacts include the loss of land for agriculture, imbalances in wetlands, dislodged populations and a deterioration of water quality during construction. From the economic point of view, the cost of transmitting this type of energy is high and limited because of difficulties of access, depending on the location of areas to be supplied.

The use of the energy consumption indicator should separate consumption of electricity from consumption of fossil fuels by private and public transport. The rationale is to distinguish properly the impact on local air quality and human health, thus making a direct link between transport and the industrial sector, and the regional and local impact that results from the emissions of gases that cause greenhouse and acidification effects. This indicator should be also associated with the urban transport distribution model and the motorization index. In the analyses, crossing these indicators also traces local and regional air quality.

WATER CONSUMPTION

As a natural resource, water is essential to nearly all human activities and an indispensable part of all terrestrial

Indicators
a) Total water consumption
b) Total volume of untreated domestic sewage

[24] Encyclopaedia of Desalination and Water Resources (DESWARE), "Solar Energy The Availability Perspective for Meeting the Future Energy Demands of the Arab as well as the Entire World," Eolss Publishers Co. Ltd. http://www.desware.net/des35a.aspx (accessed Tuesday, January 05, 2010)

ecosystems. It occupies a central place in any analysis assessing the state of the environment worldwide. In addition, freshwater is an indispensable part of all terrestrial ecosystems.

As the population and economic and social activities grow and urban development expands, so does the demand for water that has to be brought from, sources further and further away from urban centres, thereby increasing the cost of its collection, treatment and distribution. Furthermore, pollution increases and springs are harmed, water becomes scarce and conflicts arise as to its ownership and use. At stake, therefore, is the quantity and quality of available freshwater.

Much of the world lives with a serious problem of water shortages, pollution of hydraulic resources, uneven distribution of the water among the different social groups and conflicts over its multiple uses – domestic and sanitary, agricultural, industrial, urban development, energy generation, fishing, transport, entertainment – which makes water one of the two key items on the global public environmental agenda. A constant supply of clean water and sanitation play a central part in efforts to protect the environment improve the health of the population and fight poverty in urban centres.

ATMOSPHERIC EMISSIONS INDICATORS

Indicators
a) - Atmospheric emissions
b) - Distribution
c) - Motorization index

Most polluting gases in the atmosphere come from urban centres. The report has to address the pressure from the air quality pollution sources found in cities. Car, bus and truck exhausts are a main source of greenhouse gases (responsible for global warming). The burning of fossil fuels produces gases that contribute most to this: carbon monoxide (CO), carbon dioxide (CO_2), nitrous oxide (NOX) -- one of the ozone gases (O_3) – and sulphur dioxide (SO_2).

Secondly, the local team has to pay special consideration to emissions from fixed sources, especially industry and, in some cases, agriculture from burning grassland for planting. Besides greenhouse gases – CO, CO_2, NOx – industrial activities (such as mining activities in urban centres) also emit substances that deplete the ozone layer, in particular chlorofluorocarbons (CFCs), as well as diverse particle material (PM).

WASTE PRODUCTION INDICATORS

Indicators
a) Solid waste production
b) Disposal of solid waste

Accelerated population growth, the exponential increase in all kinds of consumption, the lack of financial and technical resources to collect and finally dispose of waste, as well as depositing it in inappropriate places, are among the factors that make the waste problem a matter of great concern.

There are estimates from many Arab cities that the average of generation rate of solid wastes is about one kilogram per capita per day of garbage, with variations between the wealthiest in each society and between the inhabitants of developed countries.[25] The quality of domestic waste is also a problem because it includes growing amounts of non-biodegradable products, such as plastics, aluminium and glass, as well as a vast array of substances hazardous to the environment and human health – toxic, corrosive, radioactive, inflammable, reactive or infectious..

The infrastructure for waste treatment in many Arab cities is not always adequate to handle the volume and types of urban waste. There are often problems in collecting and disposing of very large

[25] Chapter on human settlements included in the Environmental Outlook for Arab Region (EOAR), which UNEP-ROWA will publish December 2008, reports the generation rate of many Arab cities to vary between 0.7 kg/capita/day to 2.2 kg/capita/day.

objects – vehicles, furniture, electric domestic appliances; these are often dumped, in particular into areas of land outside the city limits, adding to soil pollution and environmental degradation. This can also lead to the loss of biodiversity.

SEWAGE TREATMENT INDICATOR

Indicators
a) Total volume of untreated domestic sewage

The difficulties associated with domestic and industrial effluents are similar to those related to solid waste. Discharging untreated urban effluent into bodies of water causes serious health and environmental damage to people and ecosystems. Among the most common damage is the pollution of springs, surface and groundwater, rivers and oceans, which is also a serious threat to human health, in particular among the urban poor.

Problems related to effluent include:

- Limited coverage of the urban drainage system,
- Lacking enough treatment stations for the volume of effluent produced,
- Poor territorial and social distribution of the collection system in cities,
- Financial limitations to expand the service in cities in many Arab countries,
- The rate of urban growth that outpaces the capacity of local government budgets, and
- The limited national and international financing available for these services.

These difficulties are most severe in the poorest Arab countries; their marginalized populations can become even more socially disadvantaged.

The most common untreated effluent dumped into bodies of water are:

- Domestic or sewage water that discharges organic matter into bodies of water, polluting and altering ecological balance;
- Industrial effluent chemicals resulting from production processes (mainly oil-combustibles) and dumped as untreated waste into bodies of water;
- Hospital waste, with high potential for polluting and transmitting diseases to the population.
- The growing global shortage of freshwater makes it ever more important to analyze effluent.

DEFINITION OF CORE INDICATORS: PRESSURE INDICATORS

POPULATION GROWTH

Resource: All
Type of Indicator: PRESSURE
Category: Core, Transversal

Justification: What does it mean and why is it important to measure it?
The urban population, like population density, is an indicator that measures pressure on the environment, including the exploitation of natural resources such as water and land; pollution of a city and its surroundings, atmospheric pollution due to transport and industries. Increasing or decreasing pressure on the urban environment accompanies population growth over time.

How is it identified? Data needed
Number of inhabitants in a city over a given period (2-10 years is recommended).

Measurements and units
Total number of inhabitants.

Possible time and space formats
Trend charts, maps

Reference to methodological resources
UNCHS http://www.istambul5.org/guidelines/indicators
WB, 1998. Sustainable Development Indicators.
OECD, 1997. Better Understanding Our Cities: The Role of Urban Indicators. EEA Indicator Set.
UNEP, 1999. GEO 2000: Global Environment Outlook.

Objectives
To harmonize the annual growth of a city with its environment and with the situation of settlements in general.

Goals, reference values
There are no international references.

Application examples
Population of Prague: http://www.ceroi.net/reports/prague/drivers/population/driver.htm
Urbanization of the El Cabo Metropolitan Region: http://www.cmc.gov.za.peh/soe/urban.htm

Other comments / context
The population of Africa grows by three per cent per year, the highest index in any region. Next is Western Asia with 2.8 per cent. The index for Southern Asia is 2.3 per cent, in Latin America it is 2.1 per cent, in North America 0.8 percent and in Europe 0.25 per cent. Using a medium projection it is forecast the world population will reach close to 10 000 mil ion in 2050, up from an estimated 6 260 million in 2000 (WHO, 1999).

GINI INCOME INEQUALITY INDEX

Resource: All **Type of Indicator: PRESSURE** **Category: Core, Transversal** **Source: UNCSD**
Justification: What does it mean and why is it important to measure it? This indicator is particularly important in assessing inequality in sustainable development. As income distribution has important consequences for territorial occupancy and for the pressure different social classes put on the environment, the distribution of the population in the locality must be measured. Although an automatic correlation cannot be established between poverty and pressure on the environment, as a reference of the population growth indicator, an attempt should be made to prove what seems undeniable, that the poorest areas in large cities exert the most pressure. Once the Gini index for the locality is known, as well as the distribution of the poorest groups in the urban zone, a reliable measurement may be made of urban development pressure on the environment.
How is it identified? Data needed It is an index of the difference between the true measure of income distribution, consumption pattern or other related
Measurements and units Not specific. Varies from zero to one, where zero represents no inequality and one represents the maximum possible degree of inequality
Possible time and space formats Measurements may be made locally or nationally, depending on how income is measured. This may be applied precisely to household, population group or consumption pattern according to income.
Reference to methodological resources There is no absolute international reference. The World Bank provides some reference data www.worldbank.org/data
Objectives To measure the population's income or level of inequality.
Goals, reference values Because it is a composed and relative index, per capita income, GDP or other economic development indicators may be considered.
Application examples The World Bank uses the Gini index as a reference
Other comments / context It is difficult to measure this index in poor countries.

AREA AND POPULATION OF LEGAL AND ILLEGAL URBAN SETTLEMENTS

Resource: All
Type of Indicator: PRESSURE
Category: Core, Transversal
Source: UNCSD

Justification: What does it mean and why is it important to measure it?
Illegal settlements with unauthorized constructions inhabited by those with not claim to land are generally marginalized and precarious and do not meet basic human needs. On the outskirts of cities, they are overcrowded and their land use is poor and uncontrolled. This very often puts great pressure on natural resources and the environment, deforesting wooded areas, polluting springs, occupying the most vulnerable areas without basic services such as drainage, health clinics and garbage collection. However, it should be made clear that these areas are not only occupied by poor and marginalized people; there are also settlements occupied by better-off social groups in the same situation, on illegal territories without services such as drainage.

How is it identified? Data needed
Urban residential area in square kilometres (km^2), occupied by legal and illegal settlements and the number of their inhabitants.

Measurements and units
km^2, number of inhabitants.

Possible time and space formats
Graphs, tables, maps, trend charts.

Reference to methodological resources
This indicator is from the United Nations Human Settlements Centre (HABITAT), and specifically the Urban Indicator Programme (UIP) and the Local Urban Observatory which may be consulted at: www.urbanobservatory.org/indicators/.

Objectives
Allows the measurement of marginalization of the living conditions of large groups of the population, as well as the pressure of these settlements on different resources of the local environment.

Goals, reference values
None for this indicator.

Other comments / Context
This indicator is a good example of how inequality may have perverse effects on the population and on the environment, even when illegal territorial occupancy by the wealthiest groups is taken into consideration. On the other hand, this is related to other important indicators, such as human and economic losses caused by natural disasters, the infant mortality index, the cost of local government infrastructure, and local health care services, among others

LAND USE CHANGES FROM NON-URBAN TO URBAN

Resource: All **Type of Indicator: PRESSURE** **Category: New, Transversal**
Justification: What does it mean and why is it important to measure it? One of the main pressures on the environment in cities is the change in land use from non-urban to urban. This can be verified from different legal and illegal human activities on the land (division of plots, buildings, construction of engineering infrastructure, and so on). It would be of interest to obtain a set of data on all new annual land occupancy that show how much non-urban land is replaced (green areas, agricultural land, without any artificial human intervention) by human occupation that tends to compromise the environment's balance.
How is it identified? Data needed Area (km2) included in the urban area in the past year, compared with the total urban area.
Measurements and units Area (km^2)
Possible time and space formats Graphs, maps, aerial photos and trend charts.
Reference to methodological resources
Objectives Determine the pressure on the environment and its resources by the growth of the urban area by the addition of non-urban land
Goals, reference values There are no reference values or defined goals.
Other comments / Context This is considered a transversal indicator, which is useful to analyze the pressure of urban activities on the different environmental resources considered in the GEO Cities project

REDUCTION OF VEGETABLE COVER

Resource: Biodiversity, Land, Water **Type of Indicator: PRESSURE** **Category: Transversal**
Justification: What does it mean and why is it important to measure it? The land's vegetable cover has an important function in the environment, as it shelters a complex and varied fauna and flora biodiversity, helps to preserve springs and the soil, functions as a filter for different pollutants and influences the local temperature. The reduction of wooded areas and other types of natural vegetation is one of the main consequences of urban development and becomes an important indicator of the pressure of cities on the environment. This indicator is directly related to the indicator on the state of vegetable cover.
How is it identified? Data needed Wooded area (km^2) or other type of natural vegetation deforested over a specified period (a year or any other period).
Measurements and units Area in km^2
Possible time and space formats Graphs, maps, aerial photos and trend charts.
Reference to methodological resources An approximate example of the use of this indicator may be found in the document Indicators of Sustainable Development. Framework and Methodologies", available for consultation at www.un.org/esa/sustdev
Objectives To control the destruction of forests and other forms of vegetation threatened by human development in order to preserve and protect natural resources.
Goals, reference values There are no goals or reference values related to this indicator.
Other comments / Context Controlling the reduction of vegetable cover in each city is one of the main measures to reduce the pressure of urban activities on the environment. The range of environmental services performed by natural vegetation is very broad; it is therefore of prime importance to take into account the degree of its reduction when estimating the effects on the environment, and its impact on the quality of city life.

DISTRIBUTION

Resource: Biodiversity, Land, Atmosphere, Built-up environment **Type of Indicator: PRESSURE** **Category: Core**
Justification: What does it mean and why is it important to measure it? Various types of transport put pressure on the environment. Collective transport provides more space, reduces traffic and saves the use of energy. Traffic jams are associated with pollution of the atmosphere, accidents, reduction of productivity and the population's general frustration.
How is it identified? Data needed This indicator is measured according to types of transport: proportion of journeys in private vehicles, trains or trolleybuses, buses or microbuses, motorcycles, bicycles, on foot or otherwise. This indicator is measured every year.
Measurements and units Percentage (%) of total daily journeys in the city by: bicycle, bus or minibus, on foot, by motorcycle, in private cars, trains, metro, etc.
Possible time and space formats Trend charts, bar charts, pie charts (indicating the share of each type).
Reference to methodological resources UNCHS. http://www.urbanobservatory.org/indicators/guidelines/comprehensive EF, 1998. Urban Sustainability Indicators for the Improvement of Living and Working Conditions. OECD, 1997. Better Understanding Our Cities: The Role of Human Indicators, EEA indicator set.
Objectives To minimize the number of journeys that use non-ecological transport
Goals, reference values None.
Application examples Capetown, South Africa: http://www.cmc.gov.za/peh/soe/trans_a.htm#Modeoftransport
Other comments / Context Data on types of transport are generally obtained from specific transport surveys. If detailed data are unobtainable, it may be possible to get information on private vehicles, trains, trolleybuses, buses and microbuses, as well as on non-motorized vehicles

MOTORIZATION INDEX

Resource: Biodiversity, Land, Atmosphere, Built-up environment **Type of Indicator: PRESSURE** **Category: New**
Justification: What does it mean and why is it important to measure it? The intensity of motor car use in cities is one of the main pressures on the quality of the atmosphere due to the combustion that is the principal source of CO, SO2, NOX and other greenhouse gases. The indicator is calculated by the number of authorized light vehicles in the city and, in large cities, consideration must be given to the presence of the large number of commuters' motor vehicles (or part of a migration to a specified city).
How is it identified? Data needed Number of motor cars / inhabitants. Include cars from other cities that circulate in the city.
Measurements and units Number of motor cars / inhabitants
Possible time and space formats Graphs, tables and trend charts.
Reference to methodological resources Look for research studies on origin and destination, generally carried out by city or metropolitan region management agencies.
Objectives To help control pollution caused by motor vehicle fuels in cities, reduce pollution of the atmosphere and the incidence of respiratory and cardiovascular diseases.
Goals, reference values There are no international reference values.
Application examples
Other comments / Context Although the automobile industry is the economic driving force in many industrialized countries, the increased use of motor cars exerts great pressure on the environment. It is therefore necessary to develop mechanisms to measure its impact. The motorization index, by indicating how much use the local population makes of motor cars as a means of transport, supplies information that informs strategies for the rational use of city transport systems

ANNUAL PER CAPITA CONSUMPTION OF ENERGY

Resource: Atmosphere **Type of Indicator: PRESSURE** **Category: Core** **Source: UNCSD, OECD**
Justification: What does it mean and why is it important to measure it? This indicator measures the average annual consumption of electric energy per capita and is related to the pattern of consumption, development, air quality and atmospheric emissions. It may be divided according to the sector: industrial, commercial, and household. It is different from transport energy consumption as it is directly linked to combustion.
How is it identified? Data needed Population of the city, amount of energy consumed in GWh.
Measurements and units GWh / per capita / per year
Possible time and space formats Numerical data may be presented in tables or charts to indicate trends
Reference to methodological resources OECD, 1997 Better Understanding Our Cities: The Role of Urban Indicators, EEA Indicator Set. WB, Development Data Group, 1999. World Development Indicators 1999 on CD-ROM. World Bank Publication, USA.
Objectives Reduce the city's energy consumption.
Goals, reference values There are no corresponding international patterns.
Application examples
Other comments / Context In general, electricity is produced by burning fossil fuels. Electricity generation based on fossil fuels, such as mineral carbon, natural gas and petroleum derivatives, produces greenhouse gas emissions such as carbon dioxide (CO_2). Electricity consumption is linked to productive activities that cause these emissions. Even when the matrix is based on hydroelectricity, energy consumption may reach an unsustainable level, putting pressure on hydraulic resources. To assess energy consumption, this information must be compared with consumption data in the transport sector, to enable a precise assessment of the global contribution of cities to air quality. For the indicator to be effective in measuring local air pollution, the analysis must describe the energy source used.

WATER CONSUMPTION

Resource: Water **Type of Indicator: PRESSURE** **Category: Core** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? Per capita consumption of water depends on availability, price, climate and uses (human consumption, hygiene, laundry, gardening, etc.). Water consumption, as with as other forms, is much higher in cities in high-income countries. This may indicate the quality of the supply system to the city; generally, total consumption includes losses of drinking water, paid for by the consumer.
How is it identified? Data needed By relating annual water consumption for domestic use to the number of inhabitants connected to the supply net-work. The result is divided by the number of days in a year.
Measurements and units Average water consumption (litres / day / person).
Possible time and space formats Trend charts, graphs
Reference to methodological resources OECD, 1997 Better Understanding Our Cities: The Role of Urban Indicators, EEA Indicator Set. UNCHS, 1995. Monitoring Human Settlements: A Bridged Survey, Indicator Programme. ICLEI, HTTP://WWW.ICLEI.ORG/CITIES21/C21IND.HTM EF, 1998. Urban Sustainability Indicators for the Improvement of Living and Working Conditions
Objectives To match water consumption to available water resources
Goals, reference values Local programme goals.
Application examples Percentage of water consumed by different sectors in Arendal (Norway) http://www.ceroi.nte/reports/arendal/inicatr/vann.htm City of Targoviste, Rumania: Patterns of production and consumption: http://www.bestpractices.org/cgi-bin/bp98.cgi?cmd=detail&id=12281
Other comments / Context On average, people in developed countries use 272 litres of water per day, in Africa the average is 53 litres. In North America, average city use is seven times higher than consumption in Africa.

SOLID WASTE PRODUCTION

Resource: Soil, Water
Type of Indicator: PRESSURE
Category: Core
Source: CEROI

Justification: What does it mean and why is it important to measure it?
Solid waste production increases annually due to the increase in the population, deficient services and unsustainable lifestyles. Solid waste is produced by economic and domestic sectors such as industry, commerce, health installations, tourism, transport and family units.

How is it identified? Data needed
This indicator should be measured in the two units of weight and volume wherever possible. To calculate the amount produced per capita, the total number of inhabitants must be known. The indicator should be measured annually.

Measurements and units
- ✓ Total solid waste produced (tons / inhabitant / year).
- ✓ Total solid waste produced (m3 / inhabitant / year).

Possible time and space formats
Graphs, tables and trend charts.

Reference to methodological resources
OECD, 1997 Better Understanding Our Cities: The Role of Urban Indicators, EEA Indicator Set. UNCHS, 1995. Monitoring Human Settlements: A Bridged Survey, Indicator Programme.

Objectives
To reduce the amount of waste.

Goals, reference values
There are no reference values.

Application examples
Jacksonville, Florida, "Per Capita Tons of Solid Waste Deposited in City Landfills" http://www.jcci.org/gol/natu8.htm

Other comments / Context
The indicator only considers solid waste. Management of solid waste in developing countries has shown that there are many social and health benefits to be had when the community participates: http://www.waste.nl/feature.htm

SOLID WASTE DISPOSAL

Resource: Soil, Water
Type of Indicator: PRESSURE
Category: Core
Source: CEROI

Justification: What does it mean and why is it important to measure it?
The disposal of solid waste is a serious urban problem. The reduction of its negative impact is directly related to the city's ability to dispose of garbage. If this is not good, heavy polluting pressure is placed on the land. Substandard waste disposal pollutes aquifers and the soil causing harmful to human.

How is it identified? Data needed
The indicator may be presented as the total of waste produced and disposed of (or not disposed of) in different ways, divided by the total number of inhabitants Units of weight or volume and a percentage of the total waste produced may be used.

Measurements and units
Solid waste collected and disposed of in landfills (tonnes / inhabitant; m3 / inhabitant, percentage of total waste produced). Solid waste collected and improperly disposed of in garbage dumps and otherwise (tonnes/inhabitant; m^3/inhabitant, percentage of total waste produced). Solid waste collected or recycled (tonnes/inhabitant; m^3/inhabitant, percentage of total waste produced). Uncollected and improperly disposed-of solid waste (tonnes/inhabitant; m^3/inhabitant, percentage of total waste produced).

Possible time and space formats
Graphs, tables and trend charts.

Reference to methodological resources
OECD, 1997 Better Understanding Our Cities: The Role of Urban Indicators, EEA Indicator Set. UNCHS, 1995. Monitoring Human Settlements: A Bridged Survey, Indicator Programme .ICLEI, http://www.iclei.org/cities21/c21ind.htm EF, 1998. Urban Sustainability Indicators for the Improvement of Living and Working Conditions

Objectives
To prevent atmospheric, water and land pollution by poor disposal of solid waste and reduce the incidence of disease by reducing production at source and encouraging recycling and reuse.

Goals, reference values
There are no reference values.

Application examples
Good practices: Waste and clearing in Barcelona
http://wwww.mediambient.bcn.es/eng/fmaker.htm?cont_bcn_present.htm

Other comments / Context
Even though there is strict legislation on the disposal of industrial waste, specifically on hazardous waste, they are often ignored and much is disposed of in open-air dumps or close to inhabited areas. The control and management of waste disposal is one of the most important instruments for reducing the pressure of urban centres on the environment.

TOTAL VOLUME OF UNTREATED DOMESTIC SEWAGE

Resource: Water, Biodiversity **Type of Indicator: PRESSURE** **Category: New**
Justification: What does it mean and why is it important to measure it? Untreated domestic sewage and rainwater generally drain into water basins through gravity, and pollute surface, ground and sea water. This pollution has a serious impact on the environment and quality of life, as well as on the population's health, causing water-borne diseases, the proliferation of toxic algae, and increasing the cost of treating water for domestic consumption. The pressure this places on natural resources in cities must be measured.
How is it identified? Data needed On average, 50 per cent of all the water consumed per capita becomes sewage. This indicator may be estimated by considering the present population without sewage collection and drainage treatment services, from information on total domestic consumption of water in each city. Alternatively, account may be taken of the information on the average annual volume of sewage per capita, where this information is available. The indicator may be expressed as the total volume of untreated sewage and also the percentage of the total volume of sewage produced in the city.
Measurements and units ✓ Volume of sewage disposed of in a given period, per day, per month or per year: m^3/day, m^3/month or m^3/year. ✓ Percentage of total volume of drainage
Possible time and space formats Graphs, tables, maps and trend charts.
Reference to methodological resources Other approximate uses of this indicator may be found in: www.ceroi.net : Wastewater Treatment www.iclei.org : Volume of Sewage www.urbanobservatory.org/Guide3.htm : treated sewage.
Objectives To measure the pollution in bodies of water caused by the lack of proper treatment, or restricted access to the local drainage network.
Goals, reference values There are no reference values for this indicator.
Other comments / Context Measuring the degree of organic pollution in each locality is the first step towards reducing pollution from sewage.

ATMOSPHERIC EMISSIONS

Resource: Atmosphere **Type of Indicator: PRESSURE** **Category: Core**
Justification: What does it mean and why is it important to measure it? Atmospheric pollution affects human health (acutely and chronically), vegetation, buildings, construction materials, monuments and historic heritage sites. It is caused by emissions from mobile and fixed sources directly linked to the consumption of energy, to environmental policies, urban density and to motor vehicle transport and the concentration of industries.
How is it identified? Data needed Total emissions in tonnes per capita per year of: a) SO2; b) NOx; c) CO. The inventory of emissions is usually divided by the main mobile and fixed sources of emissions.
Measurements and units CO (tonnes / per capita / year) NO_x (tonnes / per capita / year) SO_2 (tonnes / per capita / year)
Possible time and space formats Graphs, trend charts, bar charts.
Reference to methodological resources UNCHS, http://www.urbanorbsevatory.org/indicators/guidelines/extended/EC, Directorate General Environment, Working Group of the Expert Group on the Urban Environment, 2000. Towards a Local Sustainability Profile – European Common Indicators. http://www.sustainable-cities.org/indicators EF, 1998. Urban sustainability Indicators for the Improvement of Living and Working Conditions.
Objectives To reduce emissions to a minimum.
Goals, reference values The Kyoto Protocol goals for national emissions (no city goals have been established). Kyoto Protocol with the United Nations Framework Convention on Climate Change. Reduce the total of human emissions into equivalents of carbon dioxide, greenhouse effect gases by at least five per cent below 1990 levels over the period 2008 – 2012.
Application examples The World Bank programme Clean Air Initiative in Latin American Cities developed an instrument to prevent new emissions and to restore air quality in urban areas in Latin America and the Caribbean. http://www.worldbank.org/wbi/cleanair/infocenter/index.htm
Other comments / Context Internet page on urban atmospheric pollution: http://doric.bart.ucl.ac.uk/web/ben/

EMISSION OF ACID RAIN PRODUCING GASES

Resource: Atmosphere
Type of Indicator: PRESSURE
Category: Core
Source: CEROI

Justification: What does it mean and why is it important to measure it?

Sulphur oxides (SOx), nitrogenous oxide (NOx) and ammonium (NH3) are examples of acid substances released into the atmosphere. Emissions from fixed and mobile sources put pressure on the quality of urban air. SOx, NOx and NH3 produce acid rain and changes in the chemical composition of land and surface water; they also affect flora and fauna.

How is it identified? Data needed

To calculate emissions per capita, the total emissions of (a) SOx, (b) NOx and (c) NH3 and the total population must be known. Acid substances may be measured as an acidity equivalent; (Aeq = total acidity caused by acid components and deposited per hectare).

Measurements and units

- ✓ Total emissions per capita and per hectare of NH3 (tonnes vs. Capita, Aeq, deposit of SO^2, NO^2, NH^3 per hectare)
- ✓ Total emissions per capita and per hectare of NOx (tonnes vs. Capita, Aeq, deposit of SO^2, NO^2, NH^3per hectare)
- ✓ Total emissions per capita and per hectare of SOx (tonnes vs. Capita, Aeq, deposit of SO^2, NO^2, NH^3 per hectare)

Possible time and space formats

Graphs, trend charts, bar charts

Reference to methodological resources

- ✓ UNCHS, Urban Indicators Guidelines: Better Information for Better Cities, EEA Indicator Set. EF, 1998.
- ✓ Urban Sustainability Indicators for the Improvement of Living and Working Conditions. EEA, 1998. Europeans Environment: The Second Assessment.

Objectives

To reduce emissions from fixed and mobile sources to comply with the demand for clean air quality.

Goals, reference values

To minimize pollution sources and to improve air quality in a city; the WHO goals may be used as a reference.

Application examples

Arendal, Norway: http://www.ceroi.net./reports/arendal/issues/water/pressure.htm

STATE OF THE ENVIRONMENT

This section analyses the state of the local environment with respect to priority themes including water, air, vegetation, waste and so on. The section should give a comprehensive picture or snap shot of each city's environment and the state of its ecosystems using concrete examples and indicators. This information will help answer the question: What is happening to the environment?

This section is at the centre of the GEO Cities Report. The analysis presents a definition of the essential points to assess the different environmental sectors and their respective indicators.

To begin with, the analysis must take into account the development model of the local society under review. Although the methodology proposed is designed to asses the state of the environment resulting from human pressure, it also includes elements necessary to analyse urban development as a whole.

In this context, the ecosystems in which cities are located reflect development models and their elements, whether as a source of natural resources or as deposits for urban, were revealed through the state indicators, their condition and support capacity.

Local ecosystems and their qualitative and quantitative state and that extend beyond their bioregional limits are indicators of the result of this process. It is important that, in observing how the state of the local environment evolved, to consider the region according to the ecosystem and the element in question.

Even though human beings are the focus of the action, the analysis benefits environmental indicators that include:

- ✓ Hydraulic resources in their different manifestations (bodies of water, sources, groundwater, surface and sea water, among others); atmosphere (local, regional or global level atmospheric resources);
- ✓ Soil (geomorphologic, use and occupation);
- ✓ Biodiversity (original, exotic and types of fauna, presence and quantity); and
- ✓ The characteristics of the built-up environment, i.e., the artificial urban ecosystem (housing, urban infrastructure, equipment, buildings and architecture).

The analysis also includes vulnerability of urban areas, and their effect on people who live in areas at risk of natural disasters.

An assessment of the state of the environment should be both quantitative and qualitative. The relation between both types of variables is quite close and mutually decisive. Therefore, an assessment of the state of the environment seeks to determine quality in terms of its elements and those of its ecosystems. To reach this objective, there are defined and accepted national and international parameters that serve as an assessment reference.

These parameters are quantitative indicating, for example, the number of faecal coliforms agreed as acceptable for water quality from a given river considered as safe for human consumption. Above that figure, water is not considered fit for use unless it is treated to reduce the number of coliforms in the references on water quality that may determine how many fauna and flora species survive in a given ecosystem, given the wealth and complexity of the local biodiversity.

The examples may be multiplied for all natural resources considered in this methodology indicating the qualitative effects that result from the quantitative behaviour of the variables selected to prepare the GEO Cities Report. It is important to understand there is no contradiction between the quantitative data and the qualitative analysis but that both are complementary.

How to characterize local ecosystems

1. *Quantitative and qualitative description of the main features of the municipality's predominating ecosystems from the point of view of their physical environments and resources, including existing biological diversity and the ecosystems' habitats;*
2. *Hydraulic resources and the distribution of bodies of water;*
3. *Climate (rain, relative air humidity, etc.);*
4. *Urban fauna (native and exotic);*
5. *Urban flora (forests, green areas, type and quantity);*
6. *Land (type, use and area);*
7. *Vulnerability to disasters, both natural and human-induced;*
8. *Type of occupation in risk areas*

LOCAL ECOSYSTEMS

The ecosystems to be analysed should be indicated by marking the municipal boundaries that do not always coincide with natural boundaries marked, for example, by watercourses or the region's specific geomorphologic characteristics. Furthermore, these ecosystems are associated with or linked to other natural systems outside the context being analysed and they must be considered.

Limits must be put on the scope of the analysis, as well as on the variables considered. This will set comprehensive assessment priorities, bearing in mind the notion of an interrelated system.

The description of local ecosystems should take into account each city's most important ecosystems, taking as a basis their contribution to:

- Recycling the environment's natural resources: water, air, biodiversity, etc.;
- The local population's quality of life, supplying water, regulating the local temperature, providing "environmental services; "
- Economic activities that give sustainability to local urban life.

It is hoped that the data on ecosystems will lead to a better understanding of the contribution to the quality of urban life of the life support system represented by ecosystems in general.

Besides the indicators proposed in the methodology, the analysis should describe in detail how the ecosystems could support urban environmental policies. Separating the environment into different sectors allows quantification and qualification of the environmental impacts of urban development, but the assessment cannot be confined to this point.

ANALYSIS OF THE STATE OF THE ENVIRONMENT'S NATURAL RESOURCES

Assessing the state of the local environment is first done of all by the reductionist method, that is to say, each of the natural resources is analysed separately. Thereafter, the assessment will be more general and comprehensive.

There are different ways of including natural resources into the urban development/environment cycle: as raw material, as an urban waste sink, or as territorial support.

Data related to the state (qualitative and quantitative) of these resources show, therefore, the result of this interaction from the environmental point of view and the quality of life of the people that depend on these resources.

ATMOSPHERE

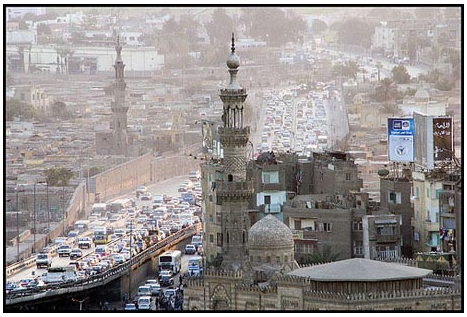
No natural resource that is less restricted to a locality than the atmosphere; however, measuring local air quality[26] is basic to assessing urban environmental quality and quality of life. A drop in air quality has environmental, social and economic implications; its consequences are long term and may be irreversible, as in the case of loss of biodiversity, or the impact on the health of children and the elderly (respiratory diseases that may even cause death).

Although atmospheric pollution is one of the harshest demonstrations of poor environmental quality, it is a secondary priority in the Arab region, with the exception of some mega cities such as Cairo.

Indicator

Air quality (CO, NOx, SOx)

The easiest to obtain direct data on air quality in cities are related to the concentration of particle material and motor vehicle emissions. In recent decades, industries have reduced their emissions of polluting substances into the air, mainly locally, because of improved production technologies and changes in urban activities (increasingly more so in the service sector). Vehicular emissions have a large share in the responsibility for polluting the atmosphere everywhere.



Cars and freeways are cutting through Cairo. Photo by seyerce from Flickr.

"According to the World Health Organization, the average resident of Cairo ingests more than 20 times the acceptable level of air pollution a day." Cobban, Helena, Nov 30, "Walking Like An Egyptian in Cairo," The CityFix, Exploring Sustainable Solutions To The Problems of Urban Mobility, thecityfix.com/walking-like-an-egyptian-in-cairo/ The Times Top 50 Eco Blogs, (accessed 28 June 2008)

Other indexes may be added according to local conditions. For example, emissions of ozone-depleting gases, measured by the production and consumption of the fluorocarbon family of gases (CFCs), or the concentration of tropospheric ozone that has a direct impact on human health.

[26] That is, in the territorial origin of the emissions (tailpipe or smokestack, the geographic localization of chimneys). Air quality is expressed also in regional and global plans for the presence of pollutants from transport and industry that cause acid rain and concentrations of gases that, in turn, cause the effect.

WATER

Water is essential to the life of species, ecosystems and societies. As a resource, its main uses are domestic and industrial, energy generation, transport and even for recreation. For the environment, it is a vital resource for natural cycles of ecosystem renovation.[27]

Indicator

Water supply quality is measured by the biological demand for oxygen, BOD and the concentration of faecal material.

The complexity of urban environmental management is made very evident when analysing the state of water. Shortage of water is a threat to many populations throughout the non-industrialized world, particularly those of the Arab region

Urban demand for water is mostly for industrial and domestic use. To assess the resource, consideration must be given to quality of supply, availability and access, as well as the replenishment capacity of bodies of water. The analysis considers the source (surface and ground water), the type (freshwater, brackish and salty) and the ecosystem (coastal zones, mangroves, lakes, rivers, and others).

Surface and groundwater, in addition to desalination are among the main sources of water supply in Arab cities. Analysing salty and brackish waters is also important to indicate the state of the general ecosystem which supports survival of species and essential economic activities in many cities of the region, in particular coastal cities.

SEWAGE AND SANITATION

Lack of sanitation is one of developing countries' most frequent urban-environmental problems. Although the problem of access to the resource has been solved in many cities, it is another matter when it comes to focussing on areas without a supply or drainage treatment. The most serious problems are pollution from untreated domestic drains, dumping sewage and industrial effluents into bodies of water, salinity and erosion.

Indicator

Shortage of water (frequency, extension duration) considered in to assessing availability of water according to seasons, duration and extension

Data on freshwater quality and availability are, consequently, highly relevant for urban environmental management, in particular in coastal zones, on the banks of rivers and in mangroves – ecosystems that shelter urban populations and are directly sensitive to water quality.

Dumping untreated domestic drainage effluents into bodies of water is a serious source of biological pollution that can affect human health. The most frequent health example poor Arab cities is infant mortality caused by water-borne diseases from contact with water polluted with faecal material.

The water quality indicators, already internationally established, may be applied with confidence to all human settlements. These include Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand or Biological Oxygen Demand (BOD), and others.

Other indicators of the third type (local) must be identified locally, according to the administrator's need to attend to the city's specific conditions, its activities and ecosystems. In the case of marine

[27] The water resources management theme has implications in all types of territories and is related to environmental themes such as climate change, biodiversity, human health and changes in land use.

ecosystems (coastal zones and islands), for example, indicators on the degree of pollution on beaches and salinity must be broadened.

LAND (SOIL)

From the urban development point of view, soil problems are revealed by how it is used, its distribution, and degree of impermeability (impassable), level of solid waste pollution and eroded areas. As a natural resource, the soil provides raw material and support for other biosphere systems and environmental services, such as drainage. Change in urban land use may have serious environmental, social and economic impacts. As human settlements expand uncontrollably into natural areas adjacent to cities, the quality of the land deteriorates, together with the other elements of ecosystems, causing landslides, erosion and pollution of bodies of water.

The most frequent forms of land change relate to:

a) An increase in vulnerability to natural disaster risks such as landslides and flooding due to its basic physical-chemical structure (gradients, porosity or compaction) and the loss of vegetation, which removes an important containment element;
b) Pollution from chemical products dumped directly or as the final result of grease-producing solid waste (effect of decomposing organic material in waste without proper final disposal);
c) Loss of biodiversity directly related to the uncontrolled occupation of the land, linked to deforestation, the reduction of vegetation and pollution.

To assess the condition of urban land, consideration is given to the most relevant aspects of the "basic basket" of indicators, to data on geologically unstable or risk areas occupied. In this case, these occupied areas provide the municipal administrator with a panorama that includes the city's social, environmental and economic aspects, thus contributing to a more in-depth analysis of subjects such as poverty, social inequity, civil defence and the health system's response capacity.

SOLID WASTE

Solid waste is perhaps the greatest source of environmental land pollution,[28] both industrial (over which there is more control at the source) and domestic (that represents the largest volume sent to rubbish dumps and landfills).

Indicator

Percentage of geologically unstable areas (risk areas) occupied

In many Arab cities, the composition of garbage has changed in recent decades, accompanying the growing consumption of industrial products. Garbage has gone from being organic and compact to be of greater volume and non-degradable, with large amounts of plastic and metals. Improvements in lifestyles are in direct proportion to the volume and composition of urban waste.

Cities in developing countries are assimilating the patterns of globalization without the authorities being able to administer the consequences of such changes. The lack of administration capacity results in improper waste disposal, in soil, water and air pollution, as well as severe impacts on the quality of life and health, above all in low-income groups.[29]

As production of waste increases, more garbage collection is needed, but the most serious problems are how to dispose of it. Most solid waste is deposited untreated in open-air "garbage dumps",

[28] GEO 2000 Report, over the past three decades production of solid waste per inhabitant rose from 0.2 to 0.5kg and from 0.5 to 1.2 kg per day per inhabitant (UNEP, 2001:51).
[29] The international reference classification for solid waste is: hazardous (class 1), non-hazardous (class 2), and inert (class 3).

causing serious environmental damage – pollution of soils and aquifers – to the quality of human life. A small part of the waste is sent to sanitary transfer stations where it can be separated according to type, and properly stored, thus controlling its impact on the environment.

Principal Solid Waste Final Disposal Destinations

Authorities in poor countries generally treat the disposal of solid waste with conventional solutions, such as open-air garbage dumps or deposits without any treatment.

Local garbage dumps are unhealthy, focal points for urban pests (rats, cockroaches, and mosquitoes), unsafe, they attract garbage collectors, including children, seeking a means of survival. The grease pollutes the soil and bodies of water. Another recurring risk is the clandestine discharge of toxic waste from industry, agriculture (pesticides), minerals (lead), and hospitals (infected or hazardous material). Methane gas is also produced that may cause explosions and make matters worse.

The most common solution used for controlled systems is sanitary disposal in sanitary landfills with a protection system consisting of:

- ✓ Waterproof layer to avoid grease pollution;
- ✓ Drainage and treatment of grease;
- ✓ Harvesting, burning and storing methane gas.
- ✓ For safety, landfills must be located far from areas where there are springs and close to clayey soils.

Incineration is another alternative in cities where there is little space available, or for hospital waste. Burning is at very high temperatures (over 1200˚C), and filters must be used for particle material. The risk is that toxic substances may be released into the atmospheres (dioxins and heavy metals) and uncertainty about the contents of the emissions. The ashes are toxic and the filters are of doubtful efficiency. It is a very expensive process.

In 2008, Dubai Municipality revealed it was studying a AED20 billion household waste-to-energy programme to incinerate municipal solid wastes to meet as much as 5% of Dubai's electricity requirements. (Source: Arab Urban Development Institute, Hot topics, http://www.araburban.org/AUDI/English/Focus_en/FOC1704080120GG.htm (accessed Monday, 19 May 2008)

MARINE AND COASTAL RESOURCES

The Arab region has extended coastal areas along major international water bodies, such as the Atlantic Ocean, the Mediterranean, the Red Sea and the Arabian Gulf. Many of Arab cities, such as Alexandria and Aden, developed as ports on the route for international trade. The transformation of these coastal areas is mainly due, in part, to human activities that change land use for urbanization, tourism and agriculture.

Human intervention disturbs the hydrological cycle, destroys natural breeding grounds and alters coastal systems' morphology with constructions and discharges of industrial and domestic waste.

Pressure is put on these ecosystems by human activities that are both economic and directly physical. Especially important economic activities include marine fishing and tourism. Maritime transport is expanding and causes direct and indirect degradation of the systems.

Cities add to the degradation of coastal zones by occupying mangroves, coral reefs and estuaries, harming their ecosystems' environmental services. Coastal areas such as bays, beaches and estuaries, provide protection against flooding, storms and erosion, filter bodies of freshwater that flow into the

sea, inhibits salinization, store and circulate nutrients and support the survival of innumerable marine and aquatic species that provide subsistence for the communities themselves.

Vulnerability to natural disasters increases with the occupation of risk areas and with human activities. The risk increases as urban populations become established in these areas.

Urban activities that degrade the environment, such as deforestation for urbanization, bring soil erosion and the production of sediments that are frequently deposited in coastal zones. Releasing untreated sewage through the drainage system that runs directly to the sea is a common practice in coastal cities in the Arab region

BIODIVERSITY

Biological diversity is one of the main resources of the Arab region where there are very particular ecosystems. Biological diversity is associated with the survival of urban communities and centres. In fishing, for example, quality depends on the guaranteed environmental biological diversity of mangroves and coastal ecosystems.

Although conserving biodiversity is most important nationally, regionally and globally, breaking up natural forest areas (restricting species and limiting their sustainability) also begins with urbanization. Urbanization poses a threat to biological biodiversity through deforestation, excessive fishing, introduction of exotic species, polluting air and water, and occupying risk areas thus increasing the vulnerability of endangered species.

Indicator

Extinct or endangered species; and known species, measured by the number of known endangered species in the local environment. These numbers are often found for large ecosystems. They may be broken down for the local level and completed with specific local information (such as the disappearance of a fish species or the proliferation of the pest whose predator is no longer present).
It is a transversal indicator that will help the impact and response analyses.

FORESTS

Destroying natural habitats not only harms resources but, as a chain reaction, the region's entire systems. Deforestation increases erosion, puts rivers at risk and disturbs the hydrologic cycle, as well as resulting in a loss of flora and fauna.

In Arab countries, deforestation originated in land use changes to expand agriculture and build human settlements. Ecosystems are broken up to permit urbanization in many areas of the region.

Removing vegetation and waterproofing the soil harms the microclimate and makes flooding, landslides on gradients and the loss of biodiversity more likely.

Indicator (Transversal):

Reduction of vegetation.

Green areas directly regulate air quality, temperature and noise. The size of green areas per inhabitant is one measure of the quality of life and human health (the World Health Organization recommends 12m^2 of green areas per inhabitant in cities).

To make forestry and urban systems compatible is a challenge to the administration. Therefore, the GEO Cities Report measures vegetation (forests, planting trees in the urban zone, green areas and original species) in urban centres.

The team responsible for elaborating the report should check how the existing vegetable mass is distributed, so that the indicator effectively reflects the quality of urban life. Most of the city's remaining vegetation tends to be concentrated in the finest urban areas or those inhabited by the wealthiest groups.

CLIMATE CHANGE AND VULNERABILITY

What is happening? What is happening to the environment resulting from climate change? This subsection attempts to answer these questions. The IPCC, in its 2007 Fourth Evaluation Report, recognizes that the vulnerability associated with climate change of sectors such as industries, settlements and societies[30] is closely associated with the extreme events that occur than to gradual variations in climate.

These sectors or systems generally adapt to variability in environmental conditions and, to a certain degree, are more resilient when these changes are included in their natural (normal) variability. But when the environmental changes are more extreme or persistent than those to which the systems or sectors normally adapt, this can lead to vulnerability.

Some authors have expressed concern over the occurrence of possible abrupt climate changes (Schneider et al 2007). An accumulation of gradual changes in a complete system can reach a tipping point that causes a sudden change, above which the natural or human system becomes overburdened and cannot adapt to change.

The IPCC (2007) report postulates that climate change is possibly, what is interacting with, (and possibly exacerbating), the climate changes that are occurring, as well as the current environmental pressures on human settlements. Briefly, climate change is not the only stress that affects human settlements (cities) but it certainly interacts, in synergy, with other existing pressures.

The increase in greenhouse gases of anthropogenic origin in the atmosphere brings about change in a number of climatic and non-climatic variables in the biosphere, with marked impact on the cities. These variables are:

1. Sea-level rise
2. Average increase in global temperature
3. Changes in rainfall distribution and quantity
4. Increase in the frequency and/or intensity of extreme events

1. RISE IN AVERAGE GLOBAL TEMPERATURE

There is total agreement in the literature to the effect that the average global rise in temperature constitutes one of the major sources of vulnerability associated with climate change affecting cities. The constant increase in the average global temperature variable constitutes for the cities, now and in the future, a thermal vulnerability associated with temperatures that they must deal with.

In the period 1996-2005, the average global temperature rose by 0.76% (0.56- 0.92) ^{0}C, prompting the IPCC (2007) to project, by 2099, an increase of 1.8 (1.1- 2.9) ^{0}C for the lowest scenario and of 4 (2.4- 6.4) ^{0}C for the highest scenario.

[30] See IPCC (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate* Change. M.L. Parry, O.F. Canziani, J.P. Palutikov, P.J. van der Linden and C.E. Hanson, Eds. Cambridge University Press, Cambridge, UK, 976 pp.

Science is currently able to predict with greater accuracy the future trends and expected results of the impact of climate change on temperature and sea-level rise. To the contrary, other variables such as precipitation, wind, extreme events such as hurricanes, for which, even though projections have been estimated. These were not as detailed and precise for the first two variables mentioned before. Since 1970, there have been more occurrences of heat waves that are closely linked to average temperature rise. Thermal vulnerability or vulnerability linked to:

State indicators linked to forest fires:

- Areas in the city or its environs (hectares) with forests or other types of vegetation that are likely to catch fire.
- Report of fires occurred in the city or surrounding areas over the past five years.
- Intensity of these fires.

State indicators linked to the retreat of mountain glaciers:
Identification of mountain glaciers that are of relevance to the city
Evolution of the glaciers identified in the last two decades

State indicators linked to urban heat islands:

- Records of temperature – average, maximum, minimum. Frequency of thermal events.
- Percentage of green areas (with trees and gardens) in the city. Distribution of these areas.
- Climatic zoning (largely temperature-related) of the city.
- Architectural regulations regarding the distribution of green areas, frontage materials, etc.

URBAN HEAT ISLANDS

There is consensus in the international scientific community (see IPCC, 2007) that the so-called urban heat islands are increasing in number and intensity. These heat islands occur in urban areas where temperatures are higher than in the surrounding rural areas. It is the result of the daily cycle of absorption and subsequent re-radiation of solar energy received as well as the thermal properties of the buildings, streets, sidewalks etc. that abound in cities, which are quite different from the vegetation that grows in rural areas, among other causes.

The reasons that condition the heat islands are complex and are linked to the interactions between the atmospheric processes at different levels. Not all urban zones are identical, neither do they have the same density of construction, tree-lined areas nor gardens.

In cities located in temperate or polar zones, and in some settlements in polar zones during the cold period of the year, the presence of polar heat islands moderate the temperature. In polar zones, during the summer, the significant increase in temperature on the land can cause melting of the ice crusts.

RETREAT OF MOUNTAIN GLACIERS

The increase in average air temperature is already causing the retreat of high mountain glaciers at median and tropical latitudes. Many tropical glaciers are expected to disappear in the upcoming decades.

FOREST FIRES

A rise in temperature, especially at certain periods of the year, added to a shortage of water, whether seasonal or as a result of drought, facilitates the occurrence of fires among the vegetation of the city and its environs, with loss of species and ecosystems, as well as damage to city infrastructure.

Although this phenomenon may be present in any of the zones analyzed where cities are located – mountains, mega-deltas, low-lying coastal areas and riverbanks, temperate zones among others, it will occur more frequently in arid or semi-arid zones.

URBAN ATMOSPHERIC POLLUTION CAUSED BY CLIMATE CHANGE

With respect to *air quality,* it is not yet clear what role climate change plays in its pollution; however, it is thought that temperature rise aggravates pollution by increasing the presence of ozone (O_3) in many cities.

Increased pollution caused by this gas will occur in cities that are already impacted by this phenomenon due to an elevated flow of traffic, the presence of polluting industries in the city (or its environs), or specific geographical conditions that cause the gas to form and settle above the city.

Examples of indicators of vulnerability associated with changes in the distribution and quantity of rainfall:

- Record of maximum and minimum rainfall, spatial distribution of rainfall, annual pattern
- Location for the city in zones with a propensity for drought
- Location of the city in zones with a propensity for heavy rainfall

- Percentage of land located below, at sea level or at sea levels lower than those projected for the next few decades
- Record of lea-level rise.
- Frequency of occurrence of events that push the sea towards the city.
- Amount of land affected Length of city coast Loss of ecosystem area, loss of species, lost or degraded environmental services

2. Average sea-level rise

In the literature reviewed on climate change, it is recognized that one of the major sources of vulnerability of many human settlements (cities) is sea level rise. It is well known that it increased by an average of 1.8 mm per year in the period 1961-2003 and by 3.1 mm per year between 1993 and 2003. Forecasts by the IPCC (2007), excluding the rapid dynamic of ice flows, project an average sea-level rise of 0.18 to 0.59 metres for the year 2099. This elevation constitutes a permanent source of vulnerability associated with sea-level rise for coastal cities.

Vulnerability associated with sea-level rise

Climate change causes sea level rise that affect natural coastal systems, such as wetlands, coral reefs, marine pastures and beaches, etc. SLR causes loss of biological diversity and deterioration in the eco-system services, such as the supply of food (fish, crustaceans, molluscs, etc.), reproduction areas of many marine species and services such as coastal protection against extreme events, conservation of carbon and water purification. Sea-level rise is also causing damage to the use of land and damage to the infrastructure of many cities with low coastal areas and mega-deltas.

Examples of indicators of vulnerability associated with changes in the distribution and quantity of rainfall:

- Record of maximum and minimum rainfall, spatial distribution of rainfall, annual pattern
- Location for the city in zones with a propensity for drought
- Location of the city in zones with a propensity for heavy rainfall

3. Changes in the quantity and distribution of rainfall

Changes in the distribution and quantity of rainfall constitute another of the main sources observed and projected that create vulnerabilities in cities, giving rise to vulnerabilities associated with precipitation. The IPCC (2007) postulates that between 1900 and 2005 rainfall increased significantly in the eastern regions of North and South America, Northern Europe as well as North and Central Asia. However, there was decreased rainfall in the Mediterranean, West Asia regions. Moreover, since 1970, there has been an increase globally in the areas affected by drought as well as intense rainfall.

Vulnerabilities associated with rainfall

a) Increase in rainfall

In certain regions, there has been a *marked increase in rainfall* caused by climate change and this trend is expected to continue as climate change worsens. Rainfall will increase particularly in several humid zones and, in many cases; this will be beneficial for the cities located in those regions. *Urban flooding* can constitute a serious problem in cities that lack, or have insufficient infrastructure for drainage of residual and rainwater. Many cities situated in mountainous regions or near geographic accidents are subjected to direct risks of landslides or rupture of dykes caused by intensification of rainfall. This rainfall can also cause flooding, especially in cities situated on riverbanks, in mega-deltas or in low-lying areas.

Examples of state indicators associated with vulnerability to increased rainfall:

- Low-lying areas of the city subjected to flood risk, flood floods or landslides (% of total city area)
- Coverage of drainage infrastructure in the city
- Frequency of flooding occurrence
- City areas permeable to drainage of surface water. (non built-up areas, unpaved areas, green areas)
- Record of level of water in the river
- Record of rainfall in the hydrographic basin

B) Reduction in rainfall

There is scientific agreement that climate change is *reducing the rainfall patterns* in arid and semi-arid zones and this decrease will continue and may even lead to a crisis in the cities located in these zones. It is very likely that periods of drought will be more frequent and prolonged.

Examples of state indicators associated with vulnerability because of reduced rainfall:

Water scarcity (frequency, extension and duration)
Frequency and duration of drought

4. Increase in the frequency and/or intensity of extreme events

An increase in the frequency and or intensity of extreme events is the main cause of the increase in the cities' vulnerability to climate change (IPCC 2007).

These extreme events result in disproportionate increases in the variables previously mentioned (temperature, rainfall, sea-level rise), which may occur alone or together, or with or without other climatic variables, but always in a harsh and intense manner over shorter intervals of time.

These extreme events are occurring with greater frequency and/or intensity and in many cases; the scientific community is attributing this behaviour largely to climate change. This source causes *vulnerability of cities as a result of extreme events.*

Vulnerability associated with extreme events

Increased intensity and/or frequency of extreme events already constitutes, and is expected to continue in the future, to be the main cause of vulnerability of cities to climate change. Historically, these urban systems may or may not have been subjected to the effects of extreme events, but what is being analyzed here is the vulnerability of cities to the intensity and/or frequency of these events, as a consequence of climate change.

Examples of state indicators associated with vulnerability to extreme events:

- Historical records of extreme events. Type, magnitude, size of city area affected.
- Location of the city in zones with a propensity for extreme events

Sandy storms and heat waves are an excellent example of extreme events, the intensity of which have increased because of climate change and are expected to continue to do so in the future, although it is not certain that they will increase in frequency. These events can affect cities located in coastal areas, on riverbanks and in mega-deltas as a result of intense waves and sea surges.

Other extreme events exacerbated by climate change are severe storms, intense heat waves, heavy rainfall, massive fires, storm surges, intense flooding and landslides caused by severe humidification of the land due to rainfall or flooding.

None of the cities located in mountainous, temperate, polar, arid or semi-arid zones, river banks, low-lying coasts and mega-deltas has escaped the impact of one or more of the extreme events previously-mentioned. Their vulnerability may vary based on their geographical location and the individual characteristics of each type of extreme event.

The extreme events associated with climate change present particular challenges for cities, especially when it is borne in mind that many of these cities are experiencing rapid urbanization in areas situated in coastal zones, close to slopes, in gullies and in other areas that are permanently at risk, or zones that are susceptible to flooding or landslides.

BUILT-UP ENVIRONMENT

It refers to urban areas with buildings of great historic or architectural importance. As it is a negative indicator that assumes recognition of a state of degradation of something of great value and that may be considered as a heritage, it is important that other indicators be considered in an overall analysis so that the indicator is assigned its proper place in the general assessment.

At this stage of the analysis, a summary should be presented on the general conditions of the local environment, assessing each element and the relations between ecosystems and urban activities.

It is important to use transversal indicators to establish these relations, both between the elements of the urban environment and between the different levels of analysis within the pressure-state-impact-response structure.

This evaluation will be the instrument that combines public sectoral policies and demonstrates the consequences that partial measures have on the city as a whole. It will help to take an integrated approach to environmental management.

On the built-up environment the relevant themes are:

- The quality of the built-up environment, shown by the state of conservation of the urban landscape and its buildings;
- Cultural, architectural and historic heritage of individual buildings and groups of buildings;
- Urban infrastructure and services.

The analysis of the built-up environment is complex because it involves the economy (deterioration of the historic heritage), social inequity (migration) and quality of life (urban landscape and efficient basic infrastructure).

Neglect of this aspect in the Arab region leads to cities with no character where the inhabitants are out of touch with the environment. Cities that invest in maintaining or rescuing the quality of the built-up environment make direct contact with the inhabitants, allow them to identify better with the quality of urban life and arouse their interest in environmental matters relating to local urban development.

Indicator (Transversal):

Percentage of degraded areas (historic centres or constructions) in relation tothe total built-up area of the city.

FIGURE 6 SANA'A YEMEN

Shoppers gather at the main entrance of Souk al-Melh (Salt Market) in the old eastern section of the city of Sana'a, capital of the Republic of Yemen. Located about 145 km (90 mi) northeast of the port Al Hudaydah on the Red Sea, Sana'a serves as an important trading centre for the nation. An ancient city, it first became significant in the 4th century AD as part of the Kingdom of Himyarites, and retains much of the its unique traditional architecture.
Source: Encarta Encyclopedia
Noboru Komine/Photo Researchers, Inc.

DEFINITION OF CORE INDICATORS: STATE INDICATORS

AIR QUALITY

Resource: Atmosphere
Type of indicator: STATE
Category: Core
Source: CEROI

Justification: What does it mean and why is it important to measure it?

Air quality is negatively affected by emissions from fixed and mobile sources, directly linked to energy consumption, environmental policies, urban density, motor vehicle transport and concentration of industries. Concentrations of pollutants have serious effects on human health, vegetation, constructions, monuments and cultural heritage.

How is it identified? Necessary data

Number of days in which the World Health Organization (WHO) or local standards are exceeded as to SO2, O3 CO, NO2, black smoke, MP, Pb. This indicator should be calculated every year.

Measurements and units

Number of days per year when the air quality standard monitored in the city does not meet each standard in the above-mentioned list (number of yearly violations of the standard)

Possible time and space formats

Graphs, trend charts

Methodological resources reference

- ✓ UNCHS. http://www.urbanobservatory.org/indicators/guidelines/comprehensive/
- ✓ WHO, 1997. Healthy Cities Indicators: Analysis of Data from Cities Across Europe.
- ✓ EEA, 1998. Assessment and Management of Urban Air Quality in Europe.
- ✓ OECD, 1999. Advanced Air Quality Indicators and Reporting: Methodological Study and Assessment. EC, Directorate General Environment, Working Group of the Expert Group on the Urban Environment, 2000. Towards a Local Sustainability Profile – European Common Indicators. http://www.sustainable-cities.org/indicators/

Objectives

Reduce atmospheric pollution and its effects on health, water and soil.

Goals, reference values

WHO Guidelines for Europe, in 1996: NO2 (200 ug/m^3, 1 hour), CO (30mg/m^3, 1 hour, 10 mg/m^3, 8 hours), SO_2 (125ug/m^3, 24 hours, 50 ug/m^3 1 year), O_3 (40 mg/m^3, 1 year; 200 mg/m^3, 1 hour), lead (0.5 mg/m^3, 1 year). More information on the WHO Guidelines available at: http://www.who.org/peh/air/airguides2.htm

WATER SHORTAGE (FREQUENCY, EXTENSION, DURATION)

Resource: Water **Type of indicator: STATE** **Category: Core** **Source: OECD,**
Justification: What does it mean and why is it important to measure it? The main urban environment hydraulic resources concern is the inefficient use of water and its consequences: shortages, salinization in coastal areas, drought, and human health impact. It is essential to guarantee sustainable administration if overexploitation and degradation of water resources in cities are to be avoided.
How is it identified? Necessary data To assess the state of water in terms of quantity and availability, account is taken of the frequency, intensity and duration of water shortages. The indicator is related to supply sources, including those outside the urban territory, and may be obtained from the local or regional water supply authority. It is also reflected in how authorities responsible for administration perform and how users behave. Water supply policies and how they are applied in a given period shows how much water is available for the city. Although this is quantitative, the information should be associated with pressure and response indicators that assess water quality, the population with access to water supply and treatment, intensity of use and the size of the local water supply basin. Charges for water should also be considered when analysing this resource.
Measurements and units Index calculated on the basis of annual water shortages, duration in number of days per year and percentage of the population affected by supply, measured over a given period.
Possible time and space formats Tables and graphs to indicate changes over time, from year to year.
Methodological resources reference OECD, Key Environmental Indicators, 2001
Objectives To guarantee sustainable management of the resource, implying reducing waste and the inefficient use of supply and treatment technology, recycling effluents and integrating water basin administration. The OCDE recommends the polluter-payer principle for water use be applied.
Goals, reference values Agenda 21, chapter 18; WHO, data on water supply and consumption per capita; local reference values available from bodies responsible for water supply, both locally and regionally.
Application examples There are no systematized examples for the urban environment.
Other comments/context Water use also depends on cultural characteristics, habits and customs. The natural availability of the resource, according to geographic and climate conditions, varies greatly from region to region, and from city to city. The most important reference is local, although some minimum global values may, of necessity, be considered.

WATER SUPPLY QUALITY

Resource: Water
Type of indicator: STATE
Category: Core
Source: UNCSD, CEROI

Justification: What does it mean and why is it important to measure it?

Percentage of freshwater with concentrations of faecal material bacteria above the levels recommended by the World Health Organization (WHO). The indicator assesses the quality of water supplied to communities for their basic needs. It identifies the localities where water from the supply network source has health threatening faecal pollutants.

How is it identified? Necessary data

Microbiological testing of water to detect Escherichia coli and streptococcus bacteria. The results are generally found in the authorities' laboratory records or in those kept by authorized testing agencies or institutions. The microbiological quality of water is measured as a relation between the number of water analyses and the results of the faecal material/100 ml above zero and the total number of samples analysed.

Measurements and units

Microbiological quality: (Percentage of samples analysed with the results of faecal material) Number of days standards are exceeded.

Possible time and space formats

Graphs, trend charts.

Methodological resources reference

- ✓ World Health Organization (WHO)
- ✓ United Nations Human Settlements Centre (Habitat)
- ✓ Food and Agriculture Organization of the United Nations (FAO)

Objectives

Combat drinking water pollution and damage to health – infant mortality due to diarrhoea – and to the environment.

Goals, reference values

WHO; National standards

Application examples

Quality of water supply in Prague: http://www.ceroi.net/Reports/prague/issues/Water/state.htm

Other comments/context

Although reference is made to drinking water, the principal type of water consumed by living creatures including human beings, faecal material pollution is also found in oceans and seas which are usually important sources of recreation and food supply for coastal cities. Therefore, the same indicator used to assess the state of the environment of these cities, may be applied in analysing salt-water quality.

PERCENTAGE OF GEOLOGICALLY INSTABLE AREAS OCCUPIED (RISK AREAS)

Resource: Land , water, biodiversity, built-up environment **Type of indicator: STATE** **Category: New** **Source: UNCSD**
Justification: What does it mean and why is it important to measure it? Accelerated urban growth with high levels of social inequity, is usually accompanied by occupation of risk areas, that is to say, areas that are most vulnerable to destructive natural events such as landslides and floods, putting the inhabitants' lives at risk. The indicator, therefore, may give an idea of the natural and social risks in a given locality.
How is it identified? Necessary data Aerial photography is an important instrument to define risk areas in each city; if data taken from the air are not available, geological maps and studies of the city may also be a good source of information for this indicator.
Measurements and units Percentage of risk areas measured in km^2.
Possible time and space formats Maps, graphs, trend charts.
Methodological resources reference ✓ UNCSD – Consult indicators that measure similar problems: ✓ Human and economic losses caused by natural disasters; ✓ Area and population of urban legal and illegal settlements.
Objectives Cooperation to reduce social and environmental vulnerability in the city's risk areas.
Goals, reference values There are no established reference values – New indicator.
Other comments/context Reducing social and environmental risks by lowering the occupation rate in areas vulnerable to natural disasters is important in reducing social inequity and building sustainable development in urban centres

POLLUTED SITES

Resource: Water **Type of indicator: STATE** **Category: Core** **Source: UNCSD, CEROI**
Justification: What does it mean and why is it important to measure it? The indicator shows us, even though indirectly, the level of pollution in the environment. Pollution affects human health and the environment itself, causing biodiversity impoverishment.
How is it identified? Necessary data Number and area of spaces recognized as polluted (total, new and rehabilitated).
Measurements and units Spaces polluted (total, new and rehabilitated) (Number of spaces, area)
Possible time and space formats Trend charts, maps, charts
Methodological resources reference New South Wales Environment Protection Authority, 1997. The Future of NSW State of the Environment Reporting: Discussion Paper, NSW Core indicators. http://www.epa.nsw.gov.au/soe/issues/paper.htm
Objectives Decontaminate spaces and improve the environment.
Goals, reference values In Europe, there are dispositions in force on: implementing an integrated and effective network of installations to eliminate waste (Dir. – Table, art. 5); separately disposing of batteries that contain hazardous substances (Dir. 91/157, art. 6); ensuring the safe combustion of residual oils and, when that is not feasible, ensuring their safe destruction or storage (Dir. 75/439, art. 4); prohibiting the disposal of printed circuits in any way not environmentally safe.
Other comments/context Polluted spaces may cause serious problems so that continuous monitoring is required. Indicators on the number of spaces and cleaning programmes in themselves say little about the problem of soil and environmental pollution. Pressures are difficult to distinguish considering the broad range of sources and the types of existing pollution; it might still be helpful to measure the use of pesticides as an indirect indicator of pollution.

VEGETABLE COVER

Resource: Biodiversity, Land , Water, Atmosphere **Type of indicator: STATE** **Category: Core, Transversal** **Source: UNCSD, CEROI**
Justification: What does it mean and why is it important to measure it? Forests with natural or planted vegetation, parks, green areas and spaces perform a primary role in the urban environment. (In hot arid zones, green areas adjacent to or within the urban district provide an essential environmental service by making the microclimate more agreeable, filtering and retaining rainwater, placing a natural control on floods, as well as providing the habitat for a varied urban fauna.
How is it identified? Necessary data Surface in hectares and percentage of the city's total area for each category of vegetable cover. In some cities with significant extensions of natural forest, a distinction may be made among the existing ecosystems (for example: rainforests shrub, mangroves, savannas).
Measurements and units Surface in hectares and percentage of the total city area in each category of vegetable cover.
Possible time and space formats Graphs, tables and trend charts.
Methodological resources reference ✓ World Conservation Union (IUCN) ✓ World Resources Institute (WRI) ✓ OECD, 1997. Better Understanding Our Cities: The Role of Urban Indicators, EEA Indicator Set
Objectives Provide the number and possible extension of a city's green areas.
Goals, reference values There are no specific international reference values.
Application examples "The Green City of Seville", Spain: http://www.bestpractices.org/cgi-bin/bp98.cgi?cmd=detail&id=2702
Other comments/context Green spaces in urban areas are extremely important for recreation and, in general, to improve the quality of life. Pressure on biodiversity comes from different interrelated sources, mainly land use changes, pollution and the introduction of exotic species

EXTINCT OR ENDANGERED SPECIES/KNOWN SPECIES

Resource: Biodiversity
Type of indicator: STATE
Category: Core, Transversal
Source: UNCSD, OECD, CEROI

Justification: What does it mean and why is it important to measure it?

Number of endangered species as a percentage of known local species. Species diversity is one of the three main levels of biodiversity, the others being diversity of ecosystems and genetic diversity. Birds in cities are a good indicator of biological diversity.

How is it identified? Necessary data

It is necessary to select all the classes whose number of local species are known (or may be estimated) and whose state is periodically monitored or assessed. For each class, a calculation must be made of local endangered species and the information compared with the number of corresponding local species. The indicator refers to species of flora and fauna. It is necessary to calculate:

- **a)** Percentage of endangered species of plants, total of all classes;
- **b)** Percentage of endangered species of each class of plants;
- **c)** Percentage of endangered vertebrate species, total of all classes;
- **d)** Percentage of each class of endangered vertebrate species.

The sub-indicators a) and c) provide a general view of the situation of plants and animals. The sub-indicators b) and d) show the most endangered classes.

Measurements and units

- ✓ Percentage of local endangered fauna and flora species, every 5 or 10 years.
- ✓ Total number of local fauna and flora.

Possible time and space formats

Graphs, tables and trend charts.

Methodological resources reference

- ✓ World Conservation Union (IUCN), World Resources Institute (WRI)
- ✓ OECD, 1997. Better Understanding Our Cities: The Role of Urban Indicators, EEA Indicator Set

Objectives

Reduce the danger of species of flora and fauna disappearing as a result of urban environmental pressure.

Goals, reference values

There are no specific international goals or reference values. References are established locally or regionally. United Nations Convention on Biodiversity (Rio, 1992), EEA, 1997. Indicators for Sustainable Urban Development: Indicators of Urban Patterns. International Institute for the Urban Environment.

Other comments/context

Endangered species are understood to be those threatened with extinction and are classified as those in danger, vulnerable, rare and undetermined, according to the World Conservation Union definitions.

PERCENTAGE OF DETERIORATED AREAS (HISTORIC CENTRES OR BUILDINGS) IN RELATION TO THE BUILT-UP URBAN AREA

Resource: Built-up environment, Land **Type of indicator: STATE** **Category: New**
Justification: What does it mean and why is it important to measure it? Percentage of built-up areas in poor condition because of the inhabitants' lack of care and the type of activities in the city. It is important to be aware of the degree of deterioration of buildings and infrastructure if action is to be taken to improve urban living conditions.
How is it identified? Necessary data Percentage of the deteriorated built-up area including Infrastructure (may be obtained by consulting available local urban development plans, or from censuses carried out by local administrations) as a basis for calculating land and property taxes or from research made by academic or institutional sources responsible for preparing general urban socio-economic information.
Measurements and units ✓ Percentage of the area (km2 deteriorated and total built-up) ✓ Percentage of buildings (relative number and total number)
Possible time and space formats Graphs, maps, trend charts.
Objectives Reduce deterioration of the built-up environment and help to improve the quality of life for the urban population.
Goals, reference values There are no established reference values
Other comments/context It is most important to include in the assessment of the quality of urban life, the aesthetic and functional elements affected by the deterioration of buildings and infrastructure

IMPACT OF THE STATE OF THE ENVIRONMENT

Chapter 4 of a typical GEO Cities report often includes information about the impacts caused by the state of the environment, in relation to natural ecosystems and their constitutive elements (water, air, soil, biodiversity) as well as the quality of life of the inhabitants, the built-up environment (buildings, urban infrastructure, etc.) and the economic activities that stimulate the city's development.

This information will help answer the question: *What is the impact of the state of the environment?* The impact must be taken to include vulnerability to accidents whether natural or provoked, that may be translated into quantitative data to help when analysing urban risk management. This is important for the areas of the Arab region subject to natural disasters and vulnerable to subsequent losses. For example, the effects of the tsunami of the Indian Ocean in December 2004 extended to inflict human settlements in coastal areas of both Yemen and Oman.

Dabut, Yemen (28 December 2004). A man stands among the rubble of Dabut market, Yemen. The main direct impact of the tsunami in Yemen was on the fishing sector. © Al Mahra Rural Development Project
Source: UNEP, National Rapid Environmental Assessment – Yemen, http://www.unep.org/tsunami/reports/TSUNAMI_YEMEN_LAYOUT.pdf (accessed 28 June 2008)

Impact indicators are of help in making a strategic analysis where decisions identify action and investment priorities. The impact data added to make the general analysis intends to calculate economic and social aspects and, therefore, may help policy-makers to calculate how external influences damage the environment. Next is to organize quantitative data according to subject: ecosystem, quality of life, urban economy, political and institutional level, and urban vulnerability.

To analyse the quality of life impact, the data help to make a qualitative assessment. The team should use the following impact indicators (mostly transversal) for this assessment:

- ✓ Loss of biodiversity
- ✓ Costs, including water collection and treatment; Cost of work on preventing and containing environmental risks;
- ✓ Incidence of floods and landslides
- ✓ Property value depreciation
- ✓ Deterioration of historic centres and cost of repairing monuments and/or restoring historic centres
- ✓ Microclimate changes
- ✓ Incidence of water-borne diseases; and public health cost of water-borne diseases
- ✓ Population in vulnerable urban areas
- ✓ Incidence of diseases caused by poisoning and pollution (skin, eyes, and others)
- ✓ Loss of urban attraction
- ✓ Juvenile crime rate
- ✓ Cardio respiratory disease incidence
- ✓ Tax losses

Assessing the impact will go into the detail required by the administrator. Whenever possible, the data should also consider international or national sources to guarantee that the analysis gives a comparative view.

- ✓ Impact on ecosystems
- ✓ Impact on quality of life and human health
- ✓ Impact on urban economy
- ✓ Impact on the built-up environment (urban vulnerability)
- ✓ Impact at the policy-institutional level

Indicator:

Biodiversity loss

An example of the conventional urban biodiversity indicator is the number of birds or species of birds found, which represents an important measurement of the city's environmental quality

IMPACT ON ECOSYSTEMS

The occupation of natural areas, cleared and levelled to allow urban occupation, change in land use for agriculture, dumping waste and polluting products into the environment and the consumption of different natural resources (water, minerals, plants and animals) make the growth of cities a vector of environmental impacts.

Impacts on ecosystems include the immediate or progressive destruction of native fauna and flora, by removing vegetation, introducing exotic species, levelling land in restricted areas, clearing hillsides of trees, draining lakes and rivers. Economic activities in smaller communities to extract forest products, over-fishing, and illegally settling on environmentally protected areas also have a direct impact on ecosystems. Dumping domestic or hazardous waste into water courses and unsuitable sites without any sanitary control also causes damage and soil pollution. The local urban population's demand for food changes natural areas into agricultural land.

In urban areas, modified ecosystems imply the fragmentation of natural areas and changes in the natural dynamics and original food chain, such as loss of 16 of fauna and flora.

A local analysis should include all the relevant factors considered to show the impact of urban growth on ecosystems and the local environment, directing the conclusions to indicate priority problems to be treated by local authorities.

IMPACT ON QUALITY OF LIFE AND HUMAN HEALTH (INEQUITY AND POVERTY)

The impact indicators of the quality of life mainly assess health and welfare conditions of city inhabitants.

How human pressure affects the population is expressed in the incidence of environment-related diseases. Therefore, the negative effect on labour (worsening workers' physical capacity, making it more difficult to engage in recreation and sports linked to environmental resources) and the spread of urban inequality and poverty are central to assessing the impact of the state of the environmental

Foremost among diseases that harm the quality of life are those related to poor sanitation and urban cleanliness (water-borne diseases) and to local atmospheric pollution (cardio respiratory diseases).

Indicator:

- ✓ Incidence of water-borne diseases associated with poverty
- ✓ Incidence of cardiovascular diseases caused by atmospheric pollution and urban stress
- ✓ Incidence of diseases caused by poisoning and pollution associated with soil pollution and urban degradation
- ✓ Microclimate changes, related to the city's thermal condition, good or bad
- ✓ Rate of juvenile crime in risk areas
- ✓ Population in vulnerable urban areas

Water-borne diseases appear, above all, among people with few resources living in degraded areas or with no proper urban infrastructure, perhaps in illegal settlements, small overcrowded tenements, or shelters where precarious building or environmental conditions help spread infectious disease vectors. In developing countries, recurrent environmental diseases such as diarrhoea, yellow fever, intestinal infections, tuberculosis and dehydration, are directly associated with poverty and social inequity closely linked to environmental degradation.

The main cause of these diseases is lack of basic sanitary services. Most of the settlements' inhabitants have little choice but to throw waste into the open air, into streams or clandestine connections to the rainwater network, or use community latrines septic tank systems that pollute the water deposit, exposing the population to the risk of consuming products (fish or fruit, for example), polluted by faecal material.

The result is an increase in the incidence of diseases whose costs have to be covered by public health services and causing a loss of productivity, low school attendance and high rates of infant mortality.

Chemical soil pollution also causes damage to human health. This type of pollution may originate in chemical effluents from industry, grease contained in waste matter or landfills or clandestine toxic waste deposits. Improper handling is a threat to the quality of city life.[31]

Manufacturing establishments are responsible for pollution from heavy metals. They deposit waste and effluents without any control, thus harming the health of the low-income groups living closest to industries where they look for work, because of the low cost of land in illegal plots, or who consume products polluted with heavy metals, as is the case of fish from polluted rivers, lagoons or coastal regions.

Finally, the effects of urban development on the environment in relation to the quality of local life also include the deterioration of urban environmental quality. Pockets of warm spots and in floods

[31] One of the most serious social problems is that of families who live among the cities' garbage dumps separating toxic, hazardous or organic waste. UNICEF sponsors a campaign to take children out of the garbage dumps. Even garbage collected in these countries may cause problems, since there is usually no separation made between toxic, hazardous or organic waste. The lack of sanitary control or control over the destination of the garbage stimulates improper and clandestine disposal, which in turn results in the emergence of diseases caused by poisoning and infections

are indication of environmental degradation. They result from the high extent, to which urban land is waterproofed, in pollution in areas with springs and in atmospheric pollution.

IMPACT ON URBAN ECONOMY (EXTERNAL CAUSES)

Indicator:

- ✓ Public health costs of borne diseases caused by pollution of natural resources such as water, air and soil. This is a transversal indicator.
- ✓ Cost of collecting and treating water from local drainage systems, and pollution of water used for drinking and economic activities.
- ✓ Cost of environmental risk prevention work such as containment of hillsides or gradients or channelling watercourses to prevent flooding.
- ✓ Cost of repairing monuments and restoring historic centres. This last named indicator is related to the deterioration of urban buildings caused, for example, by corrosion from acid rain, increased confusion and earth tremors in urban soil because of the increase in the number of buses, motor, cars and trucks in certain areas of the city

The state of the environment causes impacts on the urban economy and productivity in general. This is shown, for example, by how urban functions and living conditions in the most vulnerable zones produce environmental degradation (floods, erosion or soil pollution in water basins, pollution of air basins, warm spots) or by the worsening of risks to housing.

Atmospheric and water pollution or environmental disasters cause health problems that reduce labour productivity because of absenteeism due to illness. They also increase public health costs that Adopting preventive measures and proper socio-environmental policies can avoid increase in public health costs.

In the case of water in particular, the impact of heightened demand and the poor quality of water increase the costs of collection and treatment, costs that could be avoided with proper preventive, environmental education and waste control policies. Concerning the supply of water, the pressure of population growth and the increase in economic activities place demands on the natural resource and on the local government as well, obliging it to invest in collecting water from sources that are ever more distant. In many large cities, treated water ends up being used for other purposes besides human consumption, meaning much of it is wasted. As to treatment of sewage water, as the number of users increase, so do the costs of treatment. Proper handling that would reduce pollution at the origin would be a saving for the water authorities.

Loss of attraction and competition in cities that depend on natural resources, as in the case of tourism cities negatively affects the local urban economy. The data for this loss of urban attraction transversal indicator are specific to the locality and are based on its economy.

When it comes to the economic impact of the loss of biodiversity, recovering areas that are degraded or prone to disasters such as floods and landslides implies environmental engineering costs such as the building contention barriers, drainage ditches and others. These stop-gap measures end up consuming resources that could be employed in preventing these damages.

In developing countries, the poor marginalized urban population can only inhabit risk areas close to hazardous industries or on unstable land, such as outlying or hillside areas subject to flooding or landslides. They become more vulnerable to urban risks and have less access to support services in emergencies. Most developed countries are least vulnerable to the economic impact of disasters and have more effective conservation and recovery measures.

Although natural disasters cannot be avoided, their impact may be mitigated by preventive action. The incidence of floods, landslides and other disasters indicates how vulnerable the population is to risks that have social causes. Budgets for health, civil defence, environmental recovery work and others that may be applied to preventive action and urban improvement, are used to remedy situations that could have been avoided.

IMPACT ON THE BUILT-UP ENVIRONMENT (HUMAN SETTLEMENTS)

The built-up part of a city has physical and structural functions and is a basic reference for its inhabitants and their activities. This environment consists of buildings, architectural combinations and monuments, by the infrastructure itself and by urban installations in general that the local team has to consider in assessing the state of the environment.

Indicator:

- ✓ Depreciation of buildings
- ✓ Deterioration of historic centres
- ✓ Incidence of flooding and landslides

The impacts on the built-up environment refer to the cities' general living conditions and functionality and their urban landscape, conditions that are affected by events such as floods, erosion or soil pollution and hydrographic and air basins.

The degradation of human settlements includes destroying and abandoning buildings and failure to conserve the urban infrastructure, such as water supply and energy networks. A way of expressing the impact on the built-up environment is the deterioration of the historic, cultural and architectural heritage of the city, apart from the depreciation of historical buildings in some urban areas, because of the health risk represented by soil or air pollution areas or excessive noise on the busiest city centre roads. In this case, impact indicators should be locally defined and serve as a complement to other specific urban environment indicators in making a general analysis of cities. The definition criteria will be monuments of historic, cultural and architectural heritage, whether national or local, although they could also follow the UNESCO principles, in case there are no national criteria.

The impact on the urban infrastructure is now shown in costs such as the maintenance and repair of networks, in data on the property market that may indicate the loss of real estate market value in some city areas. Another important impact refers to the loss of urban attraction, related to the difficulty of attracting private investments or the influx of business or tourism that stimulates local economic growth.

Tourism is one of the main economic activities in the Arab region. Although natural areas are the main attraction, the cities directly depend on the environmental quality that guarantees that the activity will continue. The cities may also be tourist attractions or function as support for sustainable tourism. In this case, if urban environmental management is poor, the result may be negative because of the loss of attractiveness. The analysis, from the economic and social point of view, should take account of the decrease in the number of jobs, the reduction in trade and the loss to production of an economically active population.

IMPACT ON THE POLITICAL-INSTITUTIONAL LEVEL

The combination of the above impact may have a less important effect but one that tends to become central in urban dynamics since it may affect the capacity to regulate and intervene on a political-institutional level.

Recently, the Central Governments of Arab countries gave due attention to environmental matters for urban centres to develop by attracting investments, generating jobs and raising taxes. Today many Arab states are mainstreaming environmental affairs within public policies. The recent amendments to the Egyptian constitution indicated the necessity to protect the environment. The Kingdom of Saudi Arabia established a prize for environmental management.

Indicator:

- ✓ Loss of tax income
- ✓ Loss of urban attraction

Environmental subjects will not only become part of the public agenda with growing political weight, but may also seriously transform local administration and urban management. This is because of the need to consider the significance of these problems to local public management capacity.

Environmental problems increase public spending on the health sector (to combat diseases caused by poor quality water and air and by the lack of sanitation), to contain unstable inhabited hillsides and risk areas, to prevent or combat the socio-environmental effects of floods and by environmental engineering work (to solve pollution and deforestation problems). They also cause the loss of public income due to the downturn in economic activities such as tourism and services, industry and trade, affecting the local government's capacity to take action on sustainable urban-environmental management.

In spite of the possible difficulty of properly evaluating this impact, and in view of the need to develop clearer measuring instruments, it must be assessed and become a permanent part of the overall process of assessing the state of the local environment.

Climate Change and Vulnerability

Vulnerability to environmental disasters is now associated with global climate change, with reflections on human society.[32]

Items on the Brown Agenda21 in developing countries acquire more relevance since the accumulative effects of the environmental degradation that goes hand in hand with urban poverty darkens the picture. The lack of support Infrastructure (transport, hospitals, shelter and food) causes more than the expected number of natural disaster victims.

Indicator:

- ✓ Percentage of geologically unstable areas (risk areas) inhabited. The local team should also use the indicator to evaluate natural disaster vulnerability risks.

There number of reasons that accentuate urban vulnerability including:

- ✓ Economic and social concentration or discrimination (overcrowding of socially and economically vulnerable groups);
- ✓ The complexity and interconnection of urban systems (the infrastructure's dependence on and integration with urban systems);
- ✓ Locating settlements in unstable or critical areas;
- ✓ Accelerated urban environmental degradation;
- ✓ Irregular, inadequate and precarious buildings and infrastructure;
- ✓ Lack of political and institutional will;
- ✓ Lack of effective regulatory and control instruments and mechanisms on land use and occupation and on activities harmful to the environment

Poverty increases vulnerability to natural disasters. The groups most affected by disasters are usually the poorest living in run-down housing. This population is being pushed towards areas unsuited for occupation, economically marginalized, vulnerable and polluted, without proper infrastructure, and the most affected by flooding and landslides on hillsides caused by rain.

Socio-economic impacts on cities caused by thermal vulnerabilities (associated with high temperatures) linked to climate change.

One of the impacts of climate change on the human settlements in the Arab region is the negative impact on the agricultural production. An increase in temperature is bound to complicate the issue of drought, and affect the productivity of agricultural land around and within the city. This means more constraints on the likelihood to satisfy basic food needs. It also can cause unemployment in the rural areas around the city, which in turn will push unemployed labour to the city seeking job opportunities. [33]

[32] Developing countries are particularly vulnerable as stipulated by the International Panel on Climate Change (IPCC) in its third report (IPCC, TAR – WG I, 2001), due, in part, to financial, human and technological limitations to prevent and recover from the consequences of climate change impacts.

[33] CIEM, Training Manual on Vulnerability and Adaptation to Climate Change For Geo Cities, Draft 23.08.09 (Unpublished)

An increase in the average temperature in the Arab city will lead to an increase in energy consumption with air conditioning and food preservation. This will increase the demand for electric power, and will add financial burden on the family's budget. The poor who cannot afford acquiring an air condition and paying the monthly electricity bill will be subject to heat waves that can threaten their lives, particularly infants, elderly and those with chronic diseases.

An increase in the average temperature is bound to increase consumption of drinking water. There are number of implication such as placing pressure on sewerage system.

The high temperatures in cities with ozone pollution (O3), cause a rise in the content of this compound, which leads to health problems in the human population and damage to plants and animals. Cities located in all these regions, especially in arid and semi-arid regions with areas of vegetation (forests) and/or surrounded by vegetation nearby, are subjected to a high risk of forest fires caused by rising temperatures.

Examples of impact indicators caused by thermal vulnerabilities in cities:

- ✓ Increase in cases caused by illnesses transmitted by temperature-sensitive vectors.
- ✓ Increased death among persons treated for hyperthermia.
- ✓ Increase in consumption of potable water and water for freezing.
- ✓ Increase in the sale of fans, air-conditioners, refrigerators, and the impact of these sales on energy consumption.
- ✓ Changes in crop yield in urban or peri-urban zones.
- ✓ Percent of the population dependent on sources of water supply linked to mountain glaciers indicated as reduction in the supply of water from this source.
- ✓ Increase in bush fires.
- ✓ Decrease in the number of tourists in winter in high-mountain, polar or temperate cities.
- ✓ Increase in the concentrations of ozone in the cities.

Increased temperatures in temperate, coastal and tropical regions, as well as a rise in temperature at higher altitudes and latitudes, will cause certain illnesses transmitted by vectors that are sensitive to temperature (for example mosquitoes) to spread to other cities, with the subsequent spread of various illnesses such as dengue, yellow fever, malaria etc. This significantly increases the cost of public health.

SOCIO-ECONOMIC IMPACTS ON CITIES RESULTING FROM VULNERABILITIES ASSOCIATED WITH SEA-LEVEL RISE LINKED TO CLIMATE CHANGE

Not all coastal impacts currently observed are caused by sea-level rise linked to climate change. The coastal cities most impacted are those located in low-lying coastal zones and those located in mega-deltas. In many of these zones, various factors of anthropogenic origin are present, which reinforce their vulnerability, such as changes in land use, construction of infrastructure in places that are competing with the natural equilibrium of the ecosystems that are still there and those degraded by man.[34]

Many of the human infrastructures located in low-lying coastal regions cannot withstand the pounding of the sea (waves and tides), due to their intrinsic static instability; furthermore, they are constructions done in a zone where the forces of coastal dynamics are at work. This is the case of

[34] CIEM, Training Manual On Vulnerability and Adaptation to Climate Change For Geo Cities, Draft 23.08.09 (Unpublsihed)

buildings located on the balance profile of the beaches. The pounding of the sea, together with sea-level rise, undermines the cement of the buildings near the sea until they are completely destroyed. The sea will continue to penetrate the lowest areas of the cities, causing permanent flooding.

FIGURE 7 NILE DELTA: POTENTIAL IMPACT OF SEA LEVEL RISE

Nile Delta: Potential Impact of Sea Level Rise. Potential impacts of sea level rise on the Nile Delta include a decline in water quality. This graph shows the Nile Delta region in 2002, the area as it would appear with a 0.5 m and 1.0 m sea level rise. Source: Otto Simonett, UNEP/GRID-Geneva; Prof. G. Sestini, Florence; Remote Sensing Centre, Cairo; DIERCKE Weltwirtschaftsatlas, 2002, http://www.grida.no/climate/vitalafrica/english/16.htm (accessed 26 June 2008)

The water supply system of the city and its distribution network can suffer, depending on their location. The health services have to deal with the illnesses associated with a reduction in the supply and the progressive salination of the aquifers, as well as the re-location of the persons evacuated. [35]

Examples of impact indicators associated with sea-level rise resulting from climate change

- ✓ Examples of indicators of impact on cities caused by vulnerabilities:
- ✓ Damage caused by incidents of sea-level rise (number of deaths, number of evacuees, buildings affected, population affected, economic cost)
- ✓ Quality of water from supply sources. Degree of salination.
- ✓ Number of persons affected by water salination.
- ✓ Effects of impact on species, coastal ecosystems, ecosystem goods and ecosystem services that are still to be carried out.
- ✓ Impact on infrastructure and cost of these impacts.
- ✓ Costs per territory lost.
- ✓ Impacts on historic buildings or monuments.
- ✓ Industries affected or re-located.
- ✓ Number of unused dwellings and persons affected. Number of persons re-located

Urban and peri-urban agriculture located near the coasts can be affected by sea-level rise and salination of aquifers. Industries located near the coasts can also experience serious impacts such as destruction and flooding of their facilities. Tourism can suffer loss of its coastal facilities and register losses due to deterioration of beaches or other ecosystems or port facilities. Tourism can also be affected through destruction or deterioration of buildings and/or monuments. The systems for discharging liquid waste and rain water into the sea can also be seriously damaged.

[35] CIEM, Training Manual On Vulnerability and Adaptation to Climate Change For Geo Cities, Draft 23.08.09 (Unpublished)

REDUCTION IN RAINFALL

Rainfall will continue to decrease in arid and semi-arid areas as well as in other areas. The vast majority of these vulnerable areas are located in developing countries. This reduction in rainfall has a negative impact on water supply to the population, industry and agriculture. Most countries suffering from this water shortage do not have sufficient economic resources to support the transfer of large volumes of water from afar, or to use techniques for desalination of brackish water. The reduced access to potable water implies the proliferation of various health-related or water-borne illnesses, affecting the health systems in the country. Very often, water sources or aquifers can become salinized due to over-use and cannot be replenished. In places where rainfall has been reduced, this has had a negative impact on the generation of hydroelectric energy.[36]

SOCIO-ECONOMIC IMPACTS ON CITIES RESULTING FROM THE VULNERABILITY ASSOCIATED WITH EXTREME EVENTS LINKED TO CLIMATE CHANGE

The extreme vulnerability of cities to cyclones causes severe loss of life, infrastructure and ecosystems. Urban and peri-urban agriculture is highly vulnerable to different extreme events, because of the intensity and destructive power of these events when compared to the frailty of agricultural crops. The industry is highly vulnerable due to inactivity of industrial facilities for fairly long periods as a result of destruction of the supply networks for electricity and water, land, aerial or maritime communication, or general city services such as transportation and cleaning. [37]

Various extreme events affect city infrastructure and services to various degrees, depending on their type and intensity. The water supply system in cities is among the services most affected by these phenomena. On occasion, because of events that are non-local, but linked to sea-level rise, penetration of salt water or severe drought, the restoration of the service can take quite a long time. Owing to the complexity of the health services, which have to deal with multiple impacts (not only those brought about by extreme events which took place before, during and after the occurrence of same), and given the importance of their main objective of saving life and restoring the health of persons, they are extremely vulnerable. Prior preparation of its personnel and readiness of its services and infrastructure are fundamental to the efficient functioning during and after the passage of the event.

Almost all extreme events cause more or less permanent damage to infrastructure and services, such as certain ecosystems that represent the main source of enjoyment for tourists. Tourism industry is very vulnerable to extreme events. Most cities are vulnerable to these extreme events to a greater or lesser degree, but vulnerability increases when their economic potential is low and their social development is limited. Even for cities with a high economic potential, vulnerability is very high in certain segments of the population such as the elderly, the youth, the marginalized, indigenous populations and immigrants.

[36] CIEM, Training Manual on Vulnerability and Adaptation to Climate Change For Geo Cities, Draft 23.08.09 (Unpublished)
[37] CIEM, Training Manual on Vulnerability and Adaptation to Climate Change For Geo Cities, (Ref. Op.Cited)

NATURAL DISASTERS

Natural disasters are happenings whose danger level is associated with natural causes such as flooding, fire, earthquakes, tropical storms, and volcanic eruptions. Human-induced disasters include the degradation of the environment that adds to the effects of natural events by polluting or harming strategic natural systems that maintain urban environmental quality, thus reducing their resistance to disasters.

Source: Al-Omar, Muthana. 2005. "Post War Environmental Problems and Challenges in Iraq," Amman, Jordan: Arab Administrative Development Organization Workshop; Presentation In Arabic

Natural disasters occur in many Arab countries. In Algeria and Egypt, for example, earthquakes hit human settlements. The earthquakes of 1980 and 2003 affected 930 317 and 210 261 Algerians, respectively.[38] The earthquakes of 1994, 1992 and 1979 affected 160 660, 92 649 and 66 000 Egyptians, respectively.[39] Drought affected many Arab countries. Drought affected 8.6, 3.45 and 8.4 million Sudanese in 1991, 1987 and 1984, respectively. [40] In Syria, drought affected 329 thousand persons in 2000. [41] Flood is another major natural disaster that threatens Arab human settlements. In 1996, floods affected 238 210 Yemenis in 1996.[42] In 2003, floods affected 13 thousand Saudis.[43]

Environmental problems are also responsible for threats to human settlements. Rising sea levels due to global climate change may prove a disaster for island states like Bahrain. Experts predict that a one-metre sea level rise could flood 10 per cent of Bahrain's coastal areas.[44] Rising sea level would destroy weak parts of the sand belt, which is essential for the protection of lagoons and the low-lying reclaimed lands. The impacts would be very serious: One third of Egypt's fish catches are made in the lagoons. Sea level rise would change the water quality and affect most fresh water fish. Valuable agricultural land would be innundated. Vital, low-lying installations in Alexandria and Port Said would be threatened. Recreational tourism beach facilities would be endangered and essential groundwater would be salinated. Dykes and protective measurements would probably prevent the worst flooding up to a 50 cm sea level rise. However, it would cause serious groundwater salination and the impact of increasing wave action would be serious.[45]

In addition to disasters resulting from natural causes and environmental reasons, Arab human settlements in Iraq and Palestine suffer from conflicts and occupation. In Iraq, soil is polluted with petroleum and nuclear elements that the former regime stored for military purposes. On 29th of November 2004, for example, Jayyous residents awoke to find yet a new disaster befalling their already beleaguered Palestinian farming village of three thousands, in the form of a massive new land confiscation. Jayyous farmers arriving in their fields found construction crews with bulldozers destroying village farmland just west of the north gate--the main access Jayyous has to its fields

[38] PreventionWeb, Countries and Regions: Algeria, http://www.preventionweb.net/english/countries/africa/dza/?x=13&y=5, (accessed Tuesday, 20 May 2008)
[39] PreventionWeb, Countries and Regions: Egypt, http://www.preventionweb.net/english/countries/africa/egy/?x=9&y=3 (accessed Tuesday, 20 May 2008)
[40] PreventionWeb, Countries and Regions: Sudan, http://www.preventionweb.net/english/countries/africa/sdn/?x=9&y=6 (accessed Tuesday, 20 May 2008)
[41] PreventionWeb, Countries and Regions: Syria, http://www.preventionweb.net/english/countries/asia/syr/?x=12&y=6 (accessed Tuesday, 20 May 2008)
[42] PreventionWeb, Countries and Regions: Yemen, http://www.preventionweb.net/english/countries/asia/yem/?x=10&y=6 (accessed Tuesday, 20 May 2008)
[43] PreventionWeb, Countries and Regions: Saudi Arabia, http://www.preventionweb.net/english/countries/asia/sau/?x=16&y=10 (accessed Tuesday, 20 May 2008)
[44] Arab Environment Watch, Climate Change Alert in Bahrain, http://www.arabenvironment.net/archive/2007/10/359813.html (accessed Tuesday, 20 May 2008)
[45] UNEP, Potential impact of Sea Level Rise: Nile Delta http://www.grida.no/climate/vital/34a.htm (accessed Tuesday, 20 May 2008)

beyond Israel's illegally constructed "separation barrier". The crew explained to the Jayyousi they had their orders from the army to confiscate 850 more dunams[46] of land, and to build 80 housing units. The workers warned that over two thousand dunams may be taken in the end--nearly the remainder of the village's land, belonging to 79 Jayyous farmers.[47]

DEFINITION OF CORE INDICATORS: IMPACT INDICATORS

LOSS OF BIODIVERSITY

Resource: Biodiversity **Sphere: Ecosystem** **Type of indicator: IMPACT** **Category: New, Transversal**
Justification: What does it mean and why is it important to measure it? The risk to biodiversity - number and variety of flora and fauna species in the environment - is an excellent indicator of environmental quality. Consequently, the loss of biodiversity permits an assessment to be made of each ecosystem's sustainability.
How is it identified? Necessary data The indicator refers to a number of fauna and flora species not found now in the local environment the assessment is made, in comparison with earlier periods for which there is a record of species found. The concept of the loss of biodiversity as it is used here is not only the extinction of species; it is also their significant reduction or disappearance without being extinct. To make this calculation the number and variety of the city's species of fauna and flora, past and present, must be known.
Measurements and units Number of species of fauna and flora
Possible time and space formats Charts and localization maps
Methodological resources reference The indicator gives an approximate measurement of the number of extinct and known species given in earlier state indicators and is commonly used by the United Nations Commission Sustainable Development (UNCSD)
Objectives Reduce the impact and threat of urban development to local biodiversity
Goals, reference values There are no established reference values; the indicator is new and is adapted to the local environment.
Other comments/context This is an important instrument to assess how urbanization influences the quality of the environment. Although there is no experience in making this measurement at local level, it is important to begin collecting data to give the public authority and local society enough information to take protective measures to protect local biodiversity.

[46] 1 acre = 4 dunams

[47] Bloom, David. Dec. 10, 2004. Update From Jayyous: Israeli Settlement Seizes Palestinian Farmland. World War 4 Report http://www.ww3report.com/105/palestine/jayyous (accessed Tuesday, 20 May 2008)

INCIDENCE OF WATER-BORNE DISEASES

Resource: Water
Sphere: Quality of life
Type of indicator: IMPACT
Category: New, Transversal

Justification: What does it mean and why is it important to measure it?
The state of the water immediately affects the quality of life and the population's health. Organic material pollution – specifically from faecal material – of water used for different types of domestic consumption, is one of the principal water-borne disease vectors with a negative impact on urban quality of life. One of its principal manifestations is infant mortality associated with diseases caused by polluted water. Therefore, it is important to follow up, at the local level, on the increase of water-borne diseases to take measures to improve the quality of life and, indirectly, to improve the condition of the locality's water supply.

How is it identified? Necessary data
Data provided by local public health agencies, classified by the type of disease and the affected population.

Measurements and units
Number of persons affected by water-borne diseases according to type of disease and dates when they appear.

Possible time and space formats
Trend charts and tables.

Methodological resources reference
There are no references to other methodological resources; new indicator

Objectives
Help to improve the population's quality of life.

Goals, reference values
There are no established reference values; in the case of infant mortality, reference is made to World Health Organization standards.

Other comments/context
Water-borne diseases signify socio-economic inequality among different population groups. The poorest live in unhealthy conditions with limited access to safe drinking water and drainage, usually implying pollution of alternative water sources and children coming in contact with polluted water, thus increasing water-borne diseases. To combat these diseases by investing in good quality water supply and drainage systems, would help to reduce social inequality and improve quality for the poorest population groups

INCIDENCE OF CARDIO-RESPIRATORY DISEASES

Source: Water **Sphere: Quality of life** **Type of indicator: IMPACT** **Category: New, Transversal**
Justification: What does it mean and why is it important to measure it? It is known that water pollution has repercussions on health and on the quality of life. Frequent exposure to carbon monoxide and dioxide, nitrous oxide, ozone and other elements, brings with it an increase in cardio respiratory diseases, mainly in the elderly and children.
How is it identified? Necessary data Information about the number cardio respiratory diseases and their increase due to atmospheric pollution may be obtained from public health agencies.
Measurements and units Number of people affected by cardio-respiratory diseases, indicating their age, type of disease, and the connection with atmospheric pollution.
Possible time and space formats Trend charts and tables.
Methodological resources reference There are no references from other methodological resources; new indicator
Objectives Reduce the impact of atmospheric pollution on the local population's quality of life and health.
Goals, reference values Consult World Health Organization reference standards
Other comments/context The impact of atmospheric pollution goes far beyond its immediate effect on the quality of city life and on citizens' health. Climate change caused by rising temperatures indicates the importance of controlling its causes. Nevertheless, since such changes are accumulative and only become evident after many years, its effect on human health is even greater.

INCIDENCE OF DISEASES DUE TO POISONING AND POLLUTION

Resource: Land **Sphere: Quality of life** **Type of indicator: IMPACT** **Category: Core** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? This indicator provides basic information on the population's health in relation to the physical environment. Cases of diseases caused by pollution and poisoning due to soil and water pollution indicate the quality of urban planning and management.
How is it identified? Necessary data Number of poisonings per 100 thousand inhabitants identified as being due to soil pollution. This indicator may be subdivided to relate to specific types of illness. It is very unusual for soil pollution to cause death; however, it can occur from caesium poisoning.
Measurements and units Number of cases of diseases per 100 thousand inhabitants in a given period.
Possible time and space formats Trend charts.
Methodological resources reference SEPA 2000. Environmental Indicators in Community Planning: A Presentation of the Literature.
Objectives Reduce the risk of disease by improving living conditions by means of urban environmental planning.
Goals, reference values There are no international reference values
Application examples There are none
Other comments/context Cases of soil pollution are generally episodic (see Bophal, India, 1984 and the case of Love Canal, in the United States in the 1960s). In Brazil, the case of caesium pollution in a garbage dump was recognized because of the number of deaths from cancer it caused in the local population. "The Global Burden of Disease" (GBD) http://www.hsph.harvard.edu/organizations/bdu

MICROCLIMATE CHANGE

Resource: Biodiversity
Sphere: Quality of life
Type of indicator: IMPACT
Category: New

Justification: What does it mean and why is it important to measure it?
Public perception about the climate is important because people relate their quality of life directly to the environment. The quality of urban life, linked to a city's microclimate, is directly affected by emissions of polluting gases from industry and motor vehicles, by the lack of green areas and by soil waterproofing.

How is it identified? Necessary data
By monitoring the temperature in different zones of the city, differences are shown that may be associated with the quality of the local physical environment. Indexes on rainfal , temperature and relative air humidity are data collected local y that should be recorded over time and may help in analysing microclimate changes.

Measurements and units
Temperature variation in °C and relative air humidity.

Possible time and space formats
Graphs and tables to show the variation over time during similar periods in different years. They should be associated with data on green areas, built-up and paved areas and episodes of flooding when making an environmental quality analysis of the city.

Methodological resources reference
There are none.

Objectives
Make the public more aware of the impact of the environment on the quality of urban life. Make the authorities more sensitive to the need to improve the urban environment by, for example, planning green areas and encouraging the use of environmentally friendly building materials.

Goals, reference values
There are none.

Other comments/context
Although the data are objective, such as temperature or degree of humidity, the notion of environmental comfort is subjective. The use of these indicators in analysing environmental quality in a city should be associated with other indicators, such as the number of green areas, the motorization and air pollution index

POPULATION IN VULNERABLE URBAN AREAS

Resource: Land
Sphere: Quality of life
Type of indicator: IMPACT
Category: New

Justification: What does it mean and why is it important to measure it?
Urban vulnerability is associated with the city's physical and social and economic conditions. There is a clear relationship between vulnerability and its impact and economic development. Identifying risk situations and assessing their impact and institutional responses may help to avoid the more serious consequences of vulnerability.

How is it identified? Necessary data
Number of people in risk localities such as gradients and polluted sites. These data are obtained from local authorities.

Measurements and units
Absolute number of inhabitants in risk situations in relation to the total population in a given year and the variation of these numbers over time in a given period (2-10 years).

Possible time and space formats
Graphs, maps and tables.

Methodological resources reference
World Bank, UNCHS and UNDP for national and regional data

Objectives
Reduce urban vulnerability in relation to natural or human-induced disasters.

Goals, reference values
There are none.

Application examples
There are none

Other comments/context
A study by the United Nations Disaster Relief Office (UNDRO) 1976, estimated that the 66 per cent of the world's population living in the poorest countries account for 96 per cent of deaths from natural disasters. For example, in Japan the annual average number of deaths from natural disasters is 63; in Peru, with a similar number of natural disasters, the average number of deaths per year is 2 900. One reason for this is the lack of institutional capacity for disaster prevention response, as well as difficulties in taking remedial measures. The poorest population groups live in risk areas and, consequently, become more vulnerable to disasters.

INCIDENCE OF FLOODS, LANDSLIDES, ETC.

Resource: Land **Sphere: Urban vulnerability** **Type of indicator: IMPACT** **Category: New**
Justification: What does it mean and why is it important to measure it? Floods and landslides on gradients following heavy rains have direct, indirect and secondary impacts for the poorest people. Losses are immediate and direct, medium and long term, harmful to human health and cause indirect environmental losses. In general, natural phenomena have consequences that are in inverse proportion to the degree of planning and preparation undertaken by authorities.
How is it identified? Necessary data Data obtained from local authorities, civil defence and Public Works Departments.
Measurements and units Number of accidents in risk areas per year, measured over a given time period.
Possible time and space formats Tables, maps and graphs.
Methodological resources reference There are none.
Objectives Reduce the number of victims and consequences of disasters whose impacts could be prevented with proper planning and administration.
Goals, reference values There are none.
Other comments/context This indicator is directly associated with the pressure indicator on the relation between legal and illegal settlements and with the indicators of social inequity. Water state and response indicators linked to protecting areas with springs are also related to human vulnerability.

JUVENILE CRIME RATE

Resource: Built-up environment
Sphere: Quality of life
Type of indicator: IMPACT
Category: New

Justification: What does it mean and why is it important to measure it?
The juvenile crime rate reveals the state of a community's social health and how secure it is. Poverty, drugs and environmental degradation worsen the quality of life and this, in turn, leads to urban violence. Families without a solid structure, the lack of schools and hunger also increase juvenile crime.

How is it identified? Necessary data
Juvenile crime is classified as offences committed by people below 18 years of age. Statistical information is official, provided by local authorities and the police. A distinction should be made between felonies and misdemeanours. This information, as well as information on the relevant population, is collected annually.

Measurements and units
Number of cases per year of juvenile crime over a given period (2-10 years).

Possible time and space formats
Graphs, tables and trend charts.

Methodological resources reference
Sustainable Seattle, 1998. Indicators of Sustainable Community.
http://www.scn.org/sustainable/susthome.html

Objectives
Reduce the number of annual cases of juvenile offences in a given community.

Goals, reference values
There are none.

Application examples
Some international agencies such as UNICEF provide comparative figures on violence.

Other comments/context
Juvenile crime rates also indicate future scenarios for a community's safety. Violence affects everybody's quality of life and people say it is one of the most serious urban, political and social problems. Although there is a connection between environmental quality and violence, this is linked to a set of social, cultural and economic factors (such as inequality, the illiteracy rate, unemployment and people living in illegal settlements), and the authorities must take an integrated approach to dealing with the problem. It is important to keep in mind that the definition of crime may vary from country to country. To adopt violent crime as a reference may reduce the margin of distortion for comparison purposes

PUBLIC HEALTH COSTS DUE TO THE INCIDENCE OF WATER-BORNE DISEASES

Resource: Water
Sphere: Urban economy
Type of indicator: IMPACT
Category: New

Justification: What does it mean and why is it important to measure it?
The state of the environment may cause significant economic losses for city administrations and enterprises because of the impact on the local population's health. This indicator tries to identify, in the case of water, losses from water-borne diseases since they result from different types of water pollution. To enable the authorities to deal with this problem, measures must include increasing the number of medical consultations or the supply of medicines for sicknesses such as diarrhoea and leptospirosis, as well as the number of diagnostic tests, and this implies increasing health care budgets. The city's businesses and other economic also suffer losses from worker absenteeism because of sickness.

How is it identified? Necessary data
The indicator is based on the evolution of local public health spending in relation to the presence or the increase of water-borne diseases in the city. This implies being aware of the different headings in the local budget when making estimates. These data may be hard to obtain because this type of spending is not usually Reported. However, in this respect it is important to make an effort, together with business associations, to obtain data and estimate the losses to the sector from such diseases.

Measurements and units
The objective is to increase public and private sector budgets to control these; the unit of measurement is the local currency, which may be converted into U.S. dollars to make international comparisons.

Possible time and space formats
Graphs, tables and time charts

Methodological resources reference
There are no references from other methodological resources; new indicator

Objectives
Help the local economy by showing the economic cost to the local environment of the negative impact of poor quality water.

Goals, reference values
There are no established reference values, new indicator.

Other comments/context
This indicator, adapted to different impacts, must be used for air and land resources.

PUBLIC HEALTH COSTS DUE TO THE INCIDENCE OF WATER-BORNE DISEASES

Resource: Water
Sphere: Urban economy
Type of indicator: IMPACT
Category: New

Justification: What does it mean and why is it important to measure it?
The state of the environment may cause significant economic losses for city administrations and enterprises because of the impact on the local population's health. This indicator tries to identify, in the case of water, losses from water-borne diseases since they result from different types of water pollution. To enable the authorities to deal with this problem, measures must include increasing the number of medical consultations or the supply of medicines for sicknesses such as diarrhoea and leptospirosis, as well as the number of diagnostic tests, and this implies increasing health care budgets. The city's businesses and other economic also suffer losses from worker absenteeism because of sickness.

How is it identified? Necessary data
The indicator is based on the evolution of local public health spending in relation to the presence or the increase of water-borne diseases in the city. This implies being aware of the different headings in the local budget when making estimates. These data may be hard to obtain because this type of spending is not usually Reported. However, in this respect it is important to make an effort, together with business associations, to obtain data and estimate the losses to the sector from such diseases.

Measurements and units
The objective is to increase public and private sector budgets to control these; the unit of measurement is the local currency, which may be converted into U.S. dollars to make international comparisons.

Possible time and space formats
Graphs, tables and time charts

Methodological resources reference
There are no references from other methodological resources; new indicator

Objectives
Help the local economy by showing the economic cost to the local environment of the negative impact of poor quality water.

Goals, reference values
There are no established reference values, new indicator.

Other comments/context
This indicator, adapted to different impacts, must be used for air and land resources

COST OF WATER COLLECTION AND TREATMENT

Resource: Water
Sphere: Urban economy
Type of indicator: IMPACT
Category: New

Justification: What does it mean and why is it important to measure it?
Water pollution, its improper or wasteful use and the constantly increasing demand for the resource, together with the growth of the urban population, shows the need to increase local availability of good quality water and to guarantee a sufficient supply. This demands large amounts of financing because, for many cities, water is not available from nearby sources but must be brought from aquifers at long distances or to which access is difficult; in this respect, because water courses are general y pol uted, the water must be treated for human consumption. Al these factors require large investments if the quality of life and the health of the population are to be preserved, and if a large number of economic activities are to be made possible.

How is it identified? Necessary data
The data necessary to use this indicator should, in principle, be available from public water supply, control and monitoring bodies and from private enterprises where the local water system is privatized.

Measurements and units
Increased costs in local currency

Possible time and space formats
Trend charts and tables, such costs are compared in 5-10 year periods.

Methodological resources reference
Other indicators that may provide an approximate idea of the problem can be found at:
www.ceroi.net : Inversion in water supply systems (response indicator)
www.iclei.org : Volume of water available (pressure indicator)

Objectives
Reduce waste of resources invested in water collection and treatment by controlling water lost from leaks, making better use of water and improving its quality.

Goals, reference values
There are no reference values, new indicator.

Other comments/context
It is important to indicate, in local public finances, the impact caused by improper use, by the growth of demand and by water pollution

COST OF PREVENTING AND CONTAINING ENVIRONMENTAL RISKS

Resource: Biodiversity **Sphere: Urban economy** **Type of indicator: IMPACT** **Category: New**
Justification: What does it mean and why is it important to measure it? Spending on engineering work to contain and prevent risks is a temporary solution because of the lack of land use planning and institutional incapacity to control illegal occupation of risk areas in cities; the reference is to contention work on gradients, channelling ravines, building landfills and dams, for example.
How is it identified? Necessary data Budget information from competent local and regional authorities.
Measurements and units Absolute values and percentage of costs in the budget for environmental work.
Possible time and space formats Tables of annual spending, graphs to show trends over time during a given period.
Methodological resources reference There are none.
Objectives Reduce costs related to temporary solutions and Report environmental, social and economic cost caused by lack of planning on the use and occupation of urban land
Goals, reference values There are none.
Other comments/context This is a local indicator to compare data with local references that depend on a follow up over the period used to make the analysis.

COST OF REHABILITATING MONUMENTS AND HISTORIC CENTRES

Resource: Built-up environment **Sphere: Urban economy** **Type of indicator: IMPACT** **Category: New**
Justification: What does it mean and why is it important to measure it? The growth of the population worsens the impact on the built-up and natural environment. In the case of cities, the deterioration of monuments and historic centres indicates the lack of environmental quality and institutional capacity to administer land use and occupation
How is it identified? Necessary data Number of historic buildings, annual cost of repairing monuments and restoring historic centres, local administration's budget.
Measurements and units Variation of recovery costs in relation to the budget, in absolute values and percentages.
Possible time and space formats Graphs tables and maps
Methodological resources reference Local Government Management Board, 1994. The Sustainability Indicators Research Project: Indicators for Local Agenda 21 – a summary. United Kingdom. UNESCO.
Objectives Conserve and protect monuments and historic centres to reduce the number of buildings at risk and improve environmental quality.
Goals, reference values There are no international goals.
Application examples The Historic Centre of the City of Salzburg: http://www.unesco.org/whc/sites/784.htm Historic Centre of Havana, Cuba;Parati and Ouro Preto, Brazil.
Other comments/context Cities and Towns on the World Heritage List: http://www.unesco.org/whc/sites/cities.htm

PROPERTY DEPRECIATION

Resource: Land **Sphere: Urban economy** **Type of indicator: IMPACT** **Category: New**
Justification: What does it mean and why is it important to measure it? Property speculation, added to the lack of urban planning, leads to frenzied and predatory urbanization and harms the quality of city life by overburdening the urban Infrastructure and destroying work areas and resources. Property prices, as well as differences in price per square metre (m^2) according to the locality, may reflect the city's environmental degradation. These qualitative indicators measure the economic relation between land use and quality of life of a given locality.
How is it identified? Necessary data The indicator comes from an analysis over a period of time of a given area considering such matters as traffic and noise that affect the quality of city life. The data depend on the history of how prices per square meter differ in selected areas.
Measurements and units Variation in percentages of the relative cost per m2 of urban plots (US$/$m^2$).
Possible time and space formats Consideration should be given to time intervals of 10 years, or according to the specific situation where prices have changed considerably because of land use changes.
Methodological resources reference There are no international references.
Objectives Relate the loss of economic value due to poor environmental quality.
Goals, reference values There are none.
Other comments/context This indicator may be subdivided to assess districts or regions within the urban parameter. Its application is local and depends on national economic reference values.

LOSS OF TAXES

Resource: Land **Sphere: Political-institutional** **Type of indicator: IMPACT** **Category: New**
Justification: What does it mean and why is it important to measure it? The loss of taxes is the result of a structural deficiency in urban management, and of changing the profile of activities or considerations as to space in a given city or region. When there is much informal commercial activity, besides directly prejudicing public administration, it also harms legal trade, resulting in bankruptcies or businesses abandoning the area. The lack of infrastructure and maintenance and poor environmental quality may also lead to urban degradation and a consequent loss of taxes.
How is it identified? Necessary data Local activity budget information provided.
Measurements and units Percentage of taxes from the predominant activity, tourism for example, from year to year in a given city or area.
Possible time and space formats Trend charts
Methodological resources reference There are none.
Objectives Revitalize degraded areas by showing the damage caused by urban deterioration.
Goals, reference values There are none.
Application examples Look for examples of urban revitalization (Aleppo, Syria)
Other comments/context Other objective data on the municipal budget are used in the analysis to show the existence of external environmental and urban factors

LOSSES OF URBAN ATTRACTION

Resource: Land **Sphere: Political-institutional** **Type of indicator: IMPACT** **Category: New**
Justification: What does it mean and why is it important to measure it? Property supply and demand and the changes in property prices may reflect the change of vocation of a given city or district. These are qualitative indicators that measure the relation between economic activity and land use. They affect the social, environmental and economic quality of life in a given locality.
How is it identified? Necessary data Data may be found on the local property market in local and regional trade associations and through direct surveys.
Measurements and units The number of properties for sale in relation to the number of property operations in a year over a given period.
Possible time and space formats Tables and trend charts
Methodological resources reference There are no international references.
Objectives Relate the change of activity and the space characteristic of a given area which in turn has a poor environmental quality and loses economic value.
Goals, reference values There are none.
Other comments/context This indicator may be divided to assess districts or regions within an urban parameter. Its application is local and depends on national economic reference values

IMPACT STRATEGY

This sub-section focuses on methods to position and deliver an Integrated Environmental Assessment (IEA) for a real impact on environmental policy and practice at a series of levels, ranging from local to national. This sub-section helps the user/team responsible for elaborating the GEO City Report to determine how to engage the right people to listen to you and respond to the report and its messages. This impact process takes time; and involves real emphasis on being clear and strategic in identifying the changes that user/team want to see as a result of the assessment, i.e., the report. The process focuses on building relationships with key people, finding out what they already know and what they need to know. With that understanding, the user/team can then seek out and capitalize on the opportunities to get the messages across, to generate dialogue, and gain the attention and support of those who may have in the past appeared non-responsive to your work.

BOX 4 WHEN DO YOU PREPARE AN IMPACT STRATEGY AND WHO IS RESPONSIBLE FOR IT?

An impact strategy should be prepared once you have initiated the process for an integrated environmental assessment. It is initiated as part of the "institutional setup" stage of a GEO-style IEA process. It is formalized in the "scoping and design" stage, and regularly monitored, assessed and improved. The manager, or management team, for the IEA process should be responsible for:

- Developing the impact strategy, or ensuring that an impact strategy is developed;
- Implementing the strategy; and
- Monitoring performance on the strategy to ensure that it is achieving the results you are seeking, and modifying or adjusting it, if necessary.

Source: Creech, Heather and others, "GEO Resource Book: Developing an impact strategy for your IEA Training Module 3" *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

WHAT IS AN IMPACT STRATEGY?

An impact strategy consists of the steps the user/team take to ensure that the work done (the GEO City report) will lead to real progress on key issues or concerns. It is proactive in nature, and adaptive in a public policy environment where priorities of governments and citizens can shift and change.[48]

WHEN DOES THE TEAM PREPARE AN IMPACT STRATEGY AND WHO IS RESPONSIBLE FOR IT?

An impact strategy should be prepared once the team has initiated the process for an integrated environmental assessment. It is initiated as part of the "institutional setup" stage of a GEO-style IEA process. The team has to formalize the Impact Strategy in Stage 1: Institutional, Stage 2: Identifying Indicators, and regularly monitored, assessed and improved. The team for the IEA process should be responsible for:

- Developing the impact strategy, or ensuring that an impact strategy is developed;
- Implementing the strategy; and
- Monitoring performance on the strategy to ensure that it is achieving the results you are seeking, and modifying or adjusting it, if necessary.

THE NEED AN IMPACT STRATEGY

Assessment of the state of the environment is mandatory in many countries, and can be part of an overall part of monitoring, verification and evaluation. It also can be part of policy elaboration. In any case, elaborating a GEO City report lends itself to thinking of the potential uses for the assessment. What impact it might have on policy and planning, and what steps should be taken to ensure that the right people are willing to pay attention to the findings of the assessment.

[48] Creech, Heather and others, "GEO Resource Book: Developing an impact strategy for your IEA Training Module 3" *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

GEO Cities reports are not detailed scientific assessments. However, they may lead to paying more attention to problem areas, and they may recommend a more detailed scientific assessment of root causes and downstream effects. The result of a GEO City report can shift the mood of the public, and lead to political pressure. It may educate a wide range of audiences on key issues, and as a result, it may trigger detailed studies linked directly to specific issues and decisions.

It is often an underlying assumption of reporting that good information will lead to good decisions. However, while good information is necessary, it does not follow that decision-makers will act on it. Decision-makers are often quite well informed, but their priorities and intentions may be different from that of the team elaborating the GEO City report. The challenge is to take proactive steps to ensure that their assessment does not sit on a bookshelf once it is done, but that it provides good input to decision making. Their assessment, i.e., the GEO Cities report, will lead to recommendations for actions that may require changes in policy and practice by the government. The team members thus have to consider from the outset how the findings from their assessment might be used, and how the priorities they identify can become the priorities of their government and their country.

An impact strategy begins with articulating the changes sought because of the assessment. This provides purpose beyond simply following through on the mandated requirement for the assessment. For those conducting an IEA and elaborating the GEO City report for the first time, it may not be possible to articulate a specific policy-related change that might be necessary, as there is no prior assessment that identified priority issues. For first timers, seeking better linkages between the findings of the report and formal decision-making process in government (e.g., departmental strategic plans, policy, priorities, budgets, etc.) may be the main objective. Those who are conducting an assessment for the second time or more might be able to think more specifically about issues and necessary policy changes identified from the first process.

Regardless of the number of times, team members participated in an assessment, it is important to have a good understanding of several factors.

- Why the assessment? What is the political and bureaucratic context in which it is taking place? A legislative mandate is the case in many countries. It is powerful. Having such a mandate makes it less likely other influences will prevent you from initiating and completing your report (although limited budgets may be a constraint). Government auditors and civil society should help ensure that the legislation is followed. However, once the report is done, there is often no obligation to address its findings, so it is equally important to learn who supports the practice of assessments, and where there might be opposition to the process. These people may be key bureaucrats in the department to which a team member belongs to, or in other important government or non-government agencies, who may be elected or appointed representatives and sit on influential committees. Those who are already supportive are prime candidates to become champions of the findings. They should be briefed on the process from the beginning, informed and even engaged in the process, and be key recipients of presentations and policy briefs on the findings. Those who have concerns about the whole concept and practice of assessments may become detractors—either critical of the report, or focusing attention away from the report and on to other government matters. As member of the team, consider how you might best build bridges with them and there might be common ground.
- If assessments have been prepared in the past in your country, what happened to them? What priorities for action were recommended? Were they acted upon? Why (or why not)?

Barriers to use of previous assessments may continue to be barriers; but by identifying them ahead of time, ways to overcome them may be identified.

- Who is involved in the assessment? In advance of starting the IEA process, there may be participants that can add legitimacy to the assessment. In some cases, the participation of external experts and agencies, including UNEP, can be helpful to ensure that the process is respected.
- What is taking place within the current national political or bureaucratic context that might:
  - ✓ prevent more senior bureaucrats and key decision-makers from responding to the findings, or
  - ✓ enable them to apply the findings in support of a particular agenda.
- What is taking place within the country more generally that might provide a window of opportunity to gain public attention for the findings? For example, if there is a debate going on now about health impacts of air pollution, think about how the findings can contribute to that debate. You might personally be interested in an issue such as water pollution, but by looking for the connection to the issue on the top of today's public and political agenda, you could promote your assessment in the context of the issue "cycle" which may be the air pollution agenda.

There are many ways to get a sense of the external political and public environment in which the assessment is taking place.

- Review not only the relevant statutes and regulations that govern the assessment, but also review the debates in parliament and parliamentary committee minutes. Find the background white/green papers, or other relevant policy documents.
- Investigate with current/former bureaucrats their recollection of the process involved in securing the mandate to do the assessment.
- Review current debates in parliament. What are the hot button issues among the members?
- Monitor political and social coverage in the national media and what they think is worth reporting?
- Chat with colleagues in other departments about what the key issues are that they are addressing.
- Attend meetings of non-government organizations (NGOs) and community-based organizations within and outside of the environment sector. Find out what their priorities are. Hold focus groups to identify user needs and interests.
- Look at polling data. If you have the resources, commission a public opinion poll, or work with the government's communications department to commission a poll to find out what is important now for the citizens of your city.

Be aware that if your assessment process serves only to produce a report simply to comply with a legal or policy instruction, then the impact—the ability to have the findings used to effect change—will be severely limited.

ATTRIBUTES OF IMPACT STRATEGIES AND TRADITIONAL COMMUNICATIONS ACTIVITIES

An impact strategy incorporates communications activities combined with a good understanding of government relations as practised by advocacy groups and professional lobbyists. With communications strategies, it is necessary to identify key recipients of the assessment, prepare key messages and products that will help them grasp the essentials of the research, and identify appropriate channels to deliver those messages and products, including the media, participation in events (e.g., conferences, workshops), and electronic delivery via e-mail and web. In Stage 3,

strategies for disseminating the report, you will learn more about the full range of tools and tactics available for the production and release of the reports and its supplementary products.[49]

An impact strategy builds on communications activities[50] in several key respects.

1. Purpose

   An impact strategy is focused explicitly and deliberately on change, and on the potential of the lead institution's role as a change agent. An impact strategy starts with an articulation of what the impact of your assessment should be. What should be done differently as a direct result of the assessment. Some of the power to effect change based on the findings may indeed rest with you, depending on your role within your bureaucracy. Usually more senior bureaucrats or politicians must be engaged to bring about policy reform, or leaders in the public and private sectors who may have roles to play in changing practice. An impact strategy identifies these key actors, and plans for ways to build their receptivity to the findings.

   In the past, communications activities have tended to focus primarily on the effective and efficient delivery of the findings and recommendations. The communications plan also often has an important corporate function: the promotion of the department and government that has been responsible for developing the report and demonstrating accountability through compliance with the mandate for the assessment.

2. Audience

   The audience for the IEA and the target group for its impact strategy may be small group key actors who are in a position to have significant influence on environmental outcomes if they adopt the assessment's findings and recommendations. Directly reaching these influential actors, however, may be difficult. Instead, the impact strategy may target those who are able to influence them or try to reach them through other channels indirectly, for example through the mainstream media. Your ultimate objective should

   be to reach those people whom you definitely want to act on the IEA's results. Communications activities will always include broader audiences: those who can benefit from the information contained in the report and become actors in their own way.

3. Timing

   An impact strategy should be developed from the very beginning of the assessment process, and monitored and adjusted throughout the process. The communications activities are an important component of the impact strategy, and are usually implemented towards the end of an assessment, once the findings and recommendations become clear.

STEPS IN BUILDING AN IMPACT STRATEGY

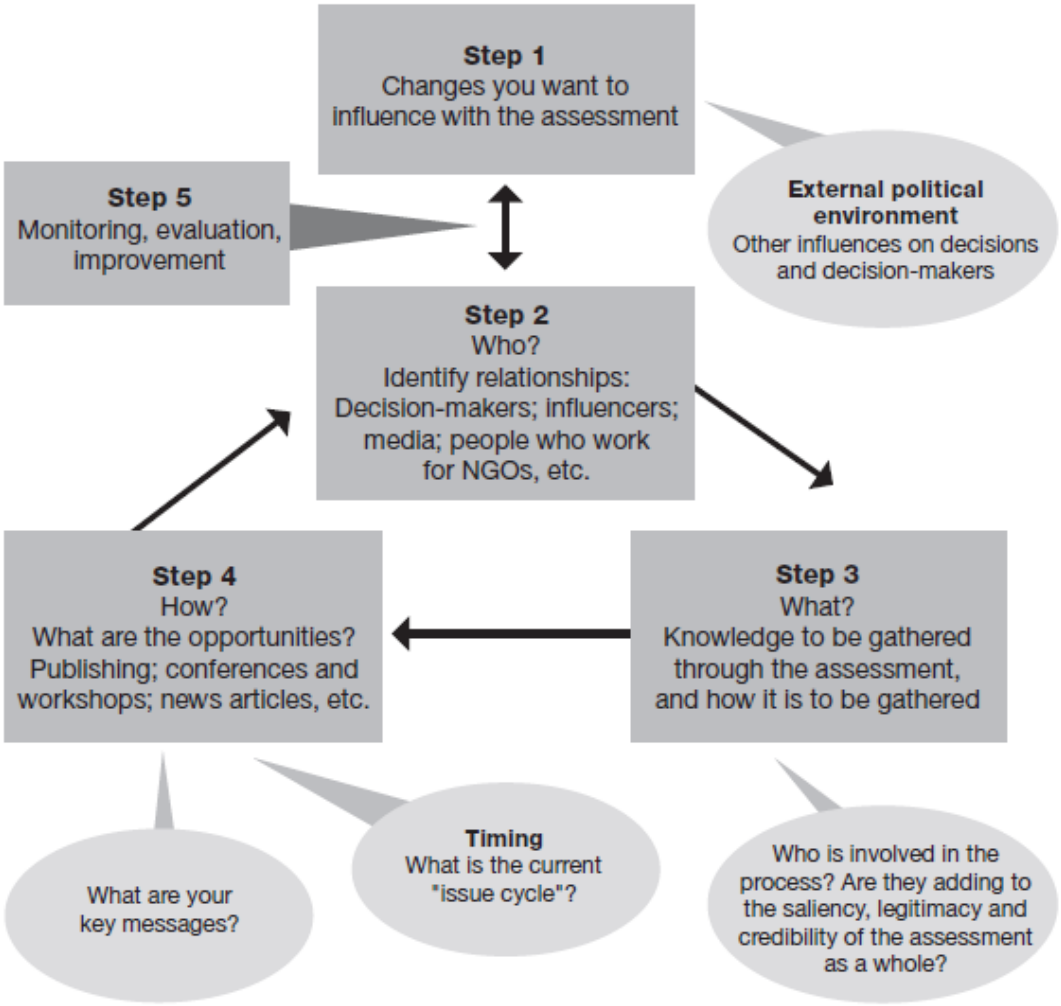
There are five main steps to creating an impact strategy, as illustrated in Figure 9.

1. ***Creating the change statement.*** What should the impact of the assessment be?
2. ***Relationship management.*** Identify the key actors that you are seeking to influence, and build connections to them.
3. ***Knowledge management.*** Gather and analyse the knowledge for the assessment.
4. ***Opportunity management.*** Move the knowledge into the hands of those that need to be influenced.
5. ***Monitoring and improvement.*** Determine whether the impact strategy is working, and adjust it as necessary.

[49] Creech, Heather and others, "GEO Resource Book: Developing an impact strategy for your IEA Training Module 3" *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

[50] Rucevska, Ieva and others, "GEO Resource Book: A training manual on Creating communication outputs from the assessment Training Module 7" *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

FIGURE 8 MODEL FOR AN IMPACT STRATEGY



Source: Creech, H. and others, GEO Resource Book A training manual on integrated environmental assessment and reporting Training Module 3 Developing an impact strategy for your IEA, UNEP and IISD

RESPONSES: POLICY INTERVENTIONS AND INSTRUMENTS

Chapter 5 of the GEO Cities Report answers the question: What are we doing now? The report examines the environmental setting of the city – the political, social, administrative, and managerial organisations and activities that determine how the city deals with its environment-development issues.[51] [52] Chapter 5 consists of three main sections:

1. Identification of stakeholders related to the urban environment
2. Urban environmental management structures and functioning
3. Implementation of environmental policies

IDENTIFICATION OF KEY STAKEHOLDERS RELATED TO THE URBAN ENVIRONMENT

This section identifies the key local participants and interest groups – the people and organisations that have important roles in relation to environmental resources; collectively, they are known as key

[51] UNCHS-UNEP, 1999
[52] Pintér, László and others, "GEO Resource Book: A training manual on Integrated analysis of environmental trends and policies Module 5," *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

actors or stakeholders. The purpose is to see the full range of "stakeholders" in the city and to understand the ways in which they currently – or potentially – affect the process of urban development and the process of environmental management. This section will include key actors in the public sector but also those in private business, NGOs, communities, and elsewhere.
When describing the various key actors it is useful to discuss briefly their activities and roles in relation to the following three aspects of urban development and environmental management:

a) Information, knowledge, technical expertise

This concerns the information, specialized knowledge, and technical expertise, which different key actors may possess or have access to. It is important to realise that relevant and useful knowledge is much more than simply the technical skills possessed by trained professionals; informal knowledge – and practical experience – is often valuable or even more valuable than formal or academic knowledge.

b) Decision making, policy formulation and policy coordination

This concerns the extent to which various key actors are involved in designing policies and in various stages of the decision making process. Private sector and community sector key actors can have significant influence and roles to play in the formulation of policies and decision making, even if public sector organisations are the main actors in this respect.

c) Policy implementation

This concerns the involvement of different key actors in implementation of the city's development and the environmental policies and programme and projects. This involvement can be formal as public sector key actors with legal implementation responsibilities or informal as in the role of communities, NGOs, and private sector groups, whose roles are not so explicit but may still be extremely important.

URBAN ENVIRONMENTAL MANAGEMENT STRUCTURES AND FUNCTIONING

This section should focus on citywide management; it should explain the general management (administrative) structure of the city. An overview should be given of the city's organisational structure, explaining which departments have which responsibilities and showing what their relationships are. This will provide a basic, static description of the city's management structure. In addition, a dynamic description should be given, explaining how the management works in practice, how the system actually functions, how departments and organizations cooperate and coordinate, etc.

This section should focus attention on four key factors:

a) Over all organization and structure

The basic structure and organisation of the city's management system - the institutions and groups that are responsible for various aspects of urban management and environmental management.

b) b) Information, knowledge and technical expertise

Organisations and groups responsible for collection, distribution, analysis, management, and use of information and specialized knowledge. Accessibility of information and main areas of technical expertise available to city management.

c) c) Decision making, policy formulation and policy coordination

Who is involved in the formulation of policies, what are the main organisations and groups with decision-making responsibility. Explain how is policy coordination handled, who is responsible and how is it done. In particular, how are policies and decisions coordinated.

d) d) Policy implementation.

Explain which organizations are responsible for implementation of public policies in the different sectors and the subject areas of concern.

In the descriptions in this section, it should be remembered there are dimensions, or levels of activity, in decision-making and policy formulation and implementation; these can be described generally as:

- Political
- Managerial/Administrative
- Operational/Technical

THE IMPLEMENTATION OF THE ENVIRONMENTAL POLICIES

This section discusses current initiatives and efforts to strengthen the city's urban environmental management systems – to increase local abilities to plan, coordinate and manage sustainable urban development. This section should only discuss city management over-all, not detailed management arrangements for specific activity sectors, specific environmental resources or specific environmental hazards (as these were covered in Chapter 3 of the GEO Cities Report).

The purpose is to highlight actions or proposals that may be working to solve some of the difficulties identified in earlier parts of Chapters 2 and 3. This means assessing the instruments being used to reduce pressure on the environment, so that any negative impact they might have on environmental resources may be lessened. These response instruments have different formats, are directed at different social stakeholders, use particular tools and have determined consequences when interacting between urban surroundings and the environment. The local technical team has to consider and analyse each instrument, as well as its effectiveness in helping protect environmental resources and improve urban environmental management.

POLICY-ADMINISTRATIVE INSTRUMENTS

The policy-administrative instruments are typical of local government that uses them to define:

- Rules on using urban and non-urban space - for example by establishing acceptable construction standards and objectives in the urban environmental conservation area and within the city limits.
- Destination of public resource: - setting priority areas for positive action (through investments for new works and maintaining and rehabilitating urban and environmental sites, as well as providing the local population with services) and areas of what might be called negative action (supervision, follow-up, taxes, control and regulations),implying putting a limit to action to be taken by different social sectors and members of society.
- The ideal city, environment, shape and type of development (economic, social and environmental) - that it is hoped to establish in the locality, setting its objectives, goals, indicators, mechanisms, instruments and estimating the budget needed.

Indicators:

Indicators:

- *Tax system according to the polluter/payer or user/payer principle*
- *Preventive warnings and fines for violating waste disposal*

Policy-administrative instruments are mechanisms, usually mandatory, that drive the actions of local public and private stakeholders. They indicate that the public sector is conscious of the different urban demands, needs and problems, and their relation to the local environment.

Their use and how they are used, suggest that if the local government really wants to take action, it should do so by inviting sectors interested in or affected by the policy in question to participate to a greater or lesser extent, as required. If these instruments are absent, or are weak, the conclusion reached is that local government and/or groups of society are not or were not capable of creating the proper mechanisms to deal with the problems that cause pressure on the environment.

These instruments include a broad range of initiatives, such as:

- Policies (environmental protection, urban development, transport, control of environmental pollution, health care).
- Normative/Legislative (standards, regulations, urban-environmental laws at local, regional, national or global level that have a local effect, assigning environmental commitment terms and applying ISO 14000 criteria).
- Institutional (establishing ministries or other environmental agencies, programmes, projects and institutional action, multilateral agreements).
- Follow-up and control (control mechanisms to enforce standards, laws and public policies; urban-environmental supervision control instruments).
- Presence of Local Agenda 21 (bodies linked to Agenda 21, social participation projects, programmes and related activities, resources allocated, participating organizations).
- Territorial planning (urban master plans, environmental management plans, laws on land use, distribution of zones according to economic and ecological characteristics, environmental protection areas).

ECONOMIC INSTRUMENTS

Considering their capacity to intervene in economic activity and in earnings by private stakeholders, on the one hand, and the possibility of imposing charges on economic and other sectors of society (including government agencies and individuals) on the other, these instruments are very important in promoting the changes in behaviour needed to improve the state of the local environment.

Economic instruments are generally associated with local government (capacity to impose tax on society) but they may also originate in the private sector.

The ISO 14000 standard, for example, was created in the private sector to assess the suitability of business and stakeholder sustainability and environmental conservation activities

In the latter case, even though this is a voluntary instrument and does not impose any direct economic cost on economic or government stakeholders, the lack of an ISO 14000 certificate may imply indirect costs since it may signify that companies lose markets, or have difficulty in getting finance for a project from government institutions or bodies.

Therefore, one way for the local government to use the ISO 14000 standard is to adopt it as a precondition for contracting engineering services, to encourage changes in production models and make companies more aware of the environment.

The analysis of economic instruments consists of:

- Financial (funds for action to protect/conserve the environment, subsidies for territorial occupation and for different activities that cause no harm to or that protect the environment), budget funding;
- Taxes (ecological ICMS24, taxes, fiscal instruments);
- Others (fines.)

TECHNOLOGICAL INSTRUMENTS

Technological instruments are another element of interest when assessing responses on the state of the environment.

Pressure to introduce new technologies is greater on private enterprises because of market competition that demands the constant addition of new technologies or because of government environmental control measures. However, also to be considered is the adoption of new technologies by the public sector that may be positive when defining new ways to assess environmental pressure caused by different urban activities.

The analysis should focus on technological advances included by the public or private sector that may be able to change environmental conditions through:

- Processes (new production technologies, solid and liquid waste treatment, pollution from industrial gas emissions, recovery of degraded areas, recycled material).
- Products (industrial filters, automobile catalysers, sprays without CFCs, unleaded gasoline).

Indicators:

- *Investment in solid waste management*

To make the most appropriate assessment of these technologies they should be related to cases where the processes are induced by local legislation, regulations or standards that will also allow an assessment to be made of the effectiveness of the State's policy-administrative instruments.

As indication must also be given as to whether the information is available, how is pressure on the environment reduced because of the introduction of the new technology; for example, how were emissions of greenhouse effect gases reduced with the introduction of industrial filters, automobile catalysers or sprays without CFCs. This will permit an assessment to be made of the effectiveness of the new technology in improving the state of the local environment.

PHYSICAL INTERVENTION INSTRUMENTS

Among the principal mechanisms to improve the local environment are physical measures used by society (local government in particular) to reduce pressure of urban activities on the environment.

These are generally sanitary engineering works (building a drainage network or a network to collect, treat and distribute water) or others designed to correct socio-environmental problems caused by uncontrolled land occupation (for example, areas at risk of landslides or subject to flooding).

These measures also run the risk of putting pressure on the environment, if no account is taken of the conditions in the ecosystems in which they are taken.

The following engineering operations and works should be analysed:

- Increasing access to public health services (building, expanding, improving infrastructure, connecting to drainage networks, collecting and treating solid waste, decontaminating rivers and other water courses).
- Creating and reclaiming green areas, parks, gardens, environmentally protected areas, even when finance alone is not a good indicator that the response is effective.
- Water supply system (financing, source, socio-spatial distribution, supply/demand relation).
- Drainage systems (financing, source, socio-spatial distribution, supply/demand relation).
- Final disposal of solid waste (financing, source, type of treatment, localization of garbage deposits, socio-spatial distribution).
- Reducing areas subject to landslides (number of areas benefited, areas container, resources, distribution in the urban area, population benefited).
- Channelling rivers, clearing watercourses, protecting springs within the municipality, conserving riverbanks (resources employed, areas benefited, distribution in the urban zone, population benefited).
- In areas subject to flooding (types of operations, amount of resources, areas and population benefited).

Indicators:

- *Total rehabilitated areas/Total degraded areas*
- *Investment in green areas, investment in environmental recovery*
- *Domestic connections*
- *Investment in public transport*
- *Investment in water supply and drainage systems*

SOCIO-CULTURAL, EDUCATIONAL AND PUBLIC COMMUNICATION INSTRUMENTS

Instruments that try to promote changes in the behaviour of individuals, companies and government bodies are increasingly employed to deal with problems that threaten the environment.

This practice is the result of understanding that, if social stakeholders do not change their posture with relation to the proper and sustainable use of natural resources, the use of other response instruments will have a very limited effect.

Environmental organizations, local government bodies involved in protecting and conserving the environment and national and international development financing agencies, today have reached a broad consensus on the central role of environmental education and communication in halting the irresponsible use of the environment.

The success and continuity of contemporary production and consumption models are supported by the constant use of advertising and marketing resources. In this respect, a wide range of instruments have been used in recent years to change consumption practices that are incompatible with the natural cycle of replenishing environmental resources and to make people more aware of the interactions between society and the environment.

Indicators:

- *Environmental education*

These instruments include mechanisms that encourage greater social participation in formulating, managing and following up on local public policies and decision-making on urban-environmental concerns about quality of life, whether the population as a whole or certain sectors of it.

In analysing this type of response, the focus should be on:

- Participation by civil society, incentives for participating in social organizations, in decision-making and in implementing public policy on the environment state/civil society/private sector projects, participating in elections, organizations that prepare environmental audits.
- Educational programmes and services (environmental education, campaigns on the use of natural resources, selective collection of waste, recycling material).
- Use of information technology (availability of environmental information on the Internet, radio and television programmes) to promote environmental communication.

OPTIONS FOR ADAPTATION TO CLIMATE CHANGE IN CITIES.

This section of the Manual refers to the segment of responses *(What are we doing?),* of the D-P-S-I-R matrix (Drivers – Pressure – State – Impacts – Responses). It is basically dedicated to actions for adaptation, as a component of the response strategies in the face of climate change in the urban setting. It must be borne in mind that cities are critical spaces, where important forces of adaptation (and mitigation) meet to combat the effects of climate change.

One of the objectives of this section is to cover one of the main gaps in the efforts to adapt to climate change: the gap between the scientific, academic and conceptual work available (on the supply side) and the concrete needs of the decision-makers in the urban centres (on the demand side).

ADAPTATION AS A RESPONSE STRATEGY IN THE FACE OF CLIMATE CHANGE.

BASIC CONCEPTS

In the response strategies to climate change, two basic strategies are identified: adaptation and mitigation, which can be deemed to be two key elements of the same agenda. According to the IPCC, adaptation is the adjustment of natural and human systems as a response to real or forecasted climatic stimuli or their effects. They are practices or actions that reduce damage or allow for opportunities that they might arise to be seized. (see IPCC, 2007).

There are initiatives and measures that are undertaken to reduce the vulnerability of natural and human systems in the face of the real or expected effects of climate change. There are different types of adaptation:

1. Preventive (anticipated) and reactive (corrective);
2. Automatic and planned;
3. Private and public;
4. Top-down and Bottom-up;
5. Oriented towards supply and oriented towards demand.

Adaptation is necessary in order to deal with the impacts of climate change and it has become inevitable due to the implications of past episodes. There are certain impacts for which adaptation constitutes the only available and convenient response.

The costs and benefits of climate change on cities vary according to different factors, chief among which are their location (temperate and polar regions, coastal areas and river banks, mountainous regions, deserts, etc.) and the scale (small, medium or large cities). In the case of adaptation, both costs and benefits are fundamental at the local level. At present, there are no exhaustive assessments of the costs and benefits of adaptation.

CAPACITY FOR ADAPTATION AND EXISTING BARRIERS

The capacity for adaptation differs from one society to another and even within societies. This capacity for adaptation is dynamic and various factors influence it, such as:

1. availability of economic resources;
2. availability of natural resources;
3. social and institutional networks;
4. preparation of human resources;
5. level of human development;
6. access to technology;
7. terms of trade and international finance;
8. Political will of governments, among others.

A high economic capacity does not necessarily translate into actions that reduce vulnerability. There are barriers, limitations and costs of adaptation. These barriers and limitations can be natural, environmental, economic, social, psychological, behavioral and gaps in knowledge and communication.

OPTIONS FOR ADAPTATION, MAIN ACTORS AND SECTORAL FOCUS.

The range of possible options for adaptation that are available to human societies is broad and includes technological, behavioral, administrative, and political options, among others. These actions involve different actors such as families, independent farmers, private enterprises, NGOs and national planning agencies. Often, planned adaptation measures are not applied as isolated measures, but rather as integrated actions within broader sectoral projects as in the case of planning of water resources, coastal defenses and risk management strategies. Adaptation measures are usually applied in sectors such as agriculture, tourism, human health, water supply, coastal management, urban planning and nature conservation.

LINKS BETWEEN ADAPTATION, MITIGATION AND SUSTAINABLE DEVELOPMENT

In those communities where sustainable development is widely practiced, there is a greater chance that they will be able to resist the impacts of climate change Policies that strengthen the capacity for adaptation and also contribute to promoting sustainable development and vice-versa.

As a part of the strategies for sustainable development, actions for addressing climate change (adaptation and mitigation) should be integrated in such a way that they can strengthen the synergies and eliminate potential conflicts as far as possible.

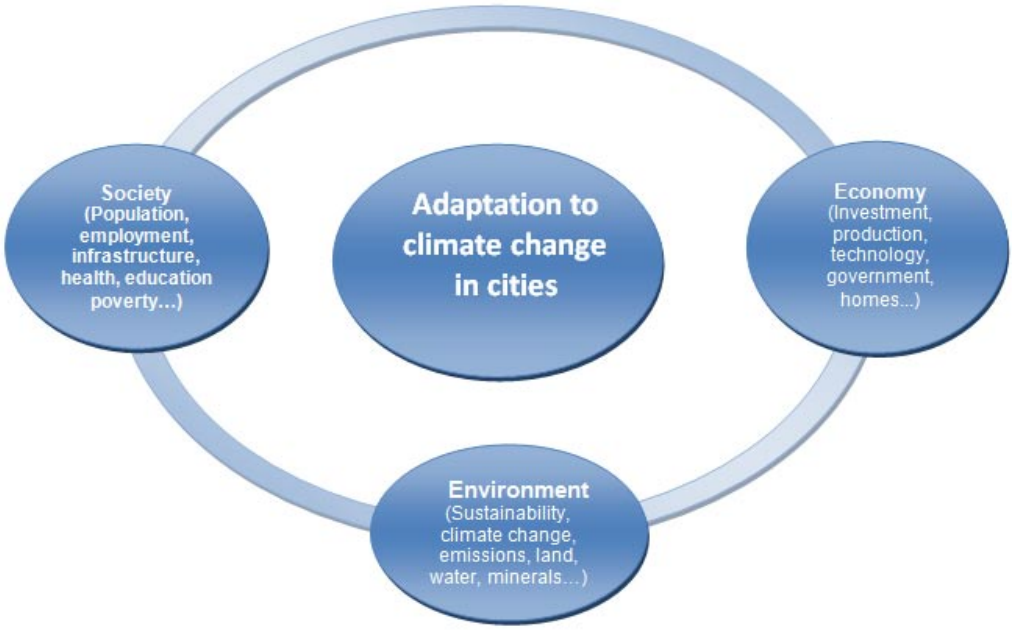
Any study of actions for adaptation in the context of sustainable development must consider:

1. the complexity and intrinsic diversity of the themes relating to adaptation;
2. the many levels and scales involved in adaptation;
3. the wide gamut of trans-disciplinary themes linked to adaptation;
4. the complex set of dynamic drivers that underpin climate change, global change and sustainability:
5. The locally-specific nature of the themes relating to adaptation.

Based on these considerations, the implementation of coherent strategies for adaptation, given the sustainable development objectives, requires trans-disciplinary foci that in order to satisfy the requirements of the decision-makers at the local level. These foci are in keeping with the need for multi-disciplinary and trans-disciplinary dialogue on themes relating to climate change, which facilitates links between the scientific community, the decision-makers and the city-dwellers.[53]

[53] See Jäger, Jill. "Climate Tools and Information to Support Adaptation", Vienna, Austria

FIGURE 9 SUB-SYSTEM DIAGRAM FOR STUDYING AND EVALUATING THE OPTIONS FOR ADAPTATION IN CITIES, AND THEIR LINK TO SUSTAINABLE DEVELOPMENT



Source: Diagram adapted from Jäger, Jill. "Climate Tools and Information to Support Adaptation", Vienna, Austria

SYSTEM OF INDICATORS FOR EVALUATING THE ADAPTATION CAPACITY OF CITIES

As a first approach to a system of indicators for evaluating the adaptation capacity of cities to deal with the impacts of climate change, the set of community-based54 disaster preparation indicators of the International Federation of Red Cross and Red Crescent Societies could be used as a reference. This is a local system of indicators for disaster preparation, which recognizes three types of indicators:

Based on the general classification expressed above, criteria are defined for indicators in eight basic areas:

1. **Degree of competence among the local population**: Local expertise (training); and Tools for preparation (guides and manuals).
2. **Local organization**: Local committees; and Supervision and monitoring.
3. **Infrastructure:** Design and maintenance (e.g. resistant construction techniques); Productive infrastructure (productive systems).
4. **Local instruments**: Early warning systems; and Emergency plan.
5. **Services**: Codes, norms and standards; and Access to communication services
6. **Information:** Learning from past experience; and Access and use of information.
7. **Investment: Maintenance, and Protection.**

[54] See: International Federation of Red Cross and Red Crescent Societies. Indicators for reduction/mitigation of risks and preparation before disasters. *Indicadores de reducción de riesgos y preparación ante desastres.* Abridged Document. First edition, June 2007.

DEFINITION OF CORE INDICATORS: RESPONSE INDICATORS

URBAN MASTER PLAN

Resource: All **Type of indicator: RESPONSE** **Category: New, Transversal**
Justification: What does it mean and why is it important to measure it? The Urban Master Plan presupposes a concern for regulating already institutionalized land use and occupation. Meanwhile, it should be associated with other responses, to specific environmental resources.
How is it identified? Necessary data Local authority and national legislation.
Measurements and units This is a qualitative indicator to be used when diagnosing the urban environment.
Possible time and space formats Information on the existence, date of local implementation.
Methodological resources reference There are none.
Objectives Guarantee planned urban development that includes questions on the environment

LEGISLATION TO PROTECT SPRINGS

Resource: Water **Type of indicator: RESPONSE** **Category: New**
Justification: What does it mean and why is it important to measure it? The existence of national and local regulations and their application has a direct impact on a city's environmental quality and natural resources.
How is it identified? Necessary data Information on legislation and on competent environmental control authorities and bodies.
Measurements and units This is a qualitative indicator in diagnosing the urban environment.
Possible time and space formats Information about, date of national, regional and local implementation.
Maps and geographic information systems. Methodological resources reference
Objectives Guarantee urban water supply quality as well as preserving biodiversity, air and soil by controlling occupation in areas where there are springs.
Goals, reference values The existence of standards and controls do not alone constitute a reference value.
Other comments/context This indicator should be associated with indicators on illegal occupation and settlements, quality and quantity of water supply and how effluents are treated.

REGULATIONS AND CONTROL OF EMISSIONS FROM MOBILE AND FIXED SOURCES

Resource: Air **Type of indicator: RESPONSE** **Category: New**
Justification: What does it mean and why is it important to measure it? National and local regulations and their application have a direct impact on city air quality.
How is it identified? Necessary data Information on legislation and on competent environmental control bodies authorities.
Measurements and units This is a qualitative indicator to diagnose the urban environment.
Possible time and space formats Information about, date of national, regional and local implementation.
Objectives Guarantee the quality of urban air by controlling emissions by industry and transport.
Goals, reference values The existence of standards and controls alone is not a reference value. Air quality may be measured according to international and national standards.

LOCAL AGENDA 21 ACTIVITIES

Resource: All **Type of indicator: RESPONSE** **Category: Core, Transversal** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? Local Agenda 21 (LA21) is an agenda for the 21st century where local government, the community and other interested stakeholders are deeply involved environmental y, economical y and social y and are focussed on the long term – with a sustainability plan, programme or set of activities. The long term effort includes setting specific goals, taking measures, following up and making assessments (such as audits, indicators and objectives).
How is it identified? Necessary data Record local cities' activities. May be defined in the LA21 table as a LA21 activity
Measurements and units Number of activities.
Possible time and space formats Tables, graphs.
Methodological resources reference ICLEI, 1998. www.iclei.org/cities21/c21ind.htm
Objectives Implement the LA21 process in the city and its local communities.
Goals, reference values The Rio Conference of 1992 decided that the LA21 processes should be implemented global y at a local level.
Application examples A21L in Durban: http://ceroi.net/Reports/durban/index.htm Sustainable cities and local government: http://www.unchs.org/scp/
Other comments/context In June 1992 the UNCSD adopted Agenda 21 as a global sustainable development action for the 21st century. The plan includes a special mandate for local authorities to act on LA21 by 1996. Document de A21L: http://iisd1.iisd.ca/rio+5/agenda/agenda21.htm

ENVIRONMENTAL EDUCATION

Resource: All **Type of indicator: RESPONSE** **Category: New, Transversal**
Justification: What does it mean and why is it important to measure it? Environmental education is the key to good environmental management so long as the responsibility for environmental quality is shared between authorities and citizens. The existence of mechanisms and actions on environment education reveals the integration of the subject into public policies and the daily life of the city's inhabitants.
How is it identified? Necessary data Local, regional and national authorities have data on environmental education legislation, standards and activities such as campaigns, movements and environmental subjects included in the formal school curriculum.
Measurements and units This is a qualitative indicator that can be used with other state and response indicators.
Possible time and space formats Existing long-term activities, expressed in charts and tables.
Objectives Stimulate awareness and public participation in the city's environmental management.
Other comments/context That the subject is institutionalized does not mean it has been included in local public policies. The subject must be associated with action, behaviour and attitudes which are, in turn, detected in the state of the environment as time passes

NUMBER OF ENVIRONMENTAL NON-GOVERNMENTAL ORGANIZATIONS (NGOS)

Resource: All **Type of indicator: RESPONSE** **Category: Core, Transversal** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? Society's participation and involvement are important for local democracy and for transparency in decision making, just as they are vital for successful Local Agenda 21 processes. The number of NGOs is an indicator of public participation and commitment.
How is it identified? Necessary data Number of groups, per 10 000 people, involved with local government
Measurements and units Number of NGOs per 10 000 people
Possible time and space formats Trend charts, graphs, tables.
Methodological resources reference ICLEI, 1998. www.iclei.org/cities21/c21ind.htm
Objectives Increase participation in and transparency of decision making processes.
Other comments/context Genuine involvement by all social groups and public participation in decisions are fundamental requirements for all Agenda 21 objectives, directives and mechanisms (Agenda 21 UNO, Chap. 23).

TAX SYSTEM BASED ON THE PRINCIPLE OF POLLUTER – PAYER AND/OR USER – PAYER

Resource: Water **Type of indicator: RESPONSE** **Category: Core** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? The application of preventive measures includes a polluter-payer tax system. Legislation is important and tax collection shows whether applying the tax is effective. It serves to internalize the environmental cost of pollution and to stimulate the use of clean technologies.
How is it identified? Necessary data Data are obtained from cities and competent environmental control authorities.
Measurements and units "Green" local tax system (percentage).
Possible time and space formats Graphs and tables.
Methodological resources reference ICLEI, 1998. Global Tomorrow Coalition, 1993. Walter Corsão: Measuring Urban sustainability. USA.
Objectives Increase the cost of polluting to encourage the adoption of clean technologies and processes.

PREVENTIVE WARNINGS AND FINES FOR VIOLATING THE WASTE DISPOSAL STANDARD

Resource: Land **Type of indicator: RESPONSE** **Category: New**
Justification: What does it mean and why is it important to measure it? The existence of solid waste disposal control mechanisms implies institutionalizing them and joint responsibility.
How is it identified? Necessary data Data obtained from local environmental control authorities.
Measurements and units Number of events per year.
Possible time and space formats Graphs and tables.
Objectives Reduce the production of solid waste, stimulate, minimize and reduce risks of environmental pollution from solid waste.

LOCAL SERVICES

Resource: All **Type of indicator: RESPONSE** **Category: Core, Transversal** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? The quality and reliability of local services are normally assured in industrialized countries, but in developing countries limited access to or the poor quality of these services may be a serious impediment to business productivity and may frustrate domestic users.
How is it identified? Necessary data Percentage of domestic services provided by water, drainage and garbage collection networks.
Measurements and units Household connected to the water supply network (total number and percentage of dwellings) Household garbage collection (total number and percentage of households)
Possible time and space formats Trend charts and plans.
Methodological resources reference UNCHS, http://www.istambul5.org/guidelines/indicators
Objectives Reduce the degree of frustration felt by the urban population.
Application examples Household Connections in Prague (CzR) http://www.ceroi.net/Reports/prague/issues/housing/state.htm

TOTAL OF REHABILITATED AREAS IN RELATION TO THE TOTAL OF DEGRADED AREAS

Resource: Land **Type of indicator: RESPONSE** **Category: Core** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? Degraded city areas being re-urbanized for other uses.
How is it identified? Necessary data Area in km2, percentage of total urban surface
Measurements and units • Area rehabilitated (km^2) • Area rehabilitated (percentage of total city surface)
Possible time and space formats Plans, trend charts, graphs.
Methodological resources reference EEA, 1997. Indicators for Sustainable Urban Development: Indicators for Urban Patterns. International Institute for the Urban Environment.
Objectives Restore affected spaces and buildings.
Goals, reference values There are no reference values.
Application examples The ongoing urban rehabilitation project: http://www.detr.gov.uk/housing/research/renewal/guidance/10.htm#1 http://www.inforegio.cec.eu.int/urban/upp/SRC/frame4.htm A good practical guide for administering and maintaining rehabilitation areas: http://www.detr.gov.uk/housing/research/renewal/guidance/09.htm#4

INVESTMENTS IN GREEN AREAS

Resource: All **Type of indicator: RESPONSE** **Category: Core, Transversal** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? The investments made to maintain and improve green areas, parks and public gardens are mainly for the city's environmental quality. This is important for recreation, as well as quality of life.
How is it identified? Necessary data Annual investment in maintaining green areas in relation to the city's GDP. It should be measured annually taking period of 2-10 years for a long-term assessment.
Measurements and units Percentage of annual investment in relation to the total municipal budget.
Possible time and space formats Graphs, tables and trend charts.
Objectives Improve green areas and public parks in cities.
Goals, reference values There are no goals or quantitative reference values, but access to green areas is considered important for the health of communities and for urban sustainability. The WHO recommends 12 m2 of green areas per inhabitant in cities.
Other comments/context It is important to guarantee the preservation of spaces, maintain them and ensure they are not replaced by built-up or waterproofed areas.

INVESTMENTS IN ENVIRONMENTAL RECUPERATION

Resource: All **Type of indicator: RESPONSE** **Category: Core, Transversal** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? Investments in degraded urban areas and those being rehabilitated for sustainable use.
How is it identified? Necessary data Data obtained from the municipality and reclamation investment programmes, total values that may be compared with the city's budget. May also include private initiative investments.
Measurements and units Value of investments in local currency or in U.S. dollars in a given year. Long-term measurement shows trends to improve environmental protection and rehabilitation.
Possible time and space formats Graphs maps and tables
Objectives Reduce the number of degraded areas and recover the quality of environmental resources.
Goals, reference values EEA, 1997. Indicators for Sustainable Urban Development: Indicators for Urban Patterns. International Institute for the Urban Environment.
Application examples On ongoing urban rehabilitation project: http://www.detr.gov.uk/housing/research/renewal/guidance/10.htm#1 http://www.inforegio.cec.eu.int/urban/upp/SRC/frame4.htm A good practical guide for administration and maintenance of renovation areas: http://www.detr.gov.uk/housing/research/renewal/guidance/09.htm#4
Other comments/context The Brownfield, United Kingdom, programme that basically seeks to develop commercial and industrial abandoned spaces and create more than 6 400 jobs. In addition, the pilot communities have already reported an economic impact of more than US$2 000 million http://www.epa.gov/epahome/headline2_0824.htm

INVESTMENTS IN WATER SUPPLY AND DRAINAGE SYSTEMS

Resource: Water **Type of indicator: RESPONSE** **Category: Core** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? Basic sanitary systems that include water supply, collection and treatment of sewage are municipal services. Supplying drinking water with no danger of pollution from sewage is necessary for life and health. This indicator measures the importance the city places on improving its water supply and drainage systems.
How is it identified? Necessary data Investment in water supply and drainage systems in relation to each city's federal income. This indicator should be measured every year.
Measurements and units Investment in water supply (Total value, incremental value = total value/number of additional households supplied, percentage of municipal income) Investment in drainage system (collection and treatment systems) (Total value, cost of collection networks increase = total value/number of households served by the network, cost of treatment per unit = cost of treatment system/population served, percentage of municipal income)
Possible time and space formats Trend charts, graphs.
Objectives Improve municipal water supply and drainage systems.
Goals, reference values There are no international reference values.
Other comments/context Throughout the world, women are mainly responsible for "picking up" and handling water. They are also responsible for household tasks, hygiene, family health and sanitary arrangements. Therefore, women must take a full and active part in programmes on water supply and sanitation.

INVESTMENTS IN WASTE MANAGEMENT

Resource: Land, water, biodiversity
Type of indicator: RESPONSE
Category: Core
Source: UNCSD

Justification: What does it mean and why is it important to measure it?
Management of urban domestic waste is mainly the responsibility of local authorities. The cost of managing waste is an important factor that defines the city's commitment to urban sustainable development. When waste management is inadequate it causes a significant worsening of health, quality of life and the environment, which adds to the loss of productivity, harms the economy and compromises urban attraction.

How is it identified? Necessary data
In general the cost of waste management includes the total spent on public and private services to collect and dispose of the city's garbage. This indicator does not include management of hazardous waste from industry which is the responsibility of the sources themselves. The indicator is calculated as a total investment in waste management services in relation to the city's income and in relation to the total volume of waste handled.

Measurements and units
Investments in waste management (total value, unit value = total value/total volume of waste handled, percentage of municipal income)

Possible time and space formats
Graphs, tables and trend charts.

Methodological resources reference
OECD, 1997. Better Understanding Our Cities: The Role of Urban Indicators. EEA Indicator Set. UNCHS, 1995. Monitoring Human Settlements: A Bridged Survey EF, 1998. Urban sustainability Indicators for the Improvement of Living and Working Conditions

Objectives
Improve the municipal waste management system.

Goals, reference values
There are no international reference values.

Application examples
Good practices: resources and urban street cleaning in Barcelona
http://wwww.mediambient.bcn.es/eng/fmaker.htm?cont_bcn_present.htm

Other comments/context
Possible investments to improve the management system may include programmes, on different scales, on selective collection, recycling, environmental education, support for initiatives linked to recycling and other activities related to waste management innovations and training. Investments in these areas, as well as being included in the total value, should be listed separately.

INVESTMENT IN PUBLIC TRANSPORT

Resource: All **Type of indicator: RESPONSE** **Category: Core** **Source: CEROI**
Justification: What does it mean and why is it important to measure it? Urban traffic is directly related to atmospheric pollution and human health problems. Investments in public transport show what is being done to reduce these pressures.
How is it identified? Necessary data Investments in public transport in relation to the total cost of the system of public roads.
Measurements and units Investments in public transport (total value, percentage of value of the cost of public roads, percentage of municipal income)
Possible time and space formats Trend charts, tables and graphs.
Methodological resources reference Local Government Management Board, 1994. The Sustainability Indicators Research Project: Indicators for Local Agenda 21 – A Summary. United Kingdom
Objectives Improve access to public transport for users and the quality of services.
Goals, reference values There are no international references.
Application examples Strasbourg Tramway: http://cities21.com/egpis/egpc-047.html
Other comments/context In recent decades, a dramatic change has been seen in passenger transport in favour of private vehicles, the percentage of these vehicles in traffic rose from 65 to 74 from 1970 to 1997. The share of air traffic, the least efficient method of transport, grew from 2 to 6.7 per cent. Rail transport's share fell from 10.1 to 5.8 per cent; walking and bicycle transport also fell dramatically. In general, more than 50 per cent of trips in motor cars are less than 6 km, a distance which in congested urban areas could be covered more quickly by bicycle; 10% of trips are less than 1 km, an ideal walking distance (http://binary.eea.eu.int/t/term2000_sum.pdf)

EMERGING ISSUES AND SCENARIOS

The GEO Cities report aims at preparing a strategic outlook that requires the technical team to identify the themes that might be seen as central to a definition of urban and environmental policies in the future. In the definition of the GEO[55] methodology the concept of emerging themes pre-supposes a medium to long-term outlook.

Environmental changes caused by human activity, with little or no short-term significance, may lead to cumulative effects over time (more than two generations). The changes in the global scene are difficult to recognize on a human lifespan or government-mandate time scale and, therefore, are uncertain and controversial.[56]

It is impossible to predict all the variables influencing environmental changes. Nevertheless, the scientific uncertainty does not justify taking no action to protect the environment.[57] Hence the strategy used to identify critical points, and to plan and implement preventive measures, uses the precaution principle as a reference.

Steps for Building Scenarios

1. *Define the environmental problems and explain its outline (policies and actions).*
2. *Diagnose the causes and consequences that determine the state of environment.*
3. *Define the objectives and goals (policies) to obtain the result required.*
4. *Identify the public policy option.*
5. *Define alternative paths to the desired objectives.*
6. *Identify possible results, problems and probable obstacles to sustainable development objectives.*
7. *Define alternative strategies.*
8. *Adopt a holistic, comprehensive approach.*
9. *Plot conclusions on the results of each of the possible scenarios.*

The GEO methodology identifies three categories of environmental material that might prove to be very important in the 21st century;

a) Unexpected events and scientific discoveries.
b) Unexpected changes in recurring events.
c) Changes in known events with unknown consequences over the medium and long term for which adequate responses are now available.

It may be possible to dispense with these themes at local level but the advantages of taking them into account are obvious:

a) to make citizens aware of how closely local and global environments are linked;
b) to act early enough to guarantee adaptations and avoid crises;
c) to provide continuity or begin keeping historical records using direct research and the systematic collection of data;
d) to promote understanding of all the relationships between human activity and the environment; to make sure scientific knowledge is included in public management.

[55] UNEP, IISD, and Ecologistics International, 2000: Capacity Building for Integrated Environmental Assessment and Reporting. Training Manual.
[56] Jäger, Jill and others, "GEO Resource Book: A training manual on Scenario development and analysisTraining Module 1" *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD
[57] The concept is new and has gained force only over the past decade in the implementation of intermediate or public policies on the environment. The United Nations 1992 Framework Convention on Climate Change serves as a legal base for international treaties, such as the Kyoto Protocol, aimed at reducing the effect of greenhouse gases.

These subjects will form part of the public agenda of cities in the not too distant future, taking into account the accumulation of environmental problems that remain to be solved (environmental liabilities), and that generally accompany urban development and the growth of cities.

These are some of the subjects to be dealt with:

- Polluted locations or brown fields, and their impact on health and ecosystems;
- Environmental conflicts related to economic losses and damage to health and quality of life caused by environmental pollution;
- Environmental compensation for pollution caused by industrial activities in the locality;
- Environmental responsibility related to generating environmental liabilities;
- Advantages and limits for competition and local development resulting from each locality's environmental liabilities;
- Urban vulnerability and environmental disasters; the effect on our planet's present climate changes due, in part, to the emission of greenhouse effect gases into the atmosphere by local industries.

Emerging themes will depend on the specific relation of the local urban situation to the territory's natural resources and ecosystems. This stage, together with the previous early warning one, includes a double resource that will influence local public policy decision-making.

The definition of emerging themes also permits the assessment of responses given to the city's main urban-environmental problems. These responses may, then, be assessed on the levels of already-existing problems and emerging themes.

BUILDING SCENARIOS: LOCAL TRENDS (INERTIA, BEST CASE, WORST CASE)

Long-term processes and the projection of scenarios that reflect civil society's responses to urban development environmental problems are necessary for sustainability to be possible in cities. The scenarios are not forecasts, but suggest a range of options that reduce uncertainty about policy options.

With the help of simulation studies, managers will assess the aims and progress of urban environmental policies according to their objectives and availability. To prepare scenarios is to set in motion possible visions of the future from present options. Building these scenarios demands the use of qualitative and quantitative data. Some trends may be easier to outline than others, and these require quantitative data.

The result will be a mixture of indicators, trends and potential goals with explanatory texts that relate the history. For effective decision-making, information on costs and benefits is also relevant because it permits the analyst to determine the feasibility of each scenario's economic and the financial needs.

The scenarios are based on three types of trends:

THE INERTIA TREND

A broadening or worsening of the problems is projected. There will be no response to environmental problems detected; if there are any, they will not be adequate or will not meet the objectives.

THE BEST CASE TREND

An improvement in the state of the local environment, either in all sectors or in those where social stakeholders have intervened. Perfectly adequate responses by local government and society and there are no obstacles to prevent appropriate action.

THE WORST CASE TREND

No response to the problems. Conditions for action are not appropriate or even obstructive; decisions by social stakeholders increase or worsen pressure on the environment.

These scenarios should help decision-makers assess the impact of action, or inaction, when faced with the city's environmental problems.

4. PREPARING GEO CITIES REPORTS

To prepare a GEO Cities Report, the local team must collect and analyze available data to carry out a comprehensive assessment of the state of the environment, environmental policies and to develop suggest solutions for problems detected. To help with the proposed task, this manual describes each step of the process. It also seeks to encourage participation by different sectors in the process and communicate the results and proposals to the largest possible number of stakeholders, both in local government and in society in general. Activities of each stage of production of the assessment may be undertaken with relative independence and, depending on local circumstances, in a different sequence than the one that appears in this manual based on what best suits the political and institutional situation in each city.

STAGE 1: INSTITUTIONAL

INSTALLATION ACTIVITIES

WHY IS THE PROCESS IMPORTANT?

As we have seen, the objectives of the integrated environmental report are broader and more ambitious than those of traditional environmental reports. Therefore, individuals and organizations must be aware of them. Members of the technical team represent different disciplines, organizations and even different social strata. They probably have different points of view, all equally valid, about the environment and the economy. Opportunities for learning will arise in the very process of producing new information, through the interaction between the team members.

Sequence: the order of the key questions (Figure 11) guides the process. We need to first know what is happening to the environment to understand why it is happening. We also need to understand the driving forces and the main causes to be able, later on, to discuss what action to take or the consequences of not taking action.

Cooperation: the task depends on the capacity of the team to work together. Integrated environmental assessment requires bringing together information and insight that usually lay scattered across a variety of disciplines and organizations. Thus it also requires bringing together organizations and people that may not have a history of collaboration. The potential for 305 tension along professional, bureaucratic, religious or political lines is considerable. Trust, confidence and cooperation both between organizations and key individuals are key for success. Buy-in: The report is meant to increase knowledge about the interaction between society and the environment so as to bring about needed changes. The best way to ensure that its observations and recommendations

influence decision-making is to involve the people who need to make the decisions and those who are affected by the results. Clarity: From the beginning, it is important to clarify the uncertainties and assumptions involved in preparing a report of this type, to permit participation and cooperation, throughout the whole process, by groups with different interests. Nevertheless, this may imply significant challenges for the participants.

FIGURE 10 GEO CITIES PROCESS

WHO WILL ADMINISTER IT? WHO WILL TAKE PART?

The organizational structure should function, both in the first stage (which studies environmental conditions) and throughout the whole process. Therefore, it is important that all participants understand the need for a long-term commitment. The assessment and integrated report are tools that can be used to facilitate communication between science and policies. This role is particularly important because the assessment and the institutionalized report may leave the way open for a continuous dialogue between the interested parties and society in general. To bring together science and politics there has to be a participatory process. However, the number of participants must be limited to make it possible to handle the report's preparation properly.

- ***Central Team:*** *five or six members of core bodies (NGOs, academia institutions, business associations)*
- ***Cabinet or Round Table:*** *high-level government body to which the Central Team submits its reports (may also be round tables, composed of different interested bodies or groups)*
- ***Principal Agency:*** *planning or environmental bodies.*
- ***Specialist or Technical Advice Group:*** *participants from different government bodies or other organizations with specialized knowledge and direct access to the main data.*
- ***Focus or Interested Parties Group:*** *representatives of social organizations. Focus groups have been used for participatory research. They inform decision-makers about society's preferences, opinions and concerns, and cooperate in decision making on complex political subjects.*

IN WHICH INSTITUTIONAL ENVIRONMENT?

In recent years, many cities, organizations or Non-Governmental Organizations and institutions have published integrated environmental assessments (IISD 1999). To avoid that local governments exclusively dominate the report and the assessment, social groups must be given a leading role.

Nevertheless, as this programme deals mainly with government reports, these efforts should be considered as being synergetic rather than competitive because they inform the public about outlooks that, while different, are also pertinent. It is important that the report's institutional context be consistent with the broadest institutional framework of the city or the country. Some cities have experience on scientific research, systematic gathering of data and planning. In these cases, information on the environment may be well developed and organized. However, in other cities the information may be scattered and, thus, the report may appear uncoordinated. As there are no fixed rules, the way is left open for many variations.

TABLE 2 MOST COMMON INSTITUTIONAL MODELS

TYPE OF AGENCY	POSSIBLE ADVANTAGES	POSSIBLE DISADVANTAGES
EXISTING GOVERNMENT BODY	Limits proliferation of special agencies. Existing regional networks. More collaboration within local government. Access to data and information.	Not recognized as being independent. Limits public and other stakeholder involvement. Tends to protect the status quo.
INDEPENDENT OR SEMIINDEPENDENT AGENCY	Autonomous. High profile and visibility. Potential for innovation and greater efficiencies. Links non-governmental stakeholders and scientists	Requires formal powers to access information. Lacks regional networks. Potentially insecure funding. No authorities are associated with the report.

Source Guidelines for AEO Cities, Integrated Environmental Assessment and Reporting, First Draft, Adapted from Environment Canada, 1992 – (Cf. Training Manual. UNEP, IISD, Ecologistics International Ltd., Op. cit.)

WHAT IS THE LEGAL MANDATE?

Assessment and reporting are complex tasks and will not produce the expected results unless they are carried out correctly. This requires that the mandates and capacities to carry out this task are considered as part of the core infrastructure of social organizations, a responsibility often of government. The mandate should be clearly backed by laws and regulations.

a) Legislation may include the degree of collaboration between government agencies that contribute to the report.

b) A joint working method may also be established between the national or local authority preparing the statistics, national or local follow-up programmes and the agencies presenting the reports.
c) It is recommended that legislation include a discussion on environmental reports between different sectors of government. A national agency may, for example, perform a catalytic and support role to prepare the report at sub-national and local levels.
d) Legislation may promote exchange of data and harmonization of report initiatives.
e) Finally, the authority prepares the way for consultations and external participation by advisory groups.

IDENTIFICATION AND COMPOSITION OF THE LOCAL TECHNICAL TEAM

IDENTIFICATION OF MULTI-SECTORAL STAKEHOLDERS, BOTH PUBLIC AND PRIVATE

One of the most important steps in the process is to identify the social stakeholders to be part of a technical team. The stakeholders are representative individuals and organizations available to participate in planning activities and in applying them. They can be:

- Suppliers: persons who control and administer services
- Users: persons who use and are directly affected by the services
- Interested: persons who will be indirectly affected by the impact of the service or of its system
- Experts: persons with specific knowledge about the service and the service of the environment
- Social groups, and
- Excluded: persons with no access to the services

TRAINING THE LOCAL TECHNICAL WORK GROUP OR TEAM

This sets out the basic steps to train the work groups in societies covered by the AEO Cities project.

1) Determine the scope of planning and define its objectives. This should be done by whatever body starts the process (the city) together with the stakeholders. It should include an educational campaign to arouse interest and gain support.
2) Create or design a General Co-ordination to regulate and guide the general planning effort, as well as to integrate the results of the debates, research and planning of an action plan or plans.
3) Establish a "Working Groups" structure under the supervision of the General Coordination. These working groups will be given responsibility for setting planning tasks such as: establishing priorities, analysing certain questions, preparing an overall view, or they may be established to study determined questions that include such matters as garbage, health and so on.
4) Identify the appropriate specialists to join the local team and the working groups.
5) Establish terms of reference for each group's activities that include defining the relations between planning the process's stages and city administrative planning, such as the budget, to free the needed resources.

This may be organized as follows:

Selecting GEO Cities report participants

Ensure the participation of:

1. Under-represented groups
2. Service users
3. Service suppliers
4. Sectors whose interests are indirectly affected by the impact of the service or of the system
5. Sectors with specific knowledge of the service or the service environment The following should be considered when electing associates:
   - The purpose of the work
   - The Involvement of the largest possible number of organizations and individuals with the political will to act
   - The desired degree of inclusion
   - The abilities, knowledge and experience with which the individuals and organizations may contribute
   - The inclusion of sectors needed to implement any project
   - The inclusion of credible individuals or organizations together with the groups they represent

Source Guidelines for AEO Cities, Integrated Environmental Assessment and Reporting, First Draft

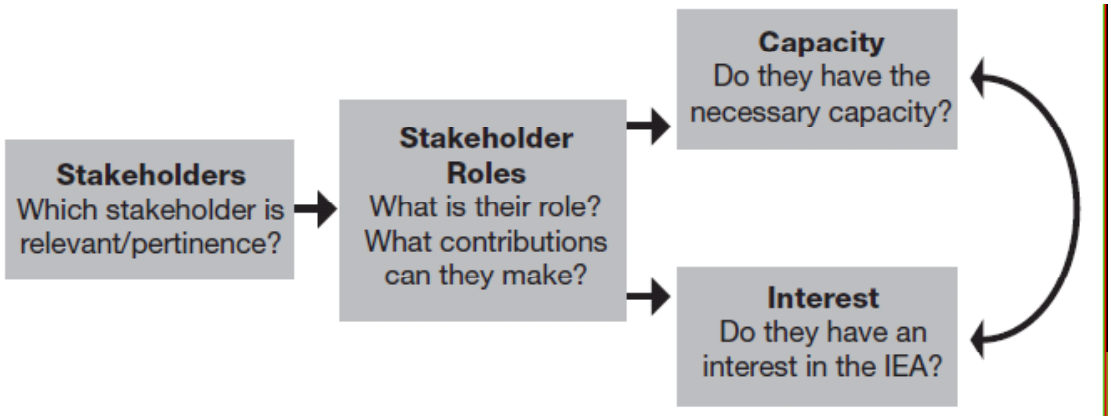
Each city will have its own possibilities of designating the local team. What is important is to ensure that, throughout the process, more stakeholders join the effort. This is an indispensable prerequisite if GEO Cities is to succeed.

STAKEHOLDER ANALYSIS

to assure that the different stakeholders are represented, stakeholder analysis is very helpful.

The analysis identifies and examines key stakeholders, fulfilling criteria such as representation across sectors, gender and available capacities. The analysis alone does not guarantee though that the identified stakeholders are going to be active in the process—this may need incentives and strong leadership, Figure 12.

FIGURE 11 IDENTIFYING STAKEHOLDERS, THEIR ROLES AND INTERESTS



Source: UN HABITAT (2002) Herramientas para una gestión urbana participativa. Colección de Manuales. *Ediciones SUR*

Stakeholder analysis includes three elements (IEA module 2):

Key issues or problems that will be discussed throughout this module. Identify stakeholders relevant to the vulnerability, climate change impacts and adaptation issues.

Stakeholder long list. Prepare a detailed list of stakeholders, structured by general categories (such as public sector and private sector) as well as sub-categories (see Table 2). The list should include stakeholders that meet any of the following criteria.

- They are affected by climate change and/or living in the areas of high vulnerability, which could exaggerated by progressing climate change.
- They have information, resources or expertise required for climate change impact and vulnerability assessment, policy formulation and strategy implementation.
- They have control or influence on key mechanisms for adaptation and strategy formulation, implementation and communication.

DEFINITION OF THE BASIC AGENDA

One way of reconciling the contribution of the different social stakeholders is to define a basic agenda, which should include:

1) The preparation of terms of reference and of commitment. Once the scope is determined, the social structures defined and identified, the next step is to use the terms of reference to define roles, responsibilities and commitments. These terms of reference include:
   - Joint activities.
   - The partners' roles, including specific activities to be carried out. The information will be provided, as well as a programme of contributions.
   - Rules for sharing information used in the process (including confidentiality agreements).
   - Decision methods (including problem solving).
   - Resources to be provided by each partner.
   - Agreements on how to integrate the results of the process into the city's planning activities.

   These terms of reference should be assigned by members of the local team and periodically reviewed to ensure they are being complied with and are kept up to date.

2) Defining the time-table for activities

   The timetable helps to plan the work and to monitor progress. 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 be as precise as possible when defining the time required. If the estimated time is very long (more than a year, for example), participation might be difficult, and it will add to the project's costs. Furthermore, the time required could mean that the quality of the work might suffer and tensions might arise among the group.

3) Defining goals (products and processes)

   The goals, together with the timetable, are the team's guide. They specify expected results and how to achieve them. The goals may be either intermediate or final. Intermediate goals are the stages needed to reach the final goals. Defining them with precision will help to reach the final result and ensure the work remains consistent. An example of an intermediate goal is holding technical discussion and methodology workshops for team members and any consultants contracted. The final goals are the GEO Cities Report, the material to be published and the seminar when the results will be presented to the public.

TRAINING THE LOCAL TEAM

The GEO Cities Report methodology requires an apprenticeship to learn what it is and how to apply it to assess the state of the local environment. There are two approaches to training in the methodology:

1) Technical training and public policy workshops

   By definition, the technical team covers a wide range of interests as to knowledge and experience on environmental problems and this demands a minimum of conceptual standardization. The training workshops help to create a basic level of understanding of the factors involved in the interaction between urban development and the environment and the features and range of the GEO Cities Report. Training has three variants:
   - Managing the GEO Cities methodology, including the use of the DPSIR matrix and the use of indicators.
   - Managing the techniques of collecting and analysing data for the report.
   - Discussion on the process of formulating, managing and following up public policies, in particular on subjects relating to urban areas and the environment..

2) Production and distribution of publications

   To prepare the report properly, all members of the team need to have access to information on their fields of interest, including GEO reports, GEO Cities methodology and specific studies on the themes relating to local environmental assessment. Information that is promptly available to all members helps the technical team to work as a unit and improves their ability to produce the report.

STAGE 2 – IDENTIFYING INDICATORS AND INFORMATION SOURCES

URBAN-ENVIRONMENTAL INDICATORS

The GEO Cities initiative uses indicators as the basis for analysis. These indicators can be seen as scientific instruments that allow a description of the characteristics of a phenomenon or the evaluation of its performance in time and space.

There are many types of indicators and which one should be selected varies according to what is being assessed. In the GEO Cities project, the indicators used will depend on the objectives defined by each technical team and will be chosen from the established group of urban-environmental indicators.

This group of indicators is presented below according to the conceptual definition of each of its components and the stage of the process in which it is to be used. In Section 3- GEO Cities Indicators, there is a detailed description of each indicator, the justification for its use and the proper way to measure it

INDICATORS: WHAT ARE THEY? HOW TO USED THEM?

An indicator should be substantial, reflecting an essential aspect of an objective in precise terms. An indicator should be independent at different levels, i.e., an indicator cannot be used for more than one objective. It should be factual reflecting than subjective impression; plausible, changes recorded directly resulted from an intervention; and finally yet importantly, obtainable data that are readily available or collected with reasonable extra effort as part of the administration of the project. To summarize, indicators should be "objectively verifiable" when different persons using the same

measuring process independently of one another obtain the same measurement; they are guiding values to analyze project concept, and then reviewed when the project becomes operational where they could be replaced by specific indicators.

An indicator has several definitions. It is a pointing or directing device, as a pointer on the dial of an instrument to show pressure, temperature, speed, volume, or the like; it is an instrument that indicates the condition of a machine or the like; or an instrument for measuring and recording variations of pressure in the cylinder of an engine. A chemical indicator is a substance, as litmus, that indicates the presence or concentration of a certain constituent. An ecological indicator is a plant, animal, or species that indicates, by its presence in a given area, the existence of certain environmental conditions.[58]

Urban indicators are regularly collected to report on progress in the twenty key areas of the Habitat Agenda at the city level. Local and national urban observatories as well as through selected regional institutions collect data.[59]

BRIEF DEFINITION

Indicators are an essential component in the overall assessment of the progress towards sustainable development. Desirable indicators are variables that summarize or otherwise simplify relevant information, make visible or perceptible phenomena of interest, and quantify, measure, and communicate relevant information (SCOPE 1997). The major functions of indicators defined by the SCOPE publication are to:

- Assess conditions and trends;
- Compare across places and situations;
- Assess conditions and trends in relation to goals and targets;
- Provide early warning information;
- Anticipate future conditions and trends.

Indicators are "packets of information" that help us understand the complex interactions between different phenomena. Indicators, by organizing and synthesizing information, perform a variety of functions and contribute to reaching different objectives, applicable to science, to politics and to daily life. Furthermore, indicators are indispensable for well-informed decision-making and in planning urban development and environmental management. Indicators give statistical, scientific and technical information to the population as a whole and to certain social sectors about public policy objectives and goals, the features and trends of urban, environmental, economic and social matters and show how effectively or otherwise public bodies perform. Figure 13 shows how indicators contribute to making policy decisions.

CRITERIA FOR THE SELECTION OF INDICATORS

Some principles must be observed when selecting indicators since many data are available, but little useful information. The essential purpose in selecting the indicators is to allow decision-makers to have quick access to reliable information on the state of the local environment. They also serve as a reference framework for technical teams, illustrating the main features of the interaction between urban development and the local environment.

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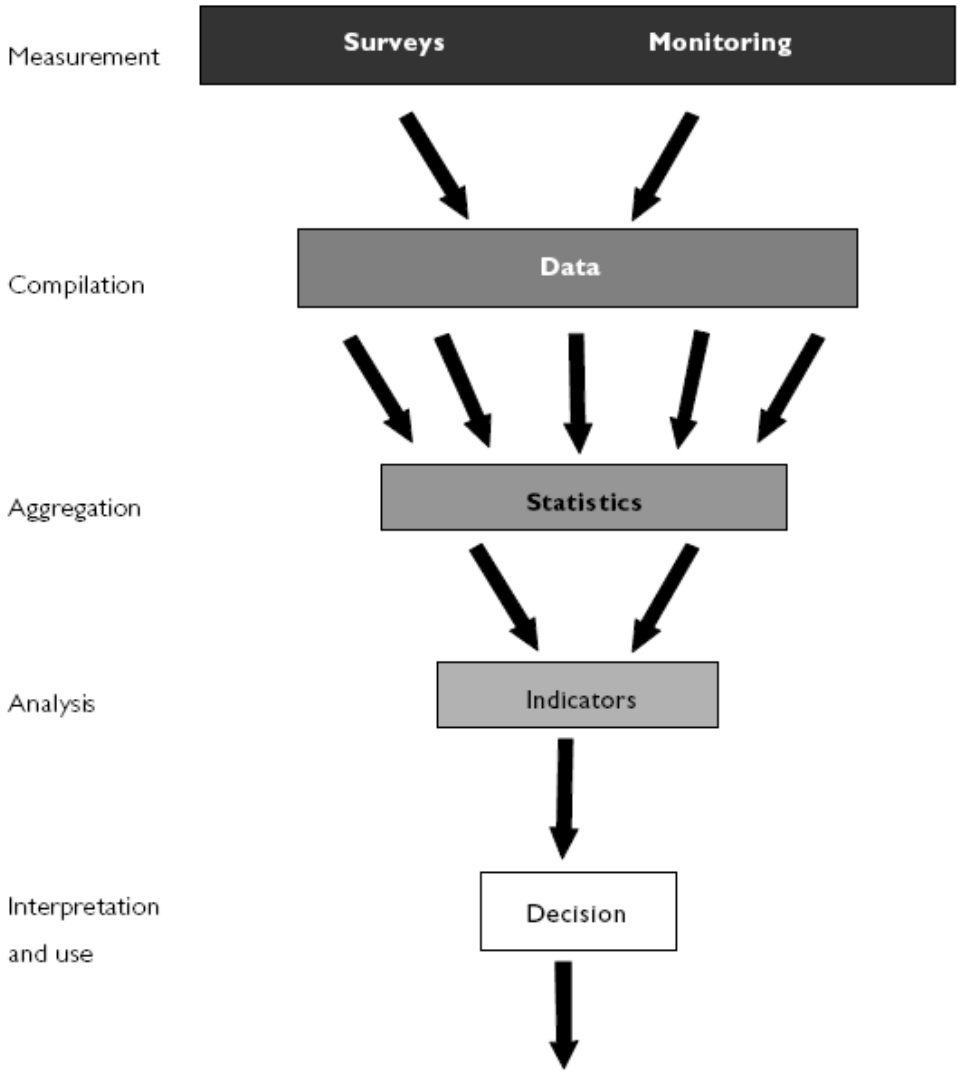
[58] Dictionary.com Unabridged (v 1.1) based on the Random House Unabridged Dictionary, © Random House, Inc. 2006. http://dictionary.reference.com/browse/Indicator (accessed Tuesday, January 05, 2010)

[59] UN-HABITAT, "Urban indicators," http://ww2.unhabitat.org/programmes/guo/urban_indicators.asp (accessed Tuesday, January 05, 2010)

FIGURE 12 INDICATORS USED IN DECISION-MAKING



Source: von Schirnding, Yasmin (Dr.) 2002. Health in Sustainable Development Planning: The role of indicators. Geneva: World Health Organization

TABLE 3 CRITERIA FOR SELECTING URBAN-ENVIRONMENTAL INDICATORS

CRITERION	SHOULD
Policy Relevance / Useful to the User	✓ Provide a representative picture of environmental conditions, of the pressure on the environment and society's response. ✓ Have an easy to understand presentation and show long-term trends. ✓ Be sensitive to changes in the environment and related human activities. ✓ Provide a basis for international comparisons. ✓ Be applicable to national and/or nationally important regional environmental material.

CRITERION	SHOULD
	✓ Correctly reflect public policy priorities.
Analytical Consistency	✓ Have scientific and technical foundations. ✓ Be based or founded on international models and on an international consensus about their validity.
Measurement	✓ Be or become available on a reasonable cost/benefit basis. ✓ Be appropriately documented and of recognized quality. ✓ Be periodically updated following appropriate procedures.

TABLE 4 ADDITIONAL CRITERIA TO SELECT INDICATORS

CRITERION	SHOULD
Easy to Understand	✓ Allow all users to have similar interpretations and perceptions. ✓ - Be transparent, that is, be easy to understand by users with different levels of comprehension and information.
Reliable	✓ Be technically-scientifically credible. ✓ Be created by institutions with recognized capacity and technically reliable.
Transversal/Universal	✓ May be used to learn about trends of different phenomena and, at the same time, allow comparisons to be made between different local situations.
Available	✓ Be or become available and, preferably, present historical territorial analyses that help to understand how phenomena behave over time.

INDICATORS AND THE PSIR MATRIX

The matrix of Pressure-State-Impact-Response (PSIR) is the reference for the indicators used in preparing the GEO Cities Reports. The example in Table 1, applied to water, shows the logical integration between the PSIR matrix indicators. As shown in the example, once the pressure indicator is defined, the other indicators must keep the same logical-causal relation that allows the Report's comprehensive assessment to be made. This format enables us to understand better the role of indicators in assessing the state of the local environment and understanding the dynamics of degradation, its diverse effects and possible solutions.

INDICATOR CATEGORIES

The urban environment indicators are divided into five categories according to how general or specific they are, or their importance to the Report (Table 5).

CORE INDICATORS

The PSIR group of indicators are the core indicators used to assess the state of the local environment. These are related to the essential elements needed to analyze it, and without which the assessment cannot be properly carried out.

TABLE 5 INDICATOR CATEGORIES

Category	Definition
Core	Already exists and considered essential to analyze the environment
Proxies	May replace the core indicator, even though its reference quality is not the same
Logical	Specific and considered necessary to understand each locality's special features
New	Suggested by the GEO Cities methodology to help with the state of the environment assessment
Transversal indicators	Used to analyse more than one environmental resources in any of the dimensions of the PSIR matrix

Most core indicators proposed in this document already exist, and are internationally recognized; the indicators produced by organizations such as OECD, UNCSD and ICLEI are especially related to pressure and state factors of the environment and, to a lesser extent, to impact and response factors.

PROXY INDICATORS

Because of the scarcity of technical and financial resources, insufficient collection of data, limited exchanges with international institutes qualified to prepare and use urban-environmental indicators, and other reasons, sufficient and reliable data are not always available to produce state-of-the-environment indicators.

Therefore, it is recommended that a number of proxy indicators be provided to give an approximate idea of the features and trends of the issues on which information is required to prepare the environmental Report for each city. The proxies are used when there are no core indicators available or when these are not up to date. Their use requires the technical team to be clear about their objectives.

Only the technical people responsible for preparing the Report may define which proxies should be used. Table 6 presents a Basket of Indicators, a list of different sources that allows indicators to be substituted when necessary. There are also Internet addresses where indicators may be located.

LOCAL INDICATORS

The technical teams are free to include or create indicators that reflect the characteristics of the local ecosystems, helping to reflect better local specific features in the Report. The use of the indicators should obey two general principles:

1. **They should be necessary for the Report.** Using many indicators is not recommended, as this might confuse users by bombarding them with information instead of helping them to understand the phenomenon, and might make it more difficult for them to adopt a practical attitude towards dealing with the problems.
2. **They should be clearly described.** Their use has to be justified, the way they are to be calculated precisely defined, and it should be made clear to which urban-environmental development model they belong (pressure, state, impact or response).

NEW INDICATORS

Urban conditions, and how they interact with the environment, are ever changing and often demand the creation of new indicators capable of keeping pace with their rhythm and direction. Among the indicators proposed by GEO Cities, an important group is focussed on how local government and society respond to environmental problems.

As cities are located in different ecosystems, with different environmental features, the environmental effects of urban growth can vary greatly, which is why these new indicators are needed.

Should the technical team propose new indicators that may or may not be the result of a combination of already-existing indicators, it is important they are described in such a way that other technical teams can use them too, if they think it necessary.

TRANSVERSAL INDICATORS

The GEO Cities methodology separates the environment into its constituent elements of water, atmosphere, soil and biodiversity so that it is easier to assess each of them, but we must remember that they are all integrated, and act in relation to each other.

For that reason, some indicators proposed here are transversal, meaning they may be used to analyze more than one environmental resource in any of the dimensions of the PSIR matrix. Transversal indicators reduce the total number of indicators, making it easier to assess the environment and clearly reveal the relationship between natural resources and the effect of urban development on the environment.

TERRITORIAL DIMENSION OF THE INDICATORS

The area to be covered by the assessment is something that the teams should pay a great deal of attention to and to which they must devote special care. This is a problem of particular interest for urban centres in metropolitan zones where the limits of the urban centre are difficult to define.

In contemporary societies, urbanization often extends beyond city limits. This can lead to some confusion regarding city boundaries, as suburbs and urban peripheries grow.

In such cases, it is also difficult to determine to what extent the local environment is the product of pressure by one particular city rather than by a cluster of urban centres.

It could also happen that the data available to make an assessment refers only to the most important city in a metropolitan area, or it may cover the entire metropolitan region. Where this is the case, it is

recommended that indicators be used with a broader territorial range than just one city, followed by a clear warning about the limits of the conclusions reached by using this method.

It should be emphasized that it is the city or municipal authority that determines the territorial area to be covered by the GEO Cities Report; the Report will cover the area necessary to help the municipal authority to intervene in urban development processes.

The suggested description of the indicators to be used in preparing the Integrated Urban Environmental Report within the context of the GEO Cities project is given in detail in Chapter 2. This chapter also contains a brief discussion of the importance of each indicator; the method of calculation suggested or adopted the model for the urban-environmental relation referred to and its level.

TABLE 6 A MATRIX OF BASIC INDICATORS FOR THE GEO CITIES REPORT - (PSIR)

	Water		Air		Soil		Biodiversity and Marine Environment (Fauna & Flora)		Built-up Environment	
	Indicator	Source	Indicator	Source	Indicator	Source	Indicator	Source	Indicator	Source
Pressure	Reduction of vegetable cover	UNCSD	Reduction of vegetable cover	UNCSD	Reduction of vegetable cover	UNCSD	Reduction of vegetable cover	UNCSD	Population growth	CEROI
	Urban settlements area and population	UNCSD	Legal and illegal urban settlements area and population	UNCSD	Legal and illegal urban settlements are and population	UNCSD	Legal and illegal urban settlements are and population	UNCSD	Gini index (social inequality)	CEROI
	Change of land from non-urban to urban uses	CEROI	Land change from non-urban to urban uses	CEROI	Land change from non-urban to urban uses	CEROI	Land change from non-urban to urban uses	CEROI	Acid rain producing gas emissions	CEROI
	Population growth	CEROI	Population growth	CEROI	Population growth	OECD	Population growth	CEROT		
	Gini index (social inequality)	UNCSD	Gini index (social inequality)	UNCSD	Gini index (social inequality)	UNCSD	Gini index (social inequality)	UNCSD		
	Total volume of untreated sewage	CEROI	Atmospheric emissions	CEROI	Solid waste production					
	Water consumption per capita	CEROI	Motorization index	CEROI	Solid waste disposal					
			Energy consumption per capita	CEROI						
State	Extinct or endangered species, known species	OECD	Extinct or endangered species, known species	CEROI	Extinct or endangered species, known species	CEROI	Extinct or endangered species, known species	OECD	% of deteriorated areas (historic centres and buildings) in	OECD

	Water		Air		Soil		Biodiversity and Marine Environment (Fauna & Flora)		Built-up Environment	
	Indicator	**Source**	**Indicator**	**Source**	**Indicator**	**Source**	**Indicator**	**Source**	**Indicator**	**Source**
									relation to total local built-up area	
	Water shortages (frequency, extension, duration)	OECD	Air quality	OECD/CEROI	% of occupied instable geological areas (risk areas)	OECD	Vegetable cover	CEROI		
	Quality of water supply	UNCSD			Contaminated sites	CEROI				
Impact (Effects on each of the following aspects)	Ecosystem: ✓ Biodiversity loss		Ecosystem: ✓ Biodiversity loss		Ecosystem: ✓ Biodiversity loss					
	Urban economy: ✓ Public health cost due to water-borne diseases ✓ Cost of water supply/ treatment				Urban economy: ✓ Property depreciation ✓ Cost of work to prevent and contain environmental risks		Urban economy: ✓ Public health cost		Urban economy: ✓ Property depreciation ✓ Cost of rehabilitating monuments and historic centres	
	Policy-institutional: ✓ Loss of urban attraction		Policy-institutional level: ✓ Loss of urban attraction		Policy-institutional level: ✓ Loss of taxes ✓ Loss of urban attraction		Policy-institutional level: ✓ Loss of urban attraction		Policy-institutional: ✓ Loss of taxes ✓ Loss of urban attraction	
	Quality of life: ✓ Incidence of water-borne diseases		Quality of life: ✓ Incidence of cardiovascular diseases		Quality of life: ✓ Incidence of diseases from		Quality of life: ✓ Micro-climate change		Quality of life: ✓ Deterioration of historic centres	

	Water		Air		Soil		Biodiversity and Marine Environment (Fauna & Flora)		Built-up Environment	
	Indicator	Source	Indicator	Source	Indicator	Source	Indicator	Source	Indicator	Source
					poisoning and pollution ✓ Incidence of diseases from poisoning and pollution ✓ Population in vulnerable urban areas ✓ Incidence of floods, landslides, etc.				✓ Juvenile crime rate	
Response (instruments existence and effectiveness)	Environmental education		Environmental education		Environmental education		Environmental education		Environmental education	
	Number of local-level environmental NGOs		Number of local-level NGOs		Number of local-level NGOs		Number of local-level NGOs		Number of local-level NGOs	
	Local Agenda 21 activities		Local Agenda 21 activities		Local Agenda 21 activities		Local Agenda 21 activities		Local Agenda 21 activities	
	Investment in environmental recovery		Investment in environmental recovery		Investment in environmental recovery		Investment in environmental recovery		Investment in environmental recovery	
	Urban master plan		Urban master plan		Urban master plan		Urban master plan		Urban master plan	
	Investment in green areas		Investment in green areas		Investment in green areas		Investment in green areas		Investment in green areas	
	Legislation to protect springs		Regulation and control of emissions from fixed and mobile		Investment in solid waste management					

	Water		Air		Soil		Biodiversity and Marine Environment (Fauna & Flora)		Built-up Environment	
	Indicator	Source	Indicator	Source	Indicator	Source	Indicator	Source	Indicator	Source
			sources							
	Polluter payers/user payer tax system		Investment in public transport		Total rehabilitated areas in relation to total degraded areas					
	Investment in water supply and drainage systems				Preventive warnings and fines for violating waste disposal standards					
	Household connections									

DATA COLLECTION AND ANALYSIS

To prepare a document such as GEO Cities Report implies managing an enormous amount of information. It is necessary, therefore, to:

- Identify sources
- Systematize information
- Create a database

IDENTIFICATION OF SOURCES OF PRIMARY DATA AND AVAILABLE INFORMATION

As it is very likely that the information needed is dispersed among different institutions, the first task is to collect all these data.

Except in special cases, the technical team should not produce primary data (new information that was not available when the proposal was evaluated). Due to limitations of time and resources, as well as the technical difficulties in gathering primary data, the material to be analyzed should consist of secondary data - that already prepared by institutions in each locality and/or country.

Identifying sources of available information is the first step to guaranteeing the quality of the work. These information sources may be classified according to the territorial range of the data produced or the institutional character of each of them.

RANGE – LOCAL, REGIONAL, NATIONAL AND INTERNATIONAL INSTITUTIONS

Data with which to formulate, manage and assess policies has become important instrument to enable local governments and society to intervene in policy-making. Some institutions become so competent in producing data that they qualify as sources for the information needed to prepare the GEO Cities Report.

The use of information depends on the specific purposes of the work to be carried out where the key is the state of the local environment. Information must first be sought from **institutions that produce data and Reports relative to each city** (for example, maps and aerial photographs). This applies to cities with the financial and technical structure for this type of information.

When local institutions do not have adequate and/or reliable data, the information must be sought from institutions that produce data covering a bigger territory. They may be regional or state (depending on the territory's institutional division), national and, to a lesser extent, international. In this case, it must be kept in mind that the information from these different levels is often the result of combining locally-based information. In principle, this allows the information to be subdivided, making it useful in local assessments. The Population Census is an example. As the basis for the census is data gathered at local or sub-local (household), the dataset enables analysis of the local situation.

Other variables serve as a basis for choosing sources of information. In order of importance, they are:

1. Reliability of data is vital, and the local team should assess the data with great care, taking into account the Report's objectivity. Reliability is never absolute, but it can be measured by the record of the institution in producing data that are not questioned by recognized professionals in the field. This clearly, can only be decided at local level.

2. The second variable is the existence of a historic data series. This allows a comparison to be made of how phenomena studied evolved, to define whether that evolution was positive or negative over the long term. This is of special interest, for example, in assessing the results of public policies and efforts by society to reverse trends that have an impact on the

environment. In this way, the situation before and after the policy intervention can be analyzed.

3. The third variable is ease of access to and availability of information, both for the Report's technical team and for potential users of the document. If the information is hard to access, is not available through electronic media, faces bureaucratic or political obstacles, and is costly or too technical, it is better to look for another source.

4. The methodologies used to produce the information greatly influence the data. It is often difficult to compare information compiled by using different methodologies, so it is better to choose sources that use the same methodologies as the GEO Cities (based on the PSIR matrix and/or a group of similar indicators, calculated in the same way).

TABLE 7 PUBLIC AND PRIVATE INSTITUTIONS POTENTIAL PRODUCERS OF DATA FOR THE REPORT

Institution	Type of Data
Government bodies	• Responsible for preparing the National Population Census. • Responsible for information to formulate local level public policies. • Responsible for formulating and administering public policies (for example, health and education agencies)
Foundations	• Public or private institutions that finance research and may establish a critical comparison with official data.
Research institutes	• Public or private, that produce socio-environmental information to complement or classify official data • Also sources of information on public opinion and the local perception of the city's urban-environmental problems.
Universities	In developing countries, academic institutions continue to be dedicated to producing information, to scientific research and whose technical staff show a more scientific slant. They are a prime source, but information from academic research tends to circulate among a restricted university public.
Non-Government Organizations	NGOs are the most important social intervention stakeholders. They all produce information and other material that may contain relevant facts.
Business associations	They have or can produce specific information on local economic activities that allow an analysis to be made of the economic dynamics and of pressure factors.
Trades unions	They have or can produce specific information about the city's economic and social situation. Their data tends to complement and/or qualify information provided by other bodies representative of business (employment, wages, income).
Local and national communications media	Newspapers, magazines, television and radio may serve as a counter-part to information collected from other local sources.
International organizations and /or bilateral and multilateral agencies	They provide financial resources, prepare projects and take action on the basis of international resolutions, supervise compliance with such resolutions and use data about the situation in each country. Although they usually do not produce these data, they finance research and provide training on producing information and, therefore, are an important source for consultation.

TABLE 8 CONTEXT DATA

Data on the local urban political, social and economic contexts
Data on the political-institutional structure, the role of social organizations, the population, economy and occupation of the territory, social inequality and factors of most pressure on the environment (such as water consumption, waste production and others).
Data on principal local ecosystems.
Data on environmental resources, water, atmosphere, soil, that indicate the hydro- logical, geomorphologic and environmental characteristics of the territory and allow an assessment to be made of the state of the local environment.
Data on the impact of the state of the environment on quality of life.
Data on how the state of the environment is affecting people's health, environmental services, the ecosystem itself and human settlements.
Data on responses from the local government and society to environmental problems. These data should be identified, taking into account political-administrative, economic, technological, socio-cultural intervention instruments. Data and information available on cartography.
Data, which, well organized, contain easy-to-assimilate visual information, especially on deforestation, urban expansion and the location of the territory's vulnerable points. It is suggested a base be used in preparing the Report (for example 1:10,000) that the technical team and potential users will find easy to understand.

SYSTEMATIZATION OF INFORMATION

COMPILING CONTEXT DATA

Once sources are identified, the first step is to collect the context data, or those that describe the evolution of the urban area and local ecosystems:

COLLECTING DATA FROM THE CORE INDICATORS MATRIX (FIRST LEVEL)

The reference for collecting data is the Core Indicators matrix (Table 6) which cross-references about 50 indicators of the pressure-state-impact-response (PSIR) structure with environmental natural resources (water, atmosphere, soil, biodiversity).

The matrix is composed of a mixture of globally-recognized indicators used in important international institutions and indicators proposed by the GEO Cities methodology. Once it is complete, using the matrix will allow a summary to be presented of the urban-environmental interaction in each city. There are two stages:

a) Compiling information related to the indicators.
b) Presenting it by filling in the respective spaces in the matrix.

COMPILING PROXY INDICATORS (SECOND LEVEL)

The information on the GEO Cities indicators will not always be found at local level; at times, the indicator will not come from local institutions, at others, the way it is produced will differ from that

described here. In these cases, the technical team will use the proxy indicators. The proxies make it possible to arrive at a fair approximation of what is being analysed, although it is not exactly the same as the original indicator.

These indicators may originate locally, but the local team must seek the documents and electronic sites of the institutions that produce them to assess whether they are the most appropriate substitutes. Whatever the solution, the technical team must point out the indicators used as proxies and present the source and methodology used in the definition resulting from their use.

Selection and compilation of local indicators (third level)

The GEO Cities Report also seeks to encourage the technical teams in each city to use information and data specific to the locality in the assessment of the state of the environment. Besides the already-mentioned indicators, this will provide the opportunity to include information typical of each city, so that its particular features appear in the final document. To do this, the technical team may choose local indicators.

In this case, it will be necessary to specify the source of the data, the methodology used and the degree of reliability of the indicators.

Two methods may be used to select the local indicators:

1. Consult local sources

Local institutions are to be preferred because, as they have local experience and knowledge, it is more likely that the information they provide can be relied upon.

2. Public consultation

Diverse social groups may be interested in a process such as the GEO Cities. For a public consultation to be feasible, it is recommended that a participatory methodology be applied that combines the use of focus groups (joining urban-environmental stakeholders with specialists) with holding open public meetings. This will validate the indicators and facilitate final acceptance of the document.

Definition and compilation of data relating to the new indicators

Finally, data corresponding to the indicators suggested by the technical team itself, even if not intended for publication, should be compiled. In this case, the team should be assisted by professionals with experience in producing indicators and combining data, as well as with enough relevant knowledge to generate new references.

As already mentioned, a description should be given of the source of the data, the methodology used and the possible degree of reliability of the new indicators, as well as the objective to be reached by including them in the state of the local environment assessment.

CREATION OF A LOCAL ENVIRONMENTAL DATABASE

The database organizes information in the format proposed for the Report according to the different subjects. The data should be arranged according to the document's chapters to enable the technical team to follow up on the collection of the information and facilitate later analyses. With programmes such as EXCEL and ACCESS, the database may be transformed into a data bank, if the data identified can be quantified, making it possible to prepare graphs and tables. This also allows an assessment to be made of the outlook for cities, indicating the main risks and the emerging themes on improving the state of the environment. After this has been done, the technical team can begin to draft the Report.

STAGE 3 – PREPARING THE GEO CITIES REPORT

ANALYSIS OF THE SET OF DATA AND INFORMATION

ASSESSING THE STATE OF THE LOCAL ENVIRONMENT

The analysis of the data and information compiled in the previous stage should meet these five objectives:

1. Identify environmental priorities;
2. Prepare the assessment of the state of the local environment;
3. Assess the responses of government and society;
4. Define emerging themes;
5. Build future scenarios.

For a detailed description of the methodology and contents of this analysis see chapter 2

IDENTIFYING ENVIRONMENTAL VULNERABILITIES AND OPPORTUNITIES TO SOLVE THEM – EARLY WARNING

The report should help identify the most significant environmental priorities in each city, as well as the opportunities most likely to be successful for local government and society to intervene over the short and medium term. Environmental bodies and institutions can be led towards creating early warning mechanisms for local government and society.

One of the expected results is to set priorities for the city's environmental problems. The proposal is, initially, to focus on the most relevant and immediate actions by the different sectors. Defining priorities does not imply jettisoning less urgent or more time-consuming decisions on promoting environmental improvements. The best strategy to follow may be to bear in mind the limits on local government resources, both economic and human.

ASSESSING THE STATE OF THE LOCAL ENVIRONMENT

The assessment of the state of the local environment has technical and policy elements on which to base decision-making when planning urban development and environmental management of cities.

It is necessary to approach technological, environmental and economic feasibility of a sustainable development plan that, if implemented, would imply profound political and social changes.

The consequences of public policy options on the state of the environment are studied, identifying implementation strategies in accordance with interests and priorities defined for urban environmental managers and decision-makers.

ASSESSING THE RESPONSES OF GOVERNMENT AND SOCIETY

The section provides a systematic description of local environmental policies and responses. It provides information on current policy initiatives, identifies major gaps and weaknesses of these policies as well as the barriers to their successful implementation. In the GEO Cities report, this section includes the analysis of multilateral environmental agreements as well as analysis of national and local legislation, economic instruments, socio-cultural, educational, public communication instruments, and the like.

DEFINITION OF EMERGING THEMES

The identification of emerging themes and future scenarios is an important part of the GEO reports. Discussing the themes that may be central to the definition of future urban environmental policies is important for medium and long term planning. In addition, by exploring an array of possible future scenarios, decision makers can get a clearer picture of what tomorrow might bring and what the impact of their decisions is likely to be. GEO scenarios do not predict, but rather they paint pictures of possible futures and explore the different outcomes of policies and environmental change.

The report also intends to prepare a strategic outlook. It therefore calls upon the technical team to identify the themes that might be seen as central to a future definition of urban and environmental policies.

In the definition of the GEO methodology, the concept of "emerging theme" assumes a medium to long-term outlook. Environmental changes due to the impact of human activity, with little or no short-term significance, may cause accumulative effects over time (more than one or two generations). The changes in the global scene are difficult to recognize on a human life or government mandate time scale and, therefore, are surrounded by uncertainty and controversy. It is impossible to predict all the variables that influence environmental changes.[60] Nevertheless, the lack of scientific certainty does not justify the lack of action to protect the environment. This is why the strategy used to identify the critical points, to plan and implement preventive measures, uses the "Precaution Principle" as a reference. The GEO methodology identifies three categories of environmental material that might prove to be of great priority during the 21st century.

a. Unexpected events and scientific discoveries.
b. Unexpected changes in

Suggested steps in policy and responses analysis

1. *Identify and list current polices and responses related to major environmental issues.*
2. *Select performance criteria for the identified policies and responses.*
3. *Evaluate the effect (intended or unintended, positive or negative) of the identified policies and responses on using the selected performance criteria.*
4. *Define best policy options and consider necessary policy modifications.*

[60] The concept is recent and only over the past decade has gained force in the implementation of intermediate or public policies on the environment. The United Nations 1992 Framework Convention on Climate Change serves as a legal base for international treaties, such as the Kyoto Protocol, aimed at reducing greenhouse effect gases.

recurring events.

c. Changes in events that are known and for which adequate responses are now available but with unknown consequences over the medium and long term.

It might seem that one could dispense with these themes at the local level. However, the advantages of considering them are obvious:

a. Make citizens aware of the intrinsic relation between the local and global environments;
b. Act with anticipation to guarantee adaptations and avoid crises;
c. Direct research and the systematic collection of data to provide continuity or begin keeping historical records; and
d. Promote the understanding of the dynamic relations between human activities and the environment; include scientific knowledge in public management.

These subjects will form part of the public agenda of cities in a not very distant future, taking into account the accumulation of still to be solved environmental problems ("environmental liabilities"), and that generally accompany urban development and the growth of cities. These are some of the subjects to deal with:

- Polluted locations or brown fields, and their impact on health and ecosystems;
- Environmental conflicts related to economic losses and damage to health and quality of life caused by environmental pollution;
- Environmental compensations resulting from pollution caused by industrial activities in the locality;
- Environmental responsibility related to generating "environmental liabilities";
- Advantages and limits for competition and local development resulting from each locality's environmental liabilities;
- Urban vulnerability and environmental disasters; and
- Effect on our planet's present climate changes due to the emission by local industries of greenhouse effect gases into the atmosphere.

Emerging themes will depend on the specific relation of the local urban situation to natural resources and ecosystems in the territory. This stage, together with the previous "early warning" one, includes a double resource that will influence local public policy decision making.

The definition of emerging themes also permits the assessment of responses given to the city's main urban-environmental problems. These responses may, then, be assessed on two levels: already-existing problems and emerging themes.

Scenario building steps

1. Define the environmental problem and explain its outline (policies and actions);
2. Diagnose the causes and consequences that determine the state of the environment;
3. Define the objectives and goals (policies) to obtain a determined result;
4. Identify public policy options;
5. Define alternative paths that might lead to the desired objectives;
6. Identify possible results, problems and probable obstacles to reach sustainable development objectives;
7. Define alternative strategies to manage the obstacles;
8. Adopt a holistic approach when preparing scenarios;
9. Plot the conclusions on the results of each of the possible scenarios.

BUILDING SCENARIOS: LOCAL TRENDS (INERTIA, BEST CASE, WORST CASE)

For sustainability to be feasible in cities presupposes long-term processes and the projection of scenarios that reflect civil society's responses to urban development environmental problems. The scenarios are not forecasts but suggest a range of options that reduces uncertainty regarding policy options.

With the help of simulation studies, managers will assess the directions of urban environmental policies according to their objectives and availability. To prepare scenarios is to set in motion possible visions of the future from options now available, and building them demands the use of qualitative and quantitative data. Some trends may be easier to outline than others and for these quantitative data are more useful.

The result will be a mixture of indicators, trends and potential goals with explanatory texts that relate the history. For effective decision-making, information on costs and benefits is also relevant because it will permit the analyst to determine how feasible the economic and financial needs of each scenario are. The scenarios are built based on three types of trends:

- ***The inertia trend***, considered as the possibility that there will be no response to the environmental problems detected, that any responses there are will not be adequate or will not meet the objectives. In this case, the future scenario will project a broadening or worsening of the problems.
- ***The best case trend***, is a situation in which the responses by the local government and society would be perfectly adequate and in which there are no obstacles that prevent action being taken on the responses. In this case, either the scenario will project an improvement in the state of the local environment in all sectors, or in those where social stakeholders have intervened.
- ***The worst case trend***, is a situation where there is no response to the problems, where conditions for acting on the responses are not appropriate or even become obstructions, or where decisions made by social stakeholders increase or worsen pressure on the environment.

These scenarios should help decision-makers to assess the impact of how they act, or fail to act, when faced with the city's environmental problems.

The conclusions should:

- ✓ Identify the principal factors of urban pressure on environmental resources and the most significant features of the state of the local environment.
- ✓ Relate the impact of the responses given, and of how they were adapted to the problems detected.
- ✓ Evaluate the conditions that assisted or impeded the technical and political effectiveness of the responses given.
- ✓ Include a brief analysis of trends detected, indicating the consequences if the problems are dealt with or if they are ignored.
- ✓ Present the technical team's main policy or response proposals.

PROPOSALS, RECOMMENDATIONS AND CONCLUSIONS

Once the four objectives of analysing information and data have been met, the technical team will be ready to draft recommendations and conclusions to guide decision-makers. The report should give social stakeholders a list of proposals on urban environmental policies designed to

change conditions that affect the local environment. Such proposals will set objectives and goals, and describe actions, instruments and institutional and financial resources needed to carry out the policies outlined in the report.

It must be shown that the policies proposed are directly connected to the analysis included in the report, indicating how implementing them will help to change the state of the environment and what impact they have on quality of life, on ecosystems and on the urban economy. An indication must always be given of what responses are expected to pressure factors, environmental conditions and impacts.

Recommendations must also be made to facilitate or create adequate institutional, financial, social, policy and cultural conditions to apply the suggested policies. These recommendations may include:

- The need for better technical training of the different social stakeholders.
- How the local government budget will be spent on socio-environmental action.
- The creation of specific urban-environmental intervention bodies.
- Institutionalizing social participation channels to formulate public policy.
- The need for exchanges with national or international bodies or institutions to broaden the local government's technical range and its urban-environmental efforts.

The conclusions include a synthetic view of the origins and features of the city's existing environmental problems, their impact, as well as responses and policy proposals to deal with them. The conclusions may be organized by following the chapters of the report or the work as a whole.

STATISTICAL ANNEXES AND BIBLIOGRAPHY

The report should include, as annexes, the statistical information on which the analyses are based. To this effect, while the report is being drafted the data which – because of their importance, ease of understanding or level of inclusion – are presented in the body of the report (as tables or charts) will have to be separated from those that may make heavy reading so that the report is harder to understand. There is no need to reproduce all the information collected. The technical team should adopt the criterion of how important is the information to be included in the statistical data.

It is recommended that the statistics be presented in the same sequence as the chapters of the report, allowing the user to relate the points treated in each chapter. Also included should be the methodology used by each information source to produce more up-to-date data on the subject in question, as well as its history, should it have one. Including the Bibliography consulted will allow the reader to learn more about aspects or subjects dealt with in the report. This should indicate the full name of the author or the institution, title of the book or report, publisher, year of publication, city or country of origin of the book and the corresponding edition.

GLOSSARY AND SOURCES OF INFORMATION

Because of its technical nature, language may be an obstacle to understanding the report. A glossary of technical terms, acronyms and concepts may make the language less specialized and easier for the reader to understand. To submit the document to the critical attention of third parties can also help to explain the difficulties of understanding and to prepare the glossary. Finally, it is important to mention all the sources of information or data employed or that serve as a reference for those who wish to analyse the subjects dealt with in more depth.

DEFINITION OF THE REPORT'S DISSEMINATION STRATEGIES

The report may be a catalyst for social mobilization on the question of the environment and sustainable development. If this is to be the case, strategies must be defined on how to disseminate it, stimulating its broadest possible social use by both citizens and public bodies not directly involved in its preparation.

A document such as the GEO Cities needs mechanisms that confirm the social and policy legitimacy of its analyses and proposals. Such legitimatization increases the possibilities that its decisions will be successful.

Media that may be employed include dissemination seminars, collective interviews, and television and radio interviews, distribution of copies to public and private bodies, to civil society organizations, universities and trade unions, the local parliament, national and international agencies, public and private schools, as well as making it available on the Internet.

STAGE 4 – INCLUSION OF SOCIAL POLICY PROPOSALS AND RECOMMENDATIONS

The inclusion of the report's proposals and recommendations on local government environmental management policy completes the work of GEO Cities. Generally, this task will be beyond the responsibility of the technical team unless its public mandate decides otherwise.

For this reason, the technical team should establish a collaboration strategy with those responsible for public policy and decision making on the state of the local environment. This approximation may promote a fruitful exchange between the people who make the decisions and socio-environmental specialists, thus broadening the scope of the proposals (these possibilities depend, clearly, on each city's political-institutional circumstances).

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INFLUENCING POLICIES

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[61] Rucevska, Ieva and others, "GEO Resource Book: A training manual on Creating communication outputs from the assessment Training Module 7" *The GEO Approach to Integrated Environmental Assessment*, UNEP and IISD

For this reason, the technical team should establish a collaboration strategy with those responsible for public policy and decision-making on the state of the local environment. This may promote a fruitful exchange between those who make the decisions and socio-environmental specialists, and broaden the scope of the proposals (these possibilities depend, clearly, on each city's political-institutional circumstances).

STAGE 5 – CONTINUING THE GEO CITIES PROCESS

With the preparation of the report, the GEO Cities project hopes to set the methodological bases for a permanent assessment process on the state of the environment. The aim is to continue periodically producing documents initiated by UNEP with the GEO series.

This stage is also beyond the responsibilities of the technical team. However, it is very important to recommend to decision-makers that the GEO Cities be produced every two or three years to follow up on advances in the city's management of the environment.

In this way, the GEO Cities report may act as a stimulus for a change in attitude by local governments and society both on environmental questions and on the impact urban development has on ecosystems and natural resources. Continuity will make it easier to create a history of cities' environmental assessments, thus allowing an analysis to be made of the suitability of the responses, as well as the specific evolution of the relation that exists between pressure factors and the state of the local environment.

The joint UN-HABITAT and UNEP Sustainable Cities Programme (SCP) and the Localising Agenda 21 Programme (LA21) are two closely linked UN programmes that work with the GEO Cities initiative. Both programmes assist cities in integrating environmental issues in their urban planning and development. They use the Environment Planning and Management (EPM) approach to build capacity among local authorities and their local stakeholders. The most urgent environmental issues and actions are identified through a broad based participatory decision making process. Both programmes use the GEO Cities process as a tool to develop State of the Environment reports and policy recommendations for cities. At the same time, the EPM approach is an ideal mechanism to take the policy recommendations from GEO city reports further and translate them into action. The SCP/LA21 programmes and GEO Cities initiative therefore combine the comparative advantages of UNEP and UN-HABITAT towards the common goal to ensure environmental sustainability (Millennium Development Goal 7).

The UNEP GEO Cities project hopes to use this report to define the process of assessing the state of the environment and use it as a base for periodic reports on the state of the urban environment using a harmonized methodology and indicator set. This stage is also beyond the responsibilities of the technical team. It is nevertheless very important to recommend to decision-makers that a GEO Cities report be produced every two or three years to follow up on the city's management of the environment.

In this way, the GEO Cities report may act as a stimulus for a change in attitude by local government/administration and society on environmental questions and on the impact urban development has on ecosystems and natural resources.

Continuity will make it easier to create an archive of cities' environmental assessments, thus allowing an analysis to be made of the suitability and effect of actions taken, as well as the evolution of the link that exists between pressure factors and the state of the local environment.

ANNEX: LIST OF PARTICIPANTS THAT ATTENDED THE GEO CITIES WORKSHOP

(in alphabetic order)

Name	Affiliation
Abahussain, Asma Ali	Director of Desert and Arid Zones Science Program, Arabian Gulf University, Manama, Bahrain
Abdel Aziz, Amira Abdullah	Physical Planner, National Urban Observatory, General Organization for Physical Planning, Egypt
Abdel-Kader, Adel Farid	Regional Coordinator, Division of Early Warning and Assessment-West Asia, Regional Office for West Asia (ROWA), Manama, Bahrain
Abdelrehim, Ahmed	Regional Programme Manager, Head of Environmental Assessment, CEDARE
Abdul Wahab, Abdullah	Director of Tripoli Environment and Development Observatory, Al-Fayhaa Urban Community, Lebanon
Abu Hamra, Izzat Ahmad	Head of Environmental Impact Assessment, Ministry of Environment, Jordan
Al-Ajjawi, Suzan Mohamed	Public Commission for the Protection of Marine Resources, Environment and Wildlife, Bahrain
Al-Baradiya, Issa Musa	Environment Quality Authority, Ramallah, Nablu, Palestine
Al-Hasimi, Radhiya	Director of Environmental Centre for Arab Towns, Dubai Municipality, Karama Centre, Dubai, United Arab Emirates
Al-Helo, Numan Mohamed Husni	Head of Agriculture Division, Aqaba Special Economic Zone Authority, Jordan
Al-Hmadi, Ameen Mohamed Qaid	Deputy General Director of Planning and Information, Environment Protection Authority, Ministry of Water and Environment, Sana'a, Yemen
Al-Musharrafi, Naeem Salim	Environmental Planner, Ministry of Environment and Climate Affairs, Muscat, Oman
Al-Sarhi, Khadija Mohamed	Future Cities Games Master, British Council, Bait Baws, Sana'a, Yemen
Al-Sokhn, Khaled Jama'n	Senior Environmental Specialist, Environmental Centre for Arab Towns, Dubai Municipality, Karama Centre, Dubai, United Arab Emirates
Belhassen, Langar	Director, Tunis Municipality, Tunisia
Bougharbal, Mohamed	Member, Communal Council of Marrakech, Morocco
El-Kallassi, Francis Hatem	Chief Municipality, Ministry of Environment, Ghazir, Kfarhbab, Lebanon
El-Kholei, Ahmed O.	Professor of Urban Planning, Menofia University

	and President of Consultants for Development and Environment, Egypt
Emad, Youssef	CEDARE
Ghaly, Catherine	Programme Assistant, Knowledge Management Programme, CEDARE
Haddad, Abdul-Majeid	Capacity Building Task Manager, UNEP/GEF Liaison Officer, Wet Asia Division of the Global Environment Facility (GEF) Coordination/Regional Office for West Asia (ROWA), Manama, Bahrain
Hamed, Mahmoud Mohamed	Manager of Environmental Monitoring department, Alexandria Governorate, Egypt
Hamza, Passant Mahmoud	Physical Planner, National Urban Observatory, General Organization for Physical Planning, Egypt
Ibrahim, Hamid Mahmoud	Director of Governorate Relations and Chairperson of the Committee of Environment, Kuwaiti governorates, Ahmadi Governorate, Kuwait
Jaheen, Amina	British Council, Cairo, Egypt
Kamal, Mona Mohamed Ahmed	Head of Environmental Indicators and Reporting Unit, Egyptian Environmental Affairs Agency, Egypt
May, Sarah	Regional Science Manager, Middle East, British Council, Cairo, Egypt
Miqdadi, Issam	Director of Infrastructure and Camp Improvement, UNRWA
Moufied, Nancy	Project Manager, Society Social and Cultural Partnerships, British Council, Cairo, Egypt
Nomicos, Sotiria Christine	Associate Liaison Office, UNEP/ALLO, Cairo, Egypt
Rislan, Samah	Engineer, EIA Directorate, GIS Unit, Ministry of Local Administration and Environment, General Commission for Environmental Affairs, Damascus, Kafrsousah, Environmental Studies Building, Syria
Sabet, Mayar	Regional Programme Assistant, CEDARE
Sayed, Samir	IT, CEDARE
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Wilson, Christine	Adviser, Social Development, British Council, Manchester, United Kingdom

LIST OF ABBREVIATIONS

BBC	British Broadcasting Company
BOD	Biochemical Oxygen Demand or Biological Oxygen Demand
CEDARE	Centre for Environment and Development Arab Region and Europe
CEROI	Cities Environmental Reports on the Internet
COD	Chemical Oxygen Demand
CSP	Concentrating Solar Power
DEWA	Division of Early Warning
DO	Dissolved Oxygen
DPSIR	Driving force, Pressure, State, Impact and Response
EPM	Environment Planning and Management
ESCWA	Economic and Social Commission for West Asia
EU	European Union
FAO	Food and Agriculture Organization
GEO	Global Environment Outlook
GRID	Global Resources Information Database
GTZ	German Technical Cooperation Agency
ICLEI	International Association of Local Governments and National and Regional Local Government Organizations
IEAs	Integrated Environmental Assessments
IISD	International Institute for Sustainable Development
LA21	Localising Agenda 21 Programme
LAS	League of Arab States
MDGs	Millennium Development Goals
OECD	Organization for Economic Cooperation and Development
ROWA	Regional Office for West Asia
SCP	Sustainable Cities Programme
UNCHS	United Nations Programme for Human Settlements (HABITAT)
UNCSD	United Nations Commission on Sustainable Development
UNDRO	United Nations Disaster Relief Office
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSDC	United Nations Sustainable Development Commission
USAID	United States Agency for International Development
WCED	World Commission on Environment and Development
WHO	World Health Organizations
WSSD	World Summit on Sustainable Development

GLOSSARY AND DEFINITIONS

Remotely sensed data can 1) provide a unique perspective from which to observe large regions; 2) sensors can measure energy at wavelengths, which are beyond the range of human vision (ultraviolet, infrared, microwave); 3) monitoring is possible from nearly anywhere on earth; remotely sensed images provide good "pictures" for convincing the public and decision makers to participate in discussions on issues of importance that may not be part of their daily life; and 4) used to monitor long-term changes; and readily integrated into GIS

Indices: Combination of two or more indicators or several data. Indices are commonly used in national and regional assessments to show higher levels of aggregation (Segnestam 2002).

Information systems: Any coordinated assemblage of persons, devices and institutions used for communicating or exchanging knowledge or data, such as by simple verbal communication, or by completely computerized methods of storing, searching and retrieving information Monitoring: Activity involving repeated observation, according to a predetermined schedule, of one or more elements of the environment to detect their characteristics (status and trends) (UNEP 2002).

Data: Consists of facts, numerical observations and statistics that describe some aspect of the environment and society, such as water quality and demographics (Abdel-Kader 1997). A basic component of indicator data needs to be processed so that it can be used to interpret changes in the state of the environment, the economy or the social aspects of society (Segnestam 2002).

Indicator: Observed value representative of a phenomenon to study. Indicators point to, provide information about, and describe the state of the environment with significance extending beyond that directly associated with the observation itself. In general, indicators quantify information by aggregating and synthesizing different and multiple data, thus simplifying information that can help reveal complex phenomena (EEA 2006)

Abiotic components are non-living chemical and physical factors in the environment. These may be classified as light, temperature, water, atmospheric gases, and wind as well as soil, and physiographic factors. The six major abiotic factors are water, sunlight, oxygen, temperature, soil and climate.

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects that moderates harm or exploits beneficial opportunities.

Adaptive Capacity: The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

An assessment is the entire social process for undertaking a critical objective evaluation and analysis of data and information designed to meet user needs, and to support decision making. It applies the judgment of experts to existing knowledge to provide scientifically credible answers to policy relevant questions, quantifying where possible the level of confidence. Source: http://www.unep.org/geo/pdfs/TowardsGeo4.pdf

Biochemical Oxygen Demand or Biological Oxygen Demand (BOD) is a chemical procedure for determining how fast biological organisms use up oxygen in a body of water. It is used in water quality management and assessment, ecology and environmental science. BOD is not an accurate quantitative test, although it could be considered as an indication of the quality of a water source.

Biodiversity is the variation of life forms within a given ecosystem, biome or for the entire Earth. Biodiversity is often used as a measure of the health of biological systems. Biodiversity found on Earth today consists of many millions of distinct biological species, the product of four billion years of evolution.

Biotic means relating to, produced by, or caused by living organisms.

Chemical Oxygen Demand (COD) test is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water (e.g. lakes and rivers), making COD a useful measure of water quality. It is expressed in milligrams per litre (mg/L), which indicates the mass of oxygen consumed per litre of solution. Older references may express the units as parts per million (ppm).

City proper is the single political jurisdiction, which contains the historical city centre.

Climate Change: Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate is the average and variations of weather in a region over long periods. Climate zones can be defined using parameters such as temperature and rainfall. Paleoclimatology focuses on ancient climate information derived from sediment found in lake beds, ice cores, as well as various fauna and flora including tree rings and coral. Climate models can be used to determine the amount of climate change anticipated in the future.

Climate Variability: Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forces (external variability).

Deforestation is the conventional of forested areas to non-forest land for use such as arable land, pasture, urban use, logged area, or wasteland. Generally, the removal or destruction of significant areas of forest cover has resulted in a degraded environment with reduced biodiversity. In many countries, massive forestation is ongoing and is shaping climate and geography. Deforestation results from removal of trees without sufficient reforestation, and results in declines in habitat and biodiversity, wood for fuel and industrial use, and quality of life.

Desertification is the degradation of land in arid, semi arid and dry sub-humid areas resulting primarily from human activities and influenced by climatic variations. Current desertification is taking place much faster worldwide than historically recorded. It usually arises from the demands of increased populations that settle on the land to grow crops and graze animals. A major impact of desertification is biodiversity loss and loss of productive capacity.

Development Pathway: An evolution based on an array of technological, economic, social, institutional, cultural and biophysical characteristics that determine the interactions between human and natural systems, including production and consumption patterns in all countries, over time at a particular scale.

Ecosystem is a natural unit consisting of all plants, animals and micro-organisms (biotic factors) in an area functioning together with all of the non-living physical (abiotic) factors of the environment

GEO Assessment DEWA, in collaboration with other UNEP programmes, and with other partners around the world, implements the UNGA resolution by, among other activities, coordinating GEO, the UNEP flagship assessment reporting process. UNEP Governing Council initiated the first GEO assessment report in 1995 in its decision 18/27, which requested UNEP's Executive Director to prepare a new, comprehensive report on the present and future state of the world environment, including possible response measures. Following the establishment of the GEO process and production of the first GEO report, the Governing Council renewed the mandate for GEO in 1997, 1999 and 2003 and 2005.1 The Governing Council/Global Ministerial Environment Forum (GC/GMEF) decisions in 2003 and 2005 facilitated the preparation of GEO-4.

Hazardous substance is any solid, liquid, or gas that can harm people, other living organisms, property, or the environment. Hazardous substances may be radioactive, flammable, explosive, toxic, corrosive, biohazardous, an oxidizer, an asphyxiant, a pathogen, an allergen, or may have other characteristics that render it hazardous in specific circumstances. Mitigating the risks associated with hazardous materials may require the application of safety precautions during their transport, use, storage and disposal. Most countries regulate hazardous materials by law, and they are subject to several international treaties as well.

ICLEI is an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development. More than 875 cities, towns, counties, and their associations worldwide comprise ICLEI's growing membership. ICLEI works with these and hundreds of other local governments through international performance-based, results-oriented campaigns and programs.

Kyoto Protocol: The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1997 in Kyoto, Japan, at the Third Session of the Conference of the Parties (COP) to the UNFCCC. It contains legally binding commitments in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol. Most Organisation for Economic Cooperation and Development countries and countries with economies in transition agreed to reduce their anthropogenic greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride) by at least 5% below 1990 levels in the commitment period 2008 to 2012. The Kyoto Protocol entered into force on 16 February 2005.

LA21 Local Agenda 21 is a program that provides a framework for implementing sustainable development at the local level. LA21 aims to build upon existing local government strategies and resources

Mainstreaming: Mainstreaming refers to the integration of adaptation objectives, strategies, policies, measures or operations such that they become part of the national and regional development policies, processes and budgets at all levels and stages.

Metropolitan area is the set of formal local government areas, which are normally taken to comprise the urban area as a whole and its primary commuter areas.

Mitigation: The promotion of policy, regulatory and project-based measures that contribute to the stabilization or reduction of greenhouse gases concentration in the atmosphere. Renewable energy programs, energy efficiency frameworks and substitution of fossil fuels are examples of climate change mitigation measures.

Oceans are major bodies of saline water, and a principal component of the hydrosphere. Approximately 71 per cent of the Earth's surface (an area of some 361 million square kilometres) is

covered by ocean, a continuous body of water that is customarily divided into several principal oceans and smaller seas. More than half of this area is over 3,000 meters (9,800 ft) deep. Average oceanic salinity is around 35 parts per thousand (ppt) (3.5 per cent), and nearly all seawater has a salinity in the range of 31 to 38 ppt.

Organic compound is any member of a large class of chemical compounds whose molecules contain carbon.

Overpopulation refers to when an organism's numbers exceed the carrying capacity of its habitat. In common parlance, the term usually refers to the relationship between the human population and its environment, the Earth. Overpopulation is not simply a function of the size or density of the population. Overpopulation can be determined using the ratio of population to available sustainable resources.

Pollution, in one sense, is the introduction of contaminants into an environment, of whatever predetermined or agreed upon proportions or frame of reference, which causes instability, disorder, harm or discomfort to the physical systems or living organisms therein. Pollution can be in the form of chemical substances, or energy such as noise, heat, or light. Pollutants can be naturally occurring substances or energies, but are considered contaminants when in excess of natural levels. Pollution is often categorized into point source and nonpoint source pollution. In another sense, pollution is a term for any substance introduced into an ecology that causes instability and breakdown of the life or reproductive forces of said system. A substance as common and generally healthy as water can become a "pollutant" at high enough concentrations, e.g. if a human were to drink excessive amounts, leading to a burden on physical systems, a breakdown of such systems, and potentially leading to death. Water has been used in just such a way in suicide attempts and successes. In an even broader application of the concept, excessive noise "pollution" and exposure is used in military exercises to induce imbalance in the subject's mental ecology, causing malfunction and psychosis.

Resilience: The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Resource-based depletion refers to depleting non-renewable resources, such as fossil fuels, and the degradation of renewable resources, such as soil and water

Stakeholders: A basic definition of stakeholders includes those: 1) whose interests are affected by environmental problems, or whose decisions have environmental effects; 2) who have information, resources or expertise required for policy formulation and strategy implementation; and/or 3) who control key mechanisms for policy and strategy formulation and implementation.

The **Intergovernmental Panel on Climate Change** (**IPCC**) is a scientific intergovernmental body focused on evaluating the risk of climate change caused by human activity. The panel was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), two organizations of the United Nations. The IPCC shared the 2007 Nobel Peace Prize with former Vice President of the United States Al Gore.

UNCSD an inter-governmental body whose members are elected by the Economic and Social Council (ECOSOC) from amongst the Member States of the United Nations and its specialized agencies. The Commission on Sustainable Development (CSD) was established as a functional commission of the

Economic and Social Council by Council decision 1993/207. Its functions are set out in General Assembly resolution 47/191 of 22 December 1992.

UNEP's Division of Early Warning and Assessment (DEWA) is one of eight UNEP sub-programmes (divisions) responsible for implementing Resolution 2997. The DEWA mission is to: "Provide the world community with improved access to meaningful environmental data and information, and to help increase the capacity of governments to use environmental information for decision making and action planning for sustainable human development."

UNFCCC (United Nations Framework Convention on Climate Change): An international treaty adopted in 1992, and entered into force in 1994, that sets an overall framework for intergovernmental efforts to address challenges posed by climate change. Under the Convention, governments cooperate in preparing for adaptation to the impacts of climate change, launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, and gather and share information on greenhouse gas emissions, national policies and best practices. One hundred and ninety-two countries have ratified their membership with UNFCCC and the Kyoto Protocol is an addition to this treaty.

Urban agglomeration is the built-up or densely populated area containing the city proper; suburbs, and continuously settled commuter areas. This may be smaller or larger than the metropolitan area. Other similar UN definition: Comprises a city or town proper and the suburban fringe or thickly settled territory lying outside, but adjacent to, its boundaries. A single large urban agglomeration may comprise several cities or towns and their suburban fringes

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

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