Developing Urban Environmental Indicators in the Third World

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EXECUTIVE SUMMARY

This report proposes an environmental information strategy for cities in the developing world. It recommends an approach to collecting and reporting indicators on the urban environment that would support problem-solving in ways appropriate to developing world cities.

Urban environmental problems represent a growing threat to progress in the developing world. Water and air pollution, solid waste dumping, accumulation of hazardous wastes, the over-use of natural resources like water, land, and energy, and vulnerability to natural disasters threaten human health, economic productivity, and the natural ecosystems that support life.

The approach to generating and reporting urban environmental indicators (UEI) recommended in this report could help lay the groundwork for successfully addressing these problems.

This report is organized in four sections. Section I provides background on urban environmental issues, on the role of USAID in urban environmental management, and on the purposes of the urban environmental information project.

Section II proposes an approach to developing urban environmental indicators. It does so by:

1) identifying the characteristics of good indicators.

2) specifying the criteria for identifying a priori (that is, before an environmental profile or quantitative environmental risk assessment has been conducted) probable key environmental problems, data needs and indicators for particular cities;

3) proposing that data collection be structured around an analytic framework that relates environmental conditions to underlying pressures and to major impacts. Use of an analytic framework will help build understanding of cause-effect relationships in environmental problems. It will help identify stakeholders -- those groups that both cause and suffer from environmental problems. It will also help build consensus for action by highlighting the costs of environmental degradation and necessary mitigating steps;

4) proposing a core set of important urban environmental indicators for developing world cities. The core set can provide a general guide for developing indicators; however, individual cities are encouraged to supplement it to meet their own needs.

5) proposing a reporting mechanism in the form of annual State of the Urban Environment Reports prepared by a network of cities around the globe. These reports would allow cities to share information on environmental problems on a regular basis among key local and national agencies, international donor agencies and other developing world cities. A properly designed reporting mechanism would help ensure the quality of data; strengthen the local capacity for data generation, analysis and reporting; and help cities share their experiences on environmental problem-solving.

6) proposing an inclusive consultative process for designing and producing the reports. This process would ensure participation in the identification and analysis of environmental problems by municipal and national government agencies, educational institutions, local environmental NGOs, community organizations, business, labor, and international donor agencies and NGOs. An inclusive reporting process would help build support for cooperative problem-solving.

7) providing harmonized information for a central database on urban environmental problems. This database would support cross-city comparisons and donor agency investment decisions.

Section III, a case study of Quito, Ecuador, explores the range of environmental information available in a mid-sized developing world city with a substantial commitment to addressing its environmental problems.

Section IV offers recommendations on further steps to help develop urban environmental indicators in the third world.

I. INTRODUCTION

A. Cities and the Environment

Cities are the main centers of population growth in the developing world. They currently absorb two-thirds of developing country population growth. Between 1960 and 1988, the share of the developing world population living in cities grew from 29 to 43 percent. That percentage will grow to 50 percent in 2000. Between 1960 and 1988, developing world urban population grew from 600 to 1,700 million people. By the end of the decade, that figure will be 2.5 billion. Two-thirds of this growth is fueled by natural increase, the rest comes mostly from rural to urban migration. (UNDP, 1990)

Cities also provide a disproportionate share of developing world economic activity, accounting for about 60 percent of total GNP. Over the next ten years, cities are expected to provide about 80 percent of developing country economic growth. (Bartone, 1992)

The growing significance of urbanization for the developing world is reflected in growth of the world's megacities. In 1960, just three of the world's 10 largest cities were in the developing world. Just one, Shanghai, had more than 10 million people. By 2000, eight of the world's ten largest cities will be in the developing world. Of the 18 cities with more than 10 million people, 10 will be in the developing world. (UNDP, 1990)

Urban population is not evenly distributed by region. In Asia and Africa, about one-third of the populations live in urban areas. In Latin America, three-quarters of the population does. (WRI, 1992-93) However, cities in Asia and Africa are growing faster than those in Latin America. Between 1985 and 2000, Africa's urban population is expected to more than double; Asia's will increase by 70 percent; Latin America's will grow by 49 percent. (UNDP, 1990)

Cities are growing because they provide greater economic and social benefits than rural areas. Cities concentrate economic activity spatially, improving productivity by increasing economies of scale. Spatial concentration also increases the efficient delivery of social services. Thus, in the developing world, incomes and living standards are higher in cities than in rural areas. (World Bank, 1991)

Despite its considerable benefits, urbanization also entails enormous costs. As centers of population and economic growth, developing world cities are increasingly the source of environmental damage.

In developing countries, many of the most important

environmental problems are urban problems that directly impair the health and welfare of city-dwellers. In the 1992 World Development Report, the World Bank lists sanitation and clean water, urban air pollution, and indoor air pollution among the most serious environmental problems facing the developing world. In the Bank's view, these problems, heavily associated with urban areas, have not won the attention they deserve in the current environmental debate. For example, while acknowledging the great risks of biodiversity loss and global warming for the developing world, the Report states that "[p]roviding access to sanitation and clean water would...be the single most effective means of alleviating human distress." (World Bank, 1992 (b))

A wide range of problems damage the urban environment, impairing the development that cities do so much to generate. Growing motor vehicle fleets contribute to traffic jams, lost productivity, and air pollution. Untreated domestic and industrial wastes contaminate fresh water supplies and coastal waters, threatening human health and damaging fisheries. The increased consumption that accompanies rising per capita income and growing populations has created increasing problems with disposal of solid wastes. Urbanization consumes vast amounts of wetlands, forest and agricultural lands, disrupting the hydrological cycle, accelerating erosion, and impairing food production. Population growth and land scarcity force the poor to settle on marginal lands, exposing them to risks from landslides and flooding and increasing the marginal costs of providing water and sewerage. Industrialization generates hazardous wastes in countries that all too often lack strong enforcement of laws regulating toxics. Finally, urbanization contributes to the loss of amenities like open spaces and peace and quiet.

Low-income groups experience these impacts more acutely than others. They are the most likely to live near factories, waste dumps and major roadways, or on land at risk from natural disasters, to live in crowded, substandard housing, to lack adequate water and sanitation services, to use poor-quality fuels in the home, and to work in hazardous occupations.

As urban populations grow, the world's poor are increasingly concentrated in cities. In 1980, 40 million urban households lived in absolute poverty compared with 80 million rural households. By 2000, 72 million urban families will live in absolute poverty compared with 56 million rural families. Currently, the very poor represent about one-quarter of developing world city residents. Unless urban environmental problems are addressed, a growing number of the most vulnerable people will suffer increasing distress. (World Bank, 1992 (b) and UNDP, 1990)

Even though the impacts of urban environmental problems are

felt most acutely within urbanized areas, cities also have environmental impacts well beyond their borders. Cities' demands for energy, minerals, timber, food and water put pressures on "upstream" resources. These demands increase such activities as extraction of oil and other minerals in fragile ecological zones, deforestation, extension of agriculture to unsuitable lands, depletion of water supplies, and blocking of waterways for hydroelectric plants.

Cities' discharges of wastes to air, water, and land also generate "downstream" impacts. For example, domestic and industrial liquid wastes degrade fresh and coastal waters. Air pollution impairs the growth of forests and crops and contributes to acid rain and global warming. And disposal of solid wastes outside the metropolitan area consumes land and disrupts communities.

Unless cities become less wasteful consumers of the materials mined, harvested, and extracted beyond their borders, the world is not likely to solve any of its pressing environmental concerns.

B. Typology of Urban Environmental Problems

For purposes of the analysis to follow, we propose a typology of urban environmental problems based on two characteristics: the spatial scale of environmental problems and the type of impact the problem causes. (In this analysis, "problem" is understood to mean a complete cause-effect relationship.)

First, cities generate environmental problems over a wide range of spatial units. As centers of population, production, and transportation, as consumers of natural resources that are obtained from outside the city, and as generators of waste that is disposed both inside and outside the city, cities cause environmental problems at the level of the household or workplace, the community, the metropolitan area, the region, and globally. **Table 1** provides examples of the kinds of problems caused by cities at different spatial scales. The first column indicates the spatial scale of the problem. The second column indicates the pressures that give rise to specific problems. The third column indicates the effect of a pressure on the state or condition of the environment.

Second, environmental problems have different kinds of impacts on society. Environmental problems may impair human health, cause economic and other welfare losses, or damage the ecosystems on which human life ultimately depends. Most environmental problems entail all three kinds of impacts. However, impacts can be direct or indirect. For example, outdoor

air pollution at the metropolitan level has a direct impact on human health, increasing the incidence of respiratory disease. Its impact on the economy is mainly indirect since economic costs result largely from impacts on human health. Column four of **table 1** indicates major direct impacts.

The horizontal organization of the table is meant to suggest that cause-effect relationships cluster within spatial units. For example, the domestic use of low-quality fuels probably has its most serious effects on air quality and on human health within the home. However, it should be kept in mind that pressures arising at one level will have effects on environmental conditions at other levels. For example, domestic fuel consumption also contributes to ambient air pollution.

Spatial scale and the type of direct impact are linked in that health impacts tend to predominate at the household, community and metropolitan levels; economic and ecological impacts are increasingly important at the regional, continental and global levels.

Table 1: Spatial Scale of Urban Environmental Problems

Scale of Problem	Pressure	Condition	Direct Impact*
Household/ Workplace	Use of low quality fuels (heating, cooking, production) Use of toxic substances Smoking Poor ventilation	Indoor air pollution	Hlth
	Lack of piped-water connections	Poor personal and food hygiene	Hlth
	Poor hygiene practices	Food contamination	Hlth
	Crowding (persons per room)	Transmission of communicable diseases	Hlth
	Lack of sanitation (lack of pit latrines)	Accumulation of excreta in soils and water	Hlth
Community/ Neighborhood	Lack of sanitation (lack of communal latrines or water-born systems)	Accumulation of excreta in soils and water	Hlth
	Lack of piped water	Unsafe drinking water Unsanitary food preparation	Hlth
	Lack of trash collection/sanitary disposal	Solid waste accumulation	Hlth
	Industrial plants near residential zones	Toxic waste exposure	Hlth
	Construction on slopes Stripping of vegetation Poor drainage	Natural disasters (floods, landslides, other)	Hlth/ Ecn
	Crowding (persons per hectare)	Transmission of communicable diseases	Hlth

* Hlth = health; Ecn = economic; Ecl = ecological.
Sources: The World Resources Institute and Bartone, 1992.

(Table 1 - continued)

Scale of Problem	Pressure	Condition	Direct Impact*
Metropolitan Area	Fossil fuel consumption (households, transportation, industry) Use of low-quality fuels Poor transportation/ land-use planning Overreliance on private automobiles	Outdoor air pollution	Hlth
	Lack of sanitation (water-born systems)	Accumulation of excreta in soils and water	Hlth
	Lack of sewage treatment Industrial wastes Lack of sanitary solid-waste disposal	Water pollution	Hlth
	Overreliance on private motor vehicles Poor transportation/ land-use planning	Traffic congestion Lack of open space	Ecn Hlth
	Urban encroachment	Loss of natural areas (wetlands, coastal zones, forests, other) Loss of cropland	Ecl/ Ecn
	Increasing demand for land and water	Increasing marginal cost of water, land, sanitation, solid waste disposal	Ecn
	Lack of land-use planning, crowding	Construction on marginal, hazard-prone lands	Hlth/ Ecn

(Table 1 - continued)

Scale of Problem	Pressure	Condition	Direct Impact*
Region	Lack of sewage treatment Industrial wastes	Water pollution Coastal zone damage	Hlth/ Ecn/ Ecl
	Use of fossil fuels Acid rain and ozone	Damage to forests, croplands Damage to oil-producing regions	Ecl/ Ecn
	Deforestation	Downstream flooding, siltation	Hlth/ Ecn/ Ecl
Continent/ Globe	Use of fossil fuels, CFCs	Global warming	Ecl
	Use of CFCs	Damage to ozone layer	Ecl

---------- End of Table 1 ----------

This typology has important implications for the analysis to follow. First, it shows that urban problems -- air and water pollution, exposure to toxics, solid waste dumping, and natural hazards -- are experienced as "people" problems with direct impacts on human health. In contrast, regional or global problems tend to have greater direct impacts on the economy and on ecological systems. In developing countries with few resources to devote to environmental problems and pressing needs for the kinds of basic services taken for granted in developed countries, urban issues might better reflect local priorities than regional or global issues.

Second, the spatial analysis indicates that pressures within cities cause serious environmental problems whose impact is felt mostly within the cities themselves. Pollution of water with domestic and industrial wastes, for example, can arise mostly from activities within the metropolitan area while most damages are felt locally, chiefly, through the health impacts of contaminated fresh water supplies and through contaminated fish. This means that cities are both responsible for the state of their own environments and could reap considerable benefits from changing polluting behaviors.

Third, in some cases, urban problems are caused by the same activities that cause regional or global problems. Fossil fuel

consumption causes air pollution that damages human health within the metropolitan areas. But it also causes upstream damages to oil-drilling regions and downstream damages in the form of acid rain and global warming. This suggests that planners can address major regional and global problems by better addressing local urban concerns. It also suggests that, for some issues, a city's energies can be mobilized to solve its own problems in ways that will have benefits beyond the city.

Developing world cities have many of the resources needed to make progress on the environment. For example, cities enjoy special advantages as centers of social organization, education, and communications. Nevertheless, barriers to progress remain. Among these barriers, a recent UN report identified overcentralization of government, lack of self-help strategies for the poor, and lack of local government tax authority. (UNDP, 1990)

This report focuses on lack of information on the urban environment as an additional important barrier to progress. Better information could contribute to improved understanding of both the causes and risks of urban environmental problems. It would also help with design of management strategies. The need for better information is widely recognized in developing countries. Indeed, Ecuador's National Plan for Social and Economic Development, 1989-1992 specifies lack of a "policy of social communication and information" as one of the country's greatest impediments to progress. (Borja, 1988)

With extensive domestic experience in environmental monitoring, impact assessment and risk analysis, United States government agencies have a comparative advantage in strengthening environmental information programs in developing world cities. Support for appropriate, city-level environmental information programs could be a relatively effective and inexpensive way to help address urban environmental problems in the developing world.

C. U.S. AID and Urban Environmental Management

The U.S. Agency for International Development (USAID) has been in the forefront among international donor agencies in its concern for environmental quality. However, most of its attention has been directed to rural environmental issues. It was not until 1990 that USAID adopted an Initiative on the Environment document that identifies urban/industrial pollution and environmental health as one of six key problem areas for technical intervention by the regional bureaus. The Initiative document identifies as special concerns such urban problems as water pollution; residential, industrial and toxic wastes; inefficient use of such natural resources as land and energy; air

pollution from automobiles and industry; and occupational health and safety. In describing several proposed "areas of intervention", USAID recommends strengthening environmental data bases and the capacity for policy analysis; strengthening local capacity in both the private and public sectors to foster concern for environmentally sound programs and policies; and, improving access to environmental information and analytic techniques. (USAID, 1990)

USAID's Environmental Strategy Framework, drafted in 1991, identifies urban and industrial pollution as one of five key areas in which to target new funding. The Strategy's goals include building awareness of the links between environmental protection and economic and social development, assisting in improving the management of natural resources, and helping developing countries contribute to solving global and regional environmental problems while working to meet their own development objectives. Among the "strategic approaches" identified in the strategy are: strengthening human/institutional capacity and building public awareness of environmental problems. Among its guidelines to help regional bureaus plan interventions, the Strategy calls for developing information to "strengthen the knowledge base of environmental problems and solutions...." In particular, it calls on regional bureaus to establish indicators to determine progress in solving environmental problems or "performance" indicators. (USAID, 1991)

Urban-environmental issues are also addressed in the recently completed Green Guidance for Latin America and The Caribbean: Integrating Environmental Concerns in AID's Programming and other regional documents prepared over the past couple of years. (USAID and WRI, 1993)

USAID's Office of Housing and Urban Programs within the Bureau for Private Enterprise (APRE/H) has Regional Housing and Urban Development Offices (RHUDO's) in developing countries that provide assistance to country missions.[1] The RHUDOs have supported shelter sector development, infrastructure provision, and land titling in marginal settlements along with guidance on municipal management and finance in over 50 countries.

In late 1990, APRE/H developed an Urban Environmental Strategy and Action Plan to guide APRE/H and RHUDOs on urban environmental issues. One of the strategy's three objectives was to help improve the analytical capability of donors and host countries.

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[1] These cities include: Kingston, Jamaica; Guatemala City, Guatemala; Quito, Ecuador; Abidjan, Cote d'Ivoire; Tunis, Tunisia; Nairobi, Kenya; and Bangkok, Thailand.

In November of 1989, APRE/H and WRI sponsored a day-long roundtable conference on urbanization and the environment in developing countries. The conference examined links between urbanization and environmental decay and sought to identify more effective methods for urban environmental management. The WRI Urban Environmental Indicators Project is a spinoff of this conference.

D. Purpose of the WRI Urban Environmental Indicators Project

The original purpose of this Project was to identify a set of urban environmental indicators that could be used by APRE/H, RHUDO staff, local counterparts and others to assess conditions and trends in the seven RHUDO cities. In addition, WRI was to propose a mechanism for reporting these indicators on a periodic basis.

In Phase I, WRI proposed a preliminary set of 64 indicators suitable for this purpose. (Linares and Tunstall, 1991)

In Phase II, as described in this report, WRI conducted a case study in Quito, Ecuador to determine the availability of urban environmental data and to test the adequacy of the a priori indicator set developed during Phase I.

During the course of Phase II, it became obvious that the original purpose of this project should be expanded. In particular, the high level of commitment in the Quito municipal government to urban environmental problems, the importance to USAID of strengthening local institutions and participation, the low levels of donor agency funds available for urban environmental planning and projects, and the uneven coverage and quality of data available in Quito suggest that a reporting mechanism be designed that does more to help local policymakers and the public to grapple with environmental issues.

This final report, therefore, aims to fill a broader purpose. It outlines an approach to gathering and reporting indicators that serves to increase understanding of urban environmental problems in developing world cities. To fulfill the original purpose of this project, APRE/H can use the information gathered through this process to form a central database of harmonized indicators.

E. Scope of Work and Methodology

On August 5, 1991, WRI submitted its Phase I Report: Development of Urban Environmental Indicators to APRE/H. In the report, WRI recommended a set of 64 indicators that could be used

to describe environmental conditions and trends in the RHUDO cities. The report provided definitions, units of measure, and international norms for this preliminary list of indicators. (Linares and Tunstall, 1991)

Several principles and requirements determined inclusion in this set. First, WRI recommended a framework for selecting indicators that analyzed environmental problems into four parts: underlying pressure on the environment, state or condition of the environment, private and public responses to environmental conditions, and measures of the performance of the response. Second, WRI specified a set of seven "characteristics" of good indicators. Third, WRI conducted a literature review and formed a general, a priori sense of the major urban environmental issues that ought to be covered in a data list. Fourth, WRI focused the list on state of the environment data and on four categories, a) Population and Health, b) Atmosphere, c) Water, and d) Land. Fifth, WRI focused the list of indicators on environmental problems with impacts at the spatial level of the metropolitan area.

To test the availability of indicators for the RHUDO cities, WRI reviewed studies and databases maintained by donor and international organizations such as the World Bank, the Organization of American States, the Inter-American Development Bank, USAID and the Pan-American Health Organization. WRI found that data on environmental conditions in RHUDO cities were scattered, inconsistent, and incomplete. Apparently, no international organization compiles urban environmental information on a systematic basis.

In Phase II, WRI conducted a case study in one RHUDO city, Quito, Ecuador, to determine the availability of urban environmental data, to gather documentation on Quito's environmental problems and programs, and to test the adequacy of the indicator list developed during Phase I. With regard to adequacy, WRI sought to determine what indicators were necessary and sufficient to cover local perceptions of priority problems. It determined local priorities informally, as a combination of problems identified in interviews and studies or addressed by laws and regulations. In Quito, WRI also helped identify information sources for an environmental health risk assessment conducted by the Water for Sanitation and Health Project/Research Triangle Institute (WASH/RTI) and the Technologies for Primary Health Care Project (PRITECH). **Annex I** lists people interviewed in Quito for this project. In Washington, WRI conducted further review of the literature on urban environmental problems and indicators. And WASH/PRITECH provided access to documents collected during their field research in Quito.

Based on its research and the Quito Case study, WRI describes, in Section II of this report, a comprehensive approach

to urban environmental indicators for developing world cities.

II. DEVELOPING URBAN ENVIRONMENTAL INDICATORS

Indicators for our purposes can be defined as time-series data that convey information about environmental problems useful to policymakers and the public. They should tell us something about the underlying causes of environmental problems; the condition or state of the environment; the economic, health and ecosystem risks or impacts of environmental conditions; the kinds of responses taken by government or private citizens to avert those impacts; and the effectiveness of those responses.

This section of the report spells out an approach to developing urban environmental indicators. It specifies the characteristics of good indicators, criteria for selecting indicators appropriate to a particular city using basic information about a city's level of economic activity and ecozone type, and a framework for developing indicators that captures the cause-effect relationships needed to analyze and understand environmental problems.

A. Characteristics of Good Indicators

The Phase I draft report identified eight characteristics of good indicators. These should guide choices in the selection of urban environmental indicators. After review, WRI still considers them valid. They are:

1. Relevancy: indicators should tell the user something important about the environment.

2. Time Series: data should be available from ongoing monitoring programs or from repeatable studies to support comparisons over time.

3. Statistical Quality: data should be based on the best monitoring practices available.

4. Appropriate Spatial Scale: data should cover the spatial units needed to properly analyze specific problems. For purposes of urban indicators and depending on the problem of interest, the most appropriate spatial units are the household and workplace, the neighborhood or community, the city proper, and the metropolitan area. Since low-income neighborhoods tend to suffer disproportionate impacts, desegregating data for marginal neighborhoods as a group from the city as a whole may help clarify analysis.

5. Analytic Significance: data should help the user to

understand causal relationships between different aspects of an environmental problem. They should also help the user understand environmental problems in relation to performance goals or standards. For instance, air quality performance indicators could be given as number of days per year when average air quality exceeds prescribed standards.

6. Frequency: the reporting of data should be at a frequency necessary to support policy goals. For example, local air quality indexes, aggregating different air quality measures into one number, should be reported on a daily or hourly basis to achieve day to day air quality management goals or to modify behavior in appropriate ways; quarterly or annual summaries may be sufficient for long-term investment or planning decisions.

7. Feasibility: collection of environmental data and reporting of environmental indicators must be cost effective and technically feasible. Monitoring and the reporting and analysis of data should be built into all urban environmental programs.

8. Selectivity: indicators should be limited to the minimum number necessary to convey significant information about environmental problems and policy goals. Limitation of the number of reported indicators will help the public and policymakers focus on the most serious environmental problems and help build support for environmental management goals. Indexes, or aggregations of indicators, may help reduce the number of reported environmental indicators.

B. Criteria for Identifying UEI A Priori

Most of the characteristics of good-quality indicators are fairly straightforward. Relevancy is not. In particular, to determine the relevancy of an indicator requires some knowledge of a city's main environmental problems. That could be difficult for several reasons: a city may not have a strong sense of its environmental problems; a scientifically-grounded identification of problems requires environmental information, but information may not exist or may not be available; and, in all probability, no scientific risk assessment has been conducted to determine relevancy through a prioritization of risks.

Ideally, relevancy would be determined by a comparative risk assessment that ranked the importance of all three kinds of impacts -- health, economic, and ecological -- on a common scale. Environmental management strategies could then be selected that achieved the greatest risk reduction at the least cost.

However, even if risk assessments were widely available, they cannot be the sole determinant of an indicator's relevancy. Limitations of methodology and data (a special constraint in

developing countries) limit their accuracy. Moreover, the need to build political consensus to undertake management of environmental problems means that non-scientific perceptions will inevitably play a role in determining the ranking of environmental problems and, therefore, the relevancy of environmental indicators. (USEPA, 1990)

Given that many developing country cities have not clearly defined their urban environmental priorities through political processes and that risk assessment is neither widely available nor methodologically perfected, WRI proposes a simple "rule of thumb" a priori method for identifying a city's likely environmental problems (loosely understood to mean environmental risks). In the absence of more concrete information, this method offers a way to begin the data-collection, organizing and reporting process.

It may be possible to predict a city's likely environmental problems on the basis of two factors, level of economic activity and ecozone location. Level of economic activity provides basic information on the kinds of pressures a city imposes on its natural environment. Since city-level information is not widely available, country-level data is used instead. The income classifications are drawn from World Bank data. Low-income countries are those with GNP per capita of up to $610. Lower-middle-income countries are those with GNP per capita of $611 to $2,465. Middle-income counties are those with GNP per capita of $2,466 to $7,619. (Bartone, 1992)

At lower income levels, cities exert relatively greater pressures on the environment from human wastes, lack of piped water, domestic use of low-quality fuels, crowding and occupation of marginal and hazard-prone land. At higher income levels, cities exert relatively greater pressures in the form of inputs and residuals from production and consumption. These pressures include greater consumption of fossil fuels, greater use of motor vehicles, higher levels of industrial production, and higher levels of solid waste. For cities in high-income countries, the absolute level of impacts from human wastes, lack of piped water, crowding and occupation of marginal land may decline, especially for higher-income neighborhoods, due to better infrastructure, social services, planning and private defensive measures.

The four ecozones types used here represent combinations of three basic physical parameters. These are altitude (upland and lowland), temperature (cold/temperate and hot), and moisture (humid and arid). Since temperature effects are largely captured in altitude, these two parameters are combined. Effects for coastal zones are captured by lowland cities.

A city's likely environmental problems can be predicted on the basis of these two factors. Note that the following

generalizations apply to average conditions in cities. Conditions in marginal neighborhoods will be worse than in the city as a whole.

In general, water pollution problems from human wastes rise with temperature (favoring survival of pathogens), rise in lowland areas (where de-oxygenated water is not aerated and where populations live along the water supply), rise in areas of water scarcity (arid ecozones), and rise with dependence on water resources for food or income (coastal ecozones) but are constant or decline with rising income level (as sewerage, water supply and defensive measures improve). The dangers of water pollution from industrial sources are constant with changes in temperature, rise in lowland areas (dependent on coastal or fresh water fisheries), rise in arid zones (where alternative supplies are less available), and also rise with income level (due to industrialization).

Air pollution problems rise with temperature extremes (in cold areas more fuel is used for heating while in warm, sunny areas release of hydrocarbons and nitrous oxides contribute more to ozone formation), rise in upland areas (where fuel combustion is less efficient), and rise with income level (since motorization rates, industrial production and fuel consumption are higher).

The generation of municipal solid wastes rises with income; risks rise in humid ecozones (due to higher runoff) and warm zones (favoring survival of disease vectors). Generation of industrial hazardous wastes rises with income level (as industrialization increases) but is constant with ecozone. The costs of traffic congestion rise with income level (due to higher motorization rates) but are constant with ecozone. The risks of crowded housing and living conditions rise as income falls. Finally, the risks of natural disasters decline with income (as planning, infrastructure and defensive measures improve).

Table 2 sets out a matrix that identifies probable major environmental risks for developing-world cities based on four ecozone types and on three levels of per capita income. Risks are ranked in ascending order as very high, high, medium and low to provide some comparison both between different risks for a particular city and between levels of risk for different ecozone-income groupings. Taken as a whole, the matrix identifies the universe of environmental problems that should be covered in a general set of indicators suitable for all developing world cities. Alternatively, given basic information about a city's level of economic activity and ecozone type, the matrix can provide an informal way to determine a list of environmental indicators tailored to that particular city.

The matrix should be used with caution: mitigating factors

may intervene to prevent predicted risks from becoming actual impacts. For example, most large cities in low-income countries would appear to be at severe health risk from contamination of water supplies with domestic wastes. However, access to abundant clean water from upstream or protected ground-water sources may limit actual impacts.

Examples of developing world cities for which extensive empirical information is available show that the matrix is a reasonably good predictor of priority environmental problems. These cities -- together with discrepancies between the matrix predictions and empirical data -- are indicated in parentheses.

Table 2: Urban Environment Characterization Matrix for Developing Countries*

	Ecozone Location			
	Upland Arid	Upland Humid	Lowland Arid	Lowland Humid
Level of Development**				
Middle-income	1)			
Lower-middle-income	2)	**SEE BELOW**		
Low-income	3)			

Sources:
* Abt Associates et al, 1990; Amuzu et al, 1991: Borkiewicz et al, 1991; Clarke et al, 1991; Leitmann, 1991 (a); Leitmann, 1991 (b); Arcia et al, 1992.
** Bartone, 1992.

The following descriptions provide examples of the use of the matrix:

1) Middle-income; Upland/Arid (Mexico)

Medium health risk from water contaminated with domestic wastes.
High health risk from water contaminated with industrial wastes.
Very high health risk from air pollution due to vehicle,

domestic, and industrial emissions and inefficient fuel combustion.
Medium health risk, loss of amenities from municipal solid waste.
High health risk from industrial hazardous wastes.
High economic impacts from traffic congestion.
Medium health risk from crowding.
Medium risk from natural disasters.

Middle-income; Upland/Humid

Medium health risk from water contaminated with domestic wastes.
Medium health risk from water contaminated with industrial wastes.
Very high health risk from air pollution due to vehicle, industrial, and domestic emissions and inefficient fuel combustion.
Medium health risk, loss of amenities from municipal solid waste.
High health risks from industrial hazardous wastes.
High economic impacts from traffic congestion.
Medium health risk from crowding.
Medium risk from natural disasters.

Middle-income; Lowland/Arid

High health risk from water contaminated with domestic wastes (includes health risk from contaminated fish).
High health risk from water contaminated with industrial wastes (includes health risk from contaminated fish).
High health risk from air pollution due to vehicle, industrial, and domestic emissions.
Medium health risk, loss of amenities from municipal solid waste.
High health risk from industrial hazardous wastes.
High economic impacts from traffic congestion.
Medium health risk from crowding.
Medium risk from natural disasters.

Middle-income; Lowland/Humid (Sao Paulo)

Medium health risk from water contaminated with domestic wastes (includes health risk from contaminated fish).
Medium health risk from water contaminated with industrial wastes (includes health risk from contaminated fish).
High health risk from air pollution due to vehicle, industrial, and domestic emissions.
Medium health risk, loss of amenities from municipal solid waste.
Medium health risk from industrial hazardous wastes.
High economic impacts from traffic congestion.
Medium health risk from crowding.
Medium risk from natural disasters.

2) Lower-Middle Income; Upland/Arid (Katowice)

Medium health risk from water contaminated with domestic wastes.
High health risk from water contaminated with industrial wastes.
High health risk from air pollution due to vehicle, industrial, and domestic emissions and inefficient fuel combustion.
Medium health risk, loss of amenities from municipal solid waste.
Medium health risk from industrial hazardous wastes.
Medium economic impacts from traffic congestion.
High risk from crowding.
Medium risk from natural disasters.

Lower-Middle Income; Upland/Humid (Quito)

Medium health risk from water contaminated with domestic wastes.
Medium health risk from water contaminated with industrial wastes.
High health risk from air pollution due to vehicle, industrial, and domestic emissions and inefficient fuel combustion.
Medium health risk, loss of amenities from municipal solid waste.
Medium health risks from industrial hazardous wastes.
Medium economic impacts from traffic congestion.
High risk from crowding.
Medium risk from natural disasters.

Lower-Middle Income; Lowland/Arid

High health risk from water contaminated with domestic wastes (includes health risk from contaminated fish).
High health risk from water contaminated with industrial wastes (includes health risk from contaminated fish).
Medium health risk from air pollution due to vehicle, industrial, and domestic emissions.
Medium health risk, loss of amenity from municipal solid waste.
Medium health risks from industrial hazardous wastes.
Medium economic impacts from traffic congestion.
High risk from crowding.
Medium risk from natural disasters.

Lower-Middle-Income; Lowland/Humid (Bangkok)

High health risk from water contaminated with domestic wastes (includes health risk from contaminated fish).
High health risk from water contaminated with industrial wastes (includes health risk from contaminated fish).
Medium health risk from air pollution due to vehicle, industrial, and domestic emissions.
Medium health risk, loss of amenity from municipal solid waste.
Medium health risks from industrial hazardous wastes.
Medium economic impacts from traffic congestion.
High risk from crowding.
Medium risk from natural disasters.

3) Low-income; Upland/Arid (Tianjin)

Very high health risk from water contaminated with domestic wastes.
Medium health risk from water contaminated with industrial wastes.
High health risk from air pollution due to vehicle, industrial and domestic emissions, and inefficient fuel combustion.
Low health risk, loss of amenities from municipal solid waste.
Medium health risks from industrial hazardous wastes.
Low economic impacts from traffic congestion.
Very high risk from crowding.
High risk from natural disasters.

Low-income; Upland/Humid

High health risk from water contaminated with domestic wastes.
Low health risk from water contaminated with industrial wastes.
High health risk from air pollution due to vehicle, industrial and domestic emissions, and inefficient fuel combustion.
Low health risk, loss of amenity from municipal solid waste.
Low risks from industrial hazardous wastes.
Low economic impacts from traffic congestion.
Very high risk from crowding.
High risk from natural disasters.

Low-income; Lowland/Arid (Accra)

Very high health risk from water contaminated with domestic wastes (includes health risk from contaminated fish).
Low health risk from water contaminated with industrial wastes (includes health risk from contaminated fish).
Medium health risk from air pollution due to vehicle, industrial, and domestic emissions.
Low health risk, loss of amenity from municipal solid waste.
Low health risks from industrial hazardous wastes.
Low economic impacts from traffic congestion.
Very high risk from crowding.
Very high risk from natural disasters.

Low-income; Lowland/Humid

Very high health risk from water contaminated with domestic wastes (includes health risk from contaminated fish).
Low health risk from water contaminated with industrial wastes (includes health risk from contaminated fish).
Medium health risk from air pollution due to vehicle, industrial and domestic emissions.
Low health risk, loss of amenity from municipal solid waste.
Low health risks from industrial hazardous wastes.
Low economic impacts from traffic congestion.
Very high risk from crowding.

Very high risk from natural disasters.

C. Framework for Developing UEI

A conceptual framework for environmental problems can help guide the selection of indicators suitable for decision-making. Experience in Quito leads us to recommend changes in the framework proposed in our Phase I Report and to suggest additional ways to use it.

As in the Phase I Report, WRI proposes that APRE/H use a modified version of the frameworks developed by the OECD's Group on the State of the Environment, the United Nation's Statistical Office and the USEPA. As shown in **table 3**, this framework divides environmental problems into five general parts. They are presented in along the top of **table 3** as pressure, state, impact, response, and performance. Indicators can be selected for each part of the problem. The ordering of the parts implies a flow of causation between them. (UN, 1884; UN, 1988; OECD, 1991; Schulze, 1991)

The left-hand border of **table 3** indicates components of the urban environment. The components used in this study were selected to cover the universe of urban environmental problems without excessively overlapping each other. They could, of course, be modified as needed for other purposes.

In using the framework, it should be kept in mind that causation between the different parts of an environmental problem follow complex pathways that are often poorly understood and difficult to quantify. For example, one effect can have many causes, while one cause can contribute to many effects. Also, causation is probabilistic so that (assuming sufficient information exists) cause-effect relationships could be expressed as a coefficient or ratio. Finally, cause-effect coefficients will vary between cities depending on local ecological conditions, among other factors.

Table 3: Framework for Developing Urban Environmental Indicators

	Indicator Categories			
	Pressures-->	State-->	Impacts-->	Response-->
	<----------Performance---------->			
Components of the Urban Environment				
I. Population and Health				
II. Atmosphere				
III. Water				
IV. Land				
V. Economy				
VI. Ecosystem Type				
VII. Natural Disasters				

Environmental pressures. Environmental pressures include both social pressures and natural fluctuations that disturb the environment from baseline conditions. Social pressures on the environment can be divided into underlying pressures (such as population growth and level or type of economic activity) and proximate pressures (such as raw sewage discharges or emissions of air pollutants).

Indicators of pressures are essential to help policymakers and the public understand and address environmental problems: pressures are the basic causes of environmental problems; therefore, they are often the most economically efficient place to attack environmental problems that show up later as changes in the state of the environment or as environmental impacts. In developing countries that have extensive experience with the planning and analysis of economic development, information on pressures is often easier to obtain than other environmental information.

To understand the problems of particular cities, it is important to note that different local environments are likely to experience different kinds of human pressures (for example, upland regions are likely to experience greater pressures from fuel consumption because of inefficient combustion than lowland regions) and that different ecosystems will respond in different ways to the same types of human pressures (for example, sunny regions will generate more ozone for a given level of nitrous oxide and hydrocarbon emissions than cloudy regions). Thus, no two cities are likely to experience precisely the same combination and level of environmental problems.

Environmental state. The environment consists of the natural environment more or less modified by society. Ultimately, the natural environment is society's life support system. It is commonly divided between natural resources and the three media: air, water, and land. State of the environment indicators include depletion of natural resources and concentrations of wastes in water, air and on land. Since society may heavily modify the natural environment with roads and buildings, state of the environment indicators also include such measures as congestion or housing quality.

Frequently, standards reflecting important social values are set for state of the environment indicators. For example, the World Health Organization and other national and international bodies set maximum concentration standards for many pollutants in the three media and in food. Although state of the environment indicators are important in themselves, they are most useful to policymakers and the public when supplemented with indicators of pressures and impacts which show the causes and effects of changes in the state of the environment.

Environmental Impacts. Environmental impacts on society can be divided between health impacts, economic impacts, other socioeconomic impacts, and changes in the ecosystems on which society depends.

Health impacts of changes in environmental conditions can arise from exposure to pollutants, increased or new exposure to natural pathogens, disruptions in food supply or increased risk from other manmade or natural hazards. Indicators would include incidence of environmentally related diseases or injury and death rates from hazards. Environmental health impacts are often difficult to quantify because of insufficient knowledge of cause-effect (dose-response) relationships. As a result, health impacts are described in probabilistic terms as risks. With sufficient knowledge, they are expressed as a ratio between a change in the state of the environment and a change in morbidity or mortality.

Direct economic losses from changes in environmental

conditions can be estimated by estimating the costs from lost productivity due to health impacts, reduction in agricultural productivity from pollution, depletion of natural resources, time lost to congestion and other causes. (Shin, 1992) Economic losses are especially difficult to calculate when the underlying biological or physical impacts of changes in environmental quality cannot be accurately quantified.

Other socioeconomic impacts, often highly subjective and difficult to quantify, include loss of aesthetic, recreational or cultural amenities.

Society may also suffer welfare losses through damage to ecological life-support systems. Such welfare losses are especially difficult to quantify because they involve non-marketed goods and services which society takes for granted (for example, the environment's capacity to assimilate wastes) or because the effects of losing these goods and services would only be felt by future generations (for example, mining groundwater reserves).

Response. Society may respond to environmental impacts by reducing underlying or proximate pressures (for example, by installing sewer lines to remove human wastes from inhabited areas), by improving the state of the environment (for example, by cleaning up solid or hazardous waste sites) or by taking defensive action against impacts (for example, boiling water to kill microbes in drinking water). Response indicators, including measures of public opinion, environmental expenditures, environmental licensing and other regulatory actions, and protection and clean-up efforts, serve to measure levels of effort.

Performance. Social responses may bring changes in pressures on the environment, changes in the state of the environment or changes in environmental impacts. They are measured at every level of an environmental problem. Performance indicators are measures of achievement, rather than effort, in attaining targets or goals and may be expressed in terms of percent of attainment. To properly measure environmental policy performance, as recommended in AID's Initiative on the Environment, indicators must be built around a framework.

WRI's purpose in developing a framework was to provide a means of organizing information on the environment in ways useful for decision makers and the public. In particular, it provides a way to show cause-effect relationships that link pressures to the state of the environment, the state of the environment to impacts, impacts to responses, and responses to performance. As such, the framework helps policymakers and the public to see environmental problems as interconnected wholes and to design and implement policies that address problems at the appropriate

level.

D. Core Set of UEI

A core set of urban environmental indicators can be identified for developing world cities. **(See table 4.)** Since this project is meant to help address environmental information needs at the city level, the suggested core indicator list focuses on impacts at the spatial levels of the community, the city proper, and the metropolitan area. Expanding the list to include information at the spatial scale of the household and workplace, and at the regional and global levels would provide additional analytic benefits. However, the focus on city-level data is justified by the fact that most of the environmental problems that directly effect city-dwellers arise in the cities themselves.

This set is meant to cover the full range of possible ecozone types and income levels found in developing world cities. It, therefore, is drawn from the universe of potential problems identified in the city characterization matrix.

To help policymakers and the public analyze environmental problems, it tries to cover major cause-effect relationships by including indicators of pressure, state, impact and response. It does not specifically identify performance indicators because these are implicit in other indicators. For example, a government may set a performance goal that average ozone concentrations remain below WHO standards.

Since populations in marginal neighborhood are at greater risk from environmental hazards, it recommends that some indicators (marked "MN") be collected both for the city as a whole and for marginal neighborhoods as a group. Other indicators should be collected for "at risk" populations and for the city as a whole as marked.

This list is meant to be the minimum length necessary to capture both likely significant problems in all developing world cities and basic cause-effect relationships. More detailed information would be necessary for full-scale risk assessments and for investment decisions. Information at this level will, however, be sufficient to identify major environmental problems and to strengthen local institutions in the data-collection process necessary for more complete analysis and planning.

To create indicators of trends, data would, of course, have to be collected on a periodic basis. To create longer time series, data could also be collected backward and projected forward into time.

To help ensure development of comparable indicators for a large number of developing world cities, the core set of indicators identified here was selected to be compatible with the World Bank's Urban Environmental Indicators Questionnaire.

Finally, data should be collected within a clearly and consistently defined geographic area, either the city proper or the metropolitan area.

Table 4: Core Set of Urban Environmental Indicators*

I. Population and Health

A. Demography

(1) UP Total Urban Population (MN)
(2) UP Annual Population Growth Rate (including natural growth and migration) (MN)

B. Population Density

(3) UP Total Population/Total Built-Up Area (MN)

C. Housing

(4) UP Persons/Dwelling Unit or Room (MN)

(5) UP Total Number of Marginal Dwelling Units (Marginal Dwelling Units are those without water and sanitation facilities and constructed with inadequate or dangerous building materials. Marginal neighborhoods are those with a preponderance of such dwelling units.)

(6) UP Population living in Marginal Dwelling Units

D. Health: Impacts

(7) I Life Expectancy at Birth (MN)

(8) I Infant and Child Mortality Rates (MN)

(9) I Mortality and Morbidity Rates for Environmentally-related Diseases (MN)

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* (UP = underlying pressure; PP = proximate pressure; S = state of the environment; I = impact; MN = indicator should be provided both for the city as a whole and for marginal neighborhoods as a group.

E. Health: State of the Environment

(10) S Blood lead levels (at risk populations)

(11) S Lead levels in air, food and water (at risk populations)

(12) S Other toxic and microbiological contamination of food (at risk populations)

II. Atmosphere

A. Outdoor Urban Air Quality

(13) PP Emissions of Air Pollutants (calculated for transportation, industrial, commercial and domestic sectors by fuel type)

Sulphur Dioxide (SOx)
Nitrogen Oxides (NOx)
Total Suspended Particulates (TSP)
Carbon Monoxide (CO)
Volatile Organic Compounds (VOC)
Lead (Pb), Other Toxics

(14) S Concentrations of Air Pollutants

Sulfur Dioxide (SO2)
Nitrogen Dioxide (NO2)
Total Suspended Particulates (TSP)
Carbon Monoxide (CO)
Ground-level Ozone (O3)
Lead (Pb), Other Toxics

III. WATER

A. Water Resources and Use

1. Water Supply and Demand

(15) PP Volume of Water Withdrawal/Day (for domestic and industrial uses)

B. Domestic Water Supply and Sewerage

1. Water Supply Coverage

(16) S Percentage of Dwelling Units, Households or Population with Piped Water Connections,

Communal Standpipe, and Other Water Sources (MN)

(17) PP Percentage Water Loss from the Distribution System/Day

(18) S Quality of Water Consumed by City Residents (MN)

2. Sanitation Coverage

(19) S Percentage of Population with Sewer Connections, Communal Sanitation, On-Site Sanitation (MN)

C. Wastewater Treatment

1. Domestic Treatment

(20) R Percent of Population Served by Sewage Treatment (by kind of treatment: primary, secondary, tertiary and no treatment)

2. Industrial Treatment

(21) R Percent of Total Industrial Discharges Treated

D. Downstream Water Quality: Rivers, Streams and Coastal Waters

(22) P Pollutant Discharges

Biochemical Oxygen Demand (BOD)
Total Suspended Solids (TSS)
Phosphorus
Organic Nitrogen
Other Chemicals and Metals

(23) 2. S Water Quality

Total Suspended Solids (TSS)
Biochemical Oxygen Demand (BOD)
Dissolved Oxygen
Phosphates
Organic Nitrogen
Coliforms
Parasites
pH

Metals
Organic Micropollutants
Pesticides

IV. LAND

A. Urbanization

(24) S Land Area by Uses (Agricultural, Forest, Vegetated, Residential, Commercial, Industrial, Vacant, Transportation and Communications)

(25) S Area of Marginal Neighborhoods

B. Solid and Hazardous Wastes

(26) 1. PP **Waste Generation** (municipal, commercial, and industrial solid and hazardous waste generated) (MN)

(27) 2. **Waste Collection**

R Volume and Percentage of Municipal Waste Collected Daily (MN)

R Percent Municipal Solid Waste Recovered (through recycling, scavenging, and conversion)

PP Total Commercial Solid Waste Collected

PP Total Industrial Solid Waste and Hazardous Waste Collected

(28) 3. **Waste Disposal**

S Amount of Municipal Solid Wastes Disposed, by type: open dumps, sanitary land fill, municipal dump site, incineration.

S Amount of Industrial Solid Waste Disposed, by type: sanitary land fill, municipal dump site, incineration, open dumps.

S Amount of Industrial Solid and Hazardous Waste Disposed, by type: sanitary land fill, municipal dump site, incineration,

treatment, containment, open dumps.

S Population Scavenging at Dumpsites

V. Economy

A. Level of Economic Activity

(29) UP Per Capita Income (MN)

B. Transportation

(30) UP Number of Motor Vehicles (by vehicle type: cars, diesel buses and trucks, other buses and trucks, two and three-wheel vehicles, bicycles)

(31) UP Vehicle-km per day (by vehicle type: cars, diesel buses and trucks, other buses and trucks, two and three-wheel vehicles, bicycles)

(32) I Average Commuting Time to Work (by private motor vehicle, by public transportation, and by other means)

C. Industry

(33) UP SIC classification of industries and annual production (An SIC classification provides the basis of a rapid pollution inventory assessment. It can help identify the amount of production from highly-polluting industries.)

D. Energy

(34) UP Total fuel consumption by type (fuel oil, gasoline, diesel, kerosene, LPG, natural gas, coal gas, coal, soft coke, charcoal, firewood, other)

(35) UP Fuel Quality

Lead content of gasoline
Sulphur content of coal
Sulphur content of diesel

VI. (36) UP Ecosystem Type

(Table 4 - continued)

Upland/Arid

Upland/Humid

Lowland/Arid

Lowland/Humid

VII. Natural Disasters

(37) S Built-up Area and Population on Hazard-prone land (risk of volcanic activity, seismic activity, flooding, storms and typhoons, landslides and mudslides, other) (MN)

---------- **End of Table 4** ----------

E. Indicator Reporting Mechanism

The purpose of urban environmental indicators is to help policymakers and the public understand and address environmental problems. As a first step, this requires that a process be established in which local institutions work together to identify local problems and to collect and report indicators on a periodic basis. A reliable system of information collection and reporting would increase local understanding of urban environmental problems, increase demand for an improved urban environment, and, ultimately, improve urban environmental management.

Indicator collection and reporting that could achieve these objectives requires the contributions of a wide range of local private and public sector organizations. These include:

- **Municipal, provincial and national government agencies.** Government agencies are more likely than other organizations to generate primary data on the urban environment. Environmental protection agencies are the most likely source of data, especially for indicators on the state of the environment. However, planning agencies, responsible for land use, water, and sanitation, and sector agencies, responsible for energy, health, industry, traffic control and other matters, are also likely to be good sources, especially for data on environmental pressures and on environmental impacts. Participation of a wide range of government agencies would help strengthen information-sharing and planning among offices with different mandates and at different levels of government.

- **NGOs.** Many will have access to valuable information

and analysis, although NGOs may lack the government's capacity to generate primary information. The special advantage of NGOs is that in some cases they can provide continued interest in urban environmental issues as government priorities shift with changes in administrations. In addition, their expert opinion and commentary can serve as a check on the quality of information and analysis reported by others. Besides environmental NGOs, those focusing on such related issues as occupational health, public health or social services may play a useful role in collecting and reporting data on the urban environment.

- **Educational and research institutes.** These organizations would be especially useful in providing objective information through studies of specific problems.

- **Business organizations.** Businesses will be an important source of information on production processes and wastes. They could play an important role in shaping the final report by focusing discussions on such key issues as the efficient provision of city services, land-use planning, transportation, and worker health.

- **Community organizations, labor unions and informal sector organizations.** These groups generally will not have the resources to generate scientific information. However, as the groups most representative of those at greatest health risk from environmental hazards, they can play a vital role by identifying problems from the personal experiences of their members.

- **Newsmedia.** Newspapers, magazines, radio and television help educate the public about environmental issues. Like NGOs, they can help provide continuity of interest in the urban environment when government administrations change. They also provide fora for public discussion of information and analysis.

To set up the reporting process, an international development agency (IDA) or international NGO could invite interested organizations and agencies in a developing world city to help plan, publish and disseminate a periodic State of the Urban Environment Report (SOUE). Discussions with all relevant actors would be intended to encourage participation in what must finally be a joint, cooperative effort. One group or agency would be designated as coordinator for the report. The most likely candidates for this role would be a government agency or an NGO. Other groups would participate by offering their perspectives on key environmental problems, by sharing primary data and by reviewing the analyses to be presented in the final report. The IDA could agree to help fund the effort. In addition, the IDA or an international NGO could provide technical support for data collection and analysis. Ideally, a network of reporting cities would be set up around the developing world.

A broad consultative process would ensure that the final report accurately reflected a city's problems and included the full range of existing information. To ensure that the views of community, labor and informal sector groups are represented in the final report, the coordinating agency could conduct problem-identification surveys using participatory urban appraisal techniques.

The report could consist of three sections, described here in reverse order of how they might actually appear. First, the report would include tables of time-series indicators based on the core indicator list developed in the previous section and including additional indicators that reflect other local priorities. Second, the report would include an analysis of environmental conditions and trends based on the data tables. Third, the report might include a special section in each issue that highlights specific local problems and successful management strategies. The report would be reader-friendly, targeted at both the general public and at local and foreign decision-makers.

In the process of collecting data and preparing an SOUE, an informal ranking of urban environmental problems may emerge. This ranking could provide the basis for determining a narrower set of indicators more appropriate to the needs of a particular city. Reducing the number of data collected and indicators reported would decrease costs and help focus attention on key issues. Criteria for ranking problems would include the severity of health, economic, and ecological impacts and the cost-effectiveness or political acceptability of management strategies.

The report would be widely distributed to local decision-makers in the municipal and central governments, the general public, the media, local and international NGOs, other cities participating in the program, and international donor agencies. Wide dissemination of the report would greatly strengthen the quality of data, indicators, and analysis over time.

The approach WRI is recommending represents part of a low-cost alternative to the Urban Environmental Management Strategy (EMS) of the joint UNDP/World Bank/UNCHS (Habitat) Urban Management Program. As conceived by the World Bank, an EMS has four phases:

1) A consultative rapid assessment that includes extensive data collection based on an Urban Environmental Indicators Questionnaire; writing of an Urban Environmental Profile; consultations with key actors and affected groups leading to an environmental "town meeting" to discuss problems, priorities, and possible solutions. The Bank's experience shows that 60 to 80 percent of data sought for their questionnaire (that is much more detailed than the core set proposed by WRI) were available and

that roughly two consultant-months were required to fill in the questionnaire. Total local costs for the entire consultative phase of the EMS ranged from $16,000 (Accra) to $27,000 (Jakarta);

(2) Formulation of an Urban Environmental Management Strategy that includes negotitated issue-specific management strategies, long-term environmental goals, and phased targests for meeting goals;

(3) Agreement on Environmental Action Plans for achieving goals, including identification of least-cost project options, and policy and institional reforms to coordinate actions between sectors; and

(4) A consolidation phase in which policy and institutional changes are regularized and monitoring and evaluation procedures are put in place.

WRI's approach corresponds mainly to the consultative phase of the UMP strategy. Although WRI's proposal does not contemplate management strategies, action plans or donor agency investments, in the long run, it could produce a variety of benefits that include improvements in urban environmental conditions:

1) It would help educate the public and decision makers about environmental issues, helping to identify major problems, cause-effect relationships, stakeholders, and necessary responses.

2) Producing and disseminating the reports would help strengthen the capacity of local institutions for data collection and analysis and expose gaps in data availability and quality. Publishing the reports on a periodic bases would lend continuity to data collection and analysis.

3) The reporting process would raise public consciousness about urban environmental problems and increase the demand for environmental improvements.

4) Increased demand for environmental improvements would create a more receptive audience for management strategies developed elsewhere, including those developed in cities participating in the Urban Managment Program. Low-cost solutions based on cross-sectoral coordination and on full-cost pricing of environmental goods and services would be particularly attractive where donor agency financial support is not available.

5) The reports would raise the profile of urban environmental issues on the international development agenda and attract resources for urban environmental activities in cities

that prepare them.

6) If similar reports were prepared by many developing country cities, they would provide a large, harmonized data base on urban environmental problems. The data base would enhance efforts at cross-city comparisons and support efforts to generalize about causes of and solutions for urban environmental problems. APRE/H could use the reports to create a central database on urban environmental conditions for the RHUDO cities.

7) Data collected for these reports could be the basis for more in-depth analysis to prioritize a city's environmental problems. These could include urban environmental profiles or, with additional information, environmental health risk assessments.

Judging from the Bank's experience in filling out its own questionnaire and from WRI's experience in conducting the Quito case study, the level of effort required to collect data for WRI's shorter indicator list would be no more than one consultant-month at costs of less than $5,000. Preparing an SOUE might triple consultant time and costs.

WRI's proposals on strengthening urban environmental information systems are based on the recognition that international donor agencies cannot possibly provide sufficient funds to address the growing environmental problems of developing country cities. The Urban Management Program promises to pioneer important new urban management strategies, but ultimately urban environmental problems in the develping world must be solved by the cities themselves acting in their own interests with their own resources in cooperation with national authorities. By helping to mobilize local energies to understand and to address local problems, annual or biannual SOUEs could strengthen efforts at local problem-solving at relatively low cost.

III. THE QUITO CASE STUDY

In Phase II of this project, WRI conducted a case study in Quito, Ecuador. The purpose of the case study was to determine the availability of urban environmental indicators, to test the adequacy of the characterization matrix and framework, and to survey local perceptions of urban environmental priorities.

WRI conducted the Quito Case Study between March 30 and April 11, 1992. Through interviews with 21 officials of the municipal and national government, an Ecuadorian NGO, and representatives of USAID, the WRI team identified local sources of data, institutional arrangements for monitoring and reporting on Quito's environment, collected available data and documentation, elicited comments on data characteristics,

problems and reporting mechanisms and surveyed local perceptions of priority urban environmental issues.

In Quito, WRI focused the data search on a set of 64 indicators developed during Phase I. (Linares and Tunstall, 1991). However, it also sought documentary sources for the broader set of data identified in the above core list. In addition, WRI helped identify data sources for the WASH and PRITECH environmental health risk assessment project. In turn, WASH and PRITECH shared documents they collected in Quito with WRI. Given time limits, WRI did not attempt to assess the quality of data it found.

A. Profile of the City

Physical characteristics. Quito lies in a plateau at an altitude of 2,800 to 3,000 meters on the eastern slope of Ecuador's Western Cordillera. **(See map 1.)** The slopes of Pichincha Volcano on the west and foothills of the Cordillera on the east have channeled the city's growth along a narrow north-south corridor. **(See map 2.)** This accounts for the metropolitan area's unique dimensions, 3-5 km in width and 40 km in length. An irregular topography, with slopes of up to 16 percent within the city, make provision of municipal services difficult. Precipitation ranges from an annual average of 500 mm in the north of the city to 1500 mm in the south. Average temperature is 12-14 degrees centigrade. The city's main rivers, the Machangara and Monjas, flow into the Guayllabamba basin. Quito's microclimate is mostly temperate humid, with a smaller temperate semi-arid zone in the north. (Dir. de Planificacion, 1980)

Political Boundaries. Quito's political boundaries have expanded repeatedly in recent decades as successive municipal governments have sought to grapple with the city's rapid growth. Changing boundaries complicate the task of identifying consistent indicators. For purposes of most of the data cited in this study, the City of Quito (The Illustrious Municipality of Quito or IMQ) covers 12,700 hectares and is the core of the Quito Metropolitan Area (AMQ), 93,600 hectares. The AMQ lies within the canton of Quito (416,600 hectares) in Pichincha Province (containing 6 cantons). (Arcia et al, 1991; Ripalda et al, 1991)

However, a 1990 municipal ordinance expanded the IMQ to 37,225 hectares, of which 18,086 are protected areas and 19,139 hectares are consolidated areas. And the 1990 Plan of the Quito Metropolitan District created a new planning unit, the Metropolitan District of Quito (DMQ) that embraces the entire canton. **(See map 3.)** (Calvo et al, 1992)

Two independent agencies with major environmental responsibilities -- the Municipal Sewerage Agency - Quito (EMA -

Q) and the Municipal Potable Water Agency - Quito (EMAP - Q) -- have canton-wide jurisdiction.

Administration. WRI focused on Quito to gain insight into the data collection and reporting processes in a city that has made significant efforts to improve its environment. The administration of Mayor Rodrigo Paz (1988-1992) gave high priority to urban environmental issues. Among other achievements, the Paz administration created a Department of Environmental Control within the Municipal Hygiene Department; started a cooperative effort with local industries to address pollution problems in the El Inca industrial area; began planning the city's first sanitary landfill; established new environmental laws and regulations governing water pollution and air quality; and launched a new Plan for the Metropolitan District of Quito in 1990 that developed studies on population and the environment, sponsored a new Geographic Information System for the city, strengthened land use planning, and created a belt of ecologically protected lands on the steep slopes surrounding the city. By 1992, EMA - Q had extended piped water service to some 83 percent of the canton's population.

Environmental laws and regulations. Ecuador's 1976 Law for Prevention and Control of Environmental Contamination governs the protection of the country's air, water and soil. The law is coordinated by the Ministry of Health through the Ecuatorian Institute for Sanitary Works (IEOS). The law gives IEOS responsibility for conducting studies of environmental problems, centralizing technical information on the environment, and controlling pollution of water for human consumption, controlling domestic and industrial waste water, and controlling air, noise, radiation, and solid waste pollution. The Ministry of Agriculture, through the Ecuadorian Institute for Hydrological Resources (INERHI) has principle responsibility for preventing pollution of fresh water bodies. The Ministry of Natural Resources and Energy and the Ministry of Agriculture share responsibility for control of pollution of soils. The Ministry of Industry, Commerce, and Integration and the Ministry of Labor and Social Welfare are responsible for locating industrial facilities and for worker safety. The Ministry of Government, through the General Transport Office, is responsible for motor vehicle pollution. The Ministry of Public Education is responsible for environmental education. The Politechnical Universities and Schools are responsible for scientific investigations of contamination. (Ministerio de Salud Publica, 1976)

In 1989, the Ecuadorian government promulgated national standards for waste water loadings and for water quality depending on intended uses. IEOS has responsibility for administering the regulations. The Ecuadorian Institute for Standards (INEN) determines technical criteria for water quality

standards. (Gobierno del Ecuador, 1989) In 1991, the Ecuadorian government promulgated standards for air quality. Standards cover sedimentable particles, TSP, SO_2, CO, O_3, NO_2, and Pb. (Gobierno del Ecuador, 1992) Currently, the government is preparing new regulations, on industrial and vehicular gaseous emissions and on environmental impact assessment.

In early 1992, the Paz administration passed an "Ordinance for the Prevention and Control of Industrial Liquid Emissions and Emissions to the Atmosphere" and implementing regulations. The regulations adopted national standards (the minimum standards required by law) for liquid wastes from industrial sources and for air quality. The ordinance calls for periodic public reporting of air pollution exceedences of norms and provides penalties for industrial facilities exceeding norms for air and water pollution. It requires industries to obtain Certificates of Environmental Control in order to operate. To obtain Certificates, industries must submit information on industrial processes, type of product and waste generated, chemicals used, and fuels used. The law gives the city the right to restrict automobile traffic and operation of industrial facilities in the case of air pollution exceedences.

Population. 55 percent Ecuador's population lives in cities. Over one quarter of the country's population lives in the two largest cities, Quito (11 percent) and Guayaquil (16 percent). 1.1 million people live in the IMQ, up from about 210,000 in 1950. 1.2 million live in the AMQ, 1.4 million in the canton of Quito, and 1.8 million in Pichincha Province. The IMQ's 1990 growth rate of 4.5 percent is fueled largely by rural-urban migration (2.9 percent) and secondarily by natural increase (1.6 percent). Quito's growth rate is more than four times greater than the growth rate of Ecuador's rural population. At current rates, Quito's population will double in 17 years. (INEC, 1991 and Arcia et al, 1991)

Health. Mortality rates for Quito (4.1 per 1,000 in 1987) are lower than for the country as a whole (7.4 per 1,000 in 1987), reflecting better access to health services and superior socio-economic conditions. Likewise, fertility rates are lower for the city (3.0 children per woman in 1985-90) than for the country as a whole (3.6 children per woman for the same period). (Arcia et al, 1991)

Air. Quito's high altitude and narrow, hilly streets, especially in the center of town, contribute to the inefficient combustion of fuels by motor vehicles. According to one estimate based on consumption of fossil fuels, motor vehicles contribute about 75 percent of air pollution, industry about 25 percent. Growth in fossil fuel consumption has been driven not only by population increases but by growing per capita income leading to a decreasing ratio of persons per motor vehicles. Between 1970

and 1989, the motorization rate fell from 30 to 11 persons per vehicle. (Arcia et al, 1991)

Water. Quito's fresh water supply, from mountain sources above the city, is generally of high quality. However, domestic and industrial wastes are dumped untreated into the rivers that drain the city, the Machangara, the Monjas, and the San Pedro. Although not consumed directly by city residents, water from these rivers threatens residents' health because it is used to irrigate more than 1,000 hectares of crops that are sold and consumed in the city. (Arcia et al, 1991)

Solid Waste. With increasing income, solid waste generation has grown rapidly on a per capita basis, contributing to disposal problems. Quito generates about 723 tons of solid waste every day. Only about 79 percent of this waste is collected and disposed of in one of two controlled landfills. The remainder is dumped in ravines or in open lots. This dumping blocks the flow of streams and rivers, interfering with the natural hydrological cycle and contributing to risk of flooding in some areas. (Dir. de Higiene, 1992)

Land use. Total urbanized area in the AMQ now covers 22,000 hectares or 23 percent of the metropolitan area. Expansion has occurred not only along the length of the valley, but up hillsides onto forested lands and sloping terrain. The built-up area of the AMQ has grown by a factor of 20 since 1950, far outstripping population which has grown by a factor of 6. The rapid outward expansion of the city is due largely to efforts to shelter wealth from inflation by investing in land. Low-density urbanization has reduced the area of lands devoted to forests and other vegetation and agricultural lands, and has forced poor residents to occupy marginal lands. **(See Map 4.)** These pressures have in turn increased the costs of providing water and sanitation services, increased the risks of erosion, mudslides, and landslides, exposed populations to volcanic risks and interfered with the natural hydrological system. (Peltre, 1988 and Arcia et al, 1991)

Economy/Trade. Fueled by discoveries of petroleum in the eastern provinces, Ecuador's economy grew at an annual rate of 8.8 percent in the 1965-1980 period, contributing to rapid growth of Quito's industrial sector. With the end of the petroleum boom, the national growth rate slowed to an annual 2.0 percent in the 1980s, accompanied by inflation and falling real income. Industry fell behind agriculture as the economy's fastest-growing sector. In the 1980s, domestic consumption of energy grew nearly twice as fast as production, an unsustainable trend for a country that relies on petroleum exports to finance investment in other capital assets. (World Bank, 1992a)

According to 1980 data, with just 18 percent of the national

population, Pichincha Province contains more than one-third of the nation's businesses, more than one third of its jobs, and 35% of industrial production. 85 percent of the Province's economic activity and 94 percent of industrial production is concentrated in the AMQ. (Dir. de Planificacion, 1990)

Transportation. Over the past twenty years, Quito's motor vehicle population has grown more than twice as fast as population, indicating a strong influence of increasing per capita income on motorization rates. Between 1970 and 1989, the number of persons per vehicle declined from 30 to 11. Motor vehicles contribute about 75 percent of Quito's air pollution. A combination of increasing congestion and urban sprawl have increased the average annual consumption of fuel per vehicle. (Arcia et al, 1991)

Industry. Quito's industrial sector grew rapidly with the petroleum boom of the 1970s, stimulated by national policy to create urban "poles" of development. Pichincha province accounts one third of Ecuador's industrial production. Industry is responsible for 25 percent of air pollution. Most industrial waste water is dumped untreated into Quito's rivers. Industry is poorly zoned. The wide dispersion of industrial facilities throughout the AMQ reduces economies of scale for the provision of infrastructure. Also, industrial areas - San Bartolo in the South and El Inca in the north - are close to residential neighborhoods, contributing to pollution exposures. The city has established a cooperative program with industry to clean up pollution in one of these areas, El Inca. To address industrial pollution city-wide, in 1992, the municipality adopted regulations requiring enterprises to obtain Certificates of Environmental Control in order to operate. (Arcia et al, 1991 and Concejo Municipal de Quito, 1992.)

B. Environmental Information in Quito

WRI identified data sources for all but one of the 36 core indicator groups. Only average commuting time to work is missing. This indicator - or another measure of congestion - could probably be provided by the national or state transportation offices. **Table 5** presents a description of data and sources covering the core list.

Table 5: Urban Environmental Indicators in Quito

I. Population and Health

A. Demography

(1) Total Urban Population (MN)

The National Institute for Statistics and the Census (INEC) recently published The Fifth Population Census and the Fourth Housing Survey (INEC, 1991). The census provides data on population at the canton and province levels broken down for urban and rural areas. Quito's Planning Department has census data at the block level for the city of Quito. Using INEC data, Arcia et al developed population estimates for the AMQ.

In 1990, 1.1 million people lived in the IMQ, up from about 210,000 in 1950. 1.2 million lived in the AMQ, 1.4 million in the canton of Quito, and 1.8 million in Pichincha Province.

Sources: Arcia et al, 1991; Dir. de Planifcacion; INEC, 1991a; INEC, 1991b.

A 1992 study sponsored by the Office of Planning estimated the population in marginal settlements at 195,330 or 18 percent of Quito's total population.

Source: Castro, 1992.

(2) Annual Population Growth Rate (including natural growth and migration) (MN)

An annual growth rate of 4.5 percent for the AMQ is driven largely by rural-urban migration (2.9 percent) and secondarily by natural increase (1.6 percent).

Source: Arcia et al, 1991.

B. Population Density

(3) Total Population/Total Built-Up Area (MN)

The IMQ's gross population density (total population/total area) was 84.5 persons/hectare in 1989. The AMQ's gross population density was 12.0 persons/hectare. Figures on the IMQ's net population density (total pollution/built-up area) were not immediately available. The AMQ's net population density is 38 persons/hectare.

Sources: Ripalda et al, 1991; Arcia et al, 1991.

A 1992 study sponsored by the Office of Planning published information on population density for Quito's

marginal neighborhoods in the central historical district and on the city's periphery.

Source: Castro et al, 1992.

C. Housing

(4) Persons/Dwelling Unit or Room (MN)

INEC publishes data on persons per household at the canton and province levels that are broken down for urban and rural areas.

Sources: INEC, 1991a,b,c,d.

A 1992 study sponsored by the Office of Planning contains information on crowding for Quito's marginal neighborhoods in the central historical district and on the city's periphery.

Source: Castro et al, 1992.

(5) Total Number of Marginal Dwelling Units

The National Housing Council (Junta Nacional de la Vivienda or JNV) publishes national-level estimates of marginal housing. INEC publishes data in the annual housing survey on housing quality as characterized by such features as access to potable water, sanitation, sewerage, building materials, type of construction, access to solid waste disposal, electrification and telephone service. These data are provided at the level of canton and province and are broken down by urban and rural areas. CEPAR published data in 1990 that characterizes housing in Quito's marginal neighborhoods by such features as access to potable water, sanitation system, and building materials. A 1992 study sponsored by the Office of Planning contains information on type of housing, type of construction material, and availability of services such as water, sanitation and electricity for Quito's marginal neighborhoods in the central historical district and on the city's periphery.

Sources: CEPAR, 1990; INEC, 1991c; Castro et al, 1992.

(6) Population living in Marginal Dwelling Units

INEC publishes data in the annual housing survey on population in housing characterized by such features as access to potable water, sanitation, sewerage, building materials, type of construction, access to solid waste

disposal, electrification and telephone service. These data are provided at the level of canton and province and are broken down by urban and rural areas.

Sources: INEC, 1991c.

A 1992 study sponsored by the Office of Planning contains information on population in Quito's marginal neighborhoods in the central historical district and on the city's periphery.

Sources: Castro et al, 1992.

D. Health: Impacts

(7) Life Expectancy at Birth (MN)

INEC publishes figures on life expectancy on an annual basis. WRI did not identify any sources for data on life expectancy in marginal neighborhoods.

Source: INEC, 1990.

(8) Infant and Child Mortality Rates (MN)

INEC publishes figures on life expectancy on an annual basis.

Source: INEC, 1990.

Infant mortality in Quito's marginal neighborhoods declined from 56 per 1000 in 1975-1980 to 33 per 1000 live births in 1985-1990.

Source: CEPAR, 1990.

(9) Mortality and Morbidity Rates for Environmentally-related Diseases. (MN)

INEC publishes mortality and morbidity figures on 150 causes of death on an annual basis. These data are published for parishes, cantons, and provinces, and not for individual cities or metropolitan areas. Moreover, INEC officials report that data on births and deaths are unreliable because of late inscriptions and under-reporting. Nationally, in 1976, 18 percent of births were registered in the following year; 40 percent were late in 1984. Under-reporting of births is roughly 10-11 percent. Up to 50 percent of deaths go unreported.

(Table 5 - continued)

Sources: INEC, 1989; INEC, 1990.

An epidemiological study conducted under the auspices of Fundacion Natura used canton- and province-level data in an effort to link mortality from different diseases with environmental hazards. The authors found that data limitations made it difficult to establish such links. For example, data were not available on the type and frequency of pesticides used. Also, data for hazards were aggregated at too large a scale, generally canton- or province-level averages, to establish associations with health problems. According to the authors, the main achievements of the study were to assemble available data; to observe data and analysis gaps; and to provide guidance for further studies.

Source: Suarez, 1992.

E. Health: State of the Environment

(10) Blood lead levels (at risk populations)

A 1991 study of pregnant women and newborns showed blood lead levels of 15 to 23 ug/dl. The same study showed blood lead levels of 26 to 30 ug/dl for street vendors in Quito's center.

Sources: Arcia, et al, 1992; Oveida, 1991.

(11) Lead levels in air, food and water (at risk populations)

A 1992 study found that lead levels in Quito's air averaged 0.67 ug/m3. The study found that 8 percent of total air samples showed lead levels exceeding the Ecuadorian standard of 1.5 ug/m3. However, two districts, one in the central city and the other in the south of the city, produced readings well in excess of the standard.

Sources: IEOS, 1992.

(12) Other toxic and microbiological contamination of food (at risk populations)

A 1986 study of pesticide contamination of mothers milk in Quito found that, for the pesticide lindane, 80 percent of samples were contaminated at average levels more than three times higher than WHO maximum standards. In all, the study showed that average levels of three out of six pesticides in contaminated samples exceeded WHO standards.

(Table 5 - continued)

Source: Bolanos, 1986.

A 1987 study in Quito found generally low-levels of pesticide residues in all samples of fourteen different food groups. Only a few samples exceeded Ecuadorian standards.

Source: Lopez and Fernandez, 1987.

The City of Quito tests seven categories of food for microbiological contamination on a monthly basis, guided by standards set by INEN.

Sources: Arcia et al, 1992; Laboratorio Bromotalogico, IMQ.

A 1992 study in Quito used laboratories at INEN and the National Polytechnical School to test 16 food groups for chemical and biological contamination. The study found numerous exceedences of Ecuadorian and international norms.

Source: Alban, 1992.

II. Atmosphere

A. Outdoor Urban Air Quality

(13) Emissions of Air Pollutants (calculated for transportation, industrial, commercial and domestic sectors by fuel type))

Sulphur Dioxide (SOx)
Nitrogen Oxides (NOx)
Total Suspended Particulates (TSP)
Carbon Monoxide (CO)
Volatile Organic Compound (VOC)
Lead (Pb), Other Toxics

Ecuador's 1976 Law for Prevention and Control of Environmental Contamination governs the protection of the country's air (and also water and soil). However, neither the national government nor the municipality have promulgated standards for emissions of air pollutants that could be used to enforce the law. There is no inspection and maintenance program for vehicles in Ecuador.

In 1989-1990, the Department of Environmental Control (DCCA) of the Office of Hygiene conducted a preliminary survey of gaseous (and liquid) emissions from 70 representative major industries in Quito. It followed up with a survey of 80 major industries to determine industrial

processes, the nature of effluents, treatment processes, pollution loadings, and emissions coefficients. This survey yielded estimates of gas, liquid, and solid wastes emissions. These results were not extrapolated to all large industrial facilities. The National Politechnical School was to be contracted to execute a program of analysis of wastes from a sample of industrial facilities. (WRI did not determine whether this part of the program was executed).

Source: Jurado, 1990.

In 1992, the Hygiene Department was preparing a gaseous (and liquid) emissions inventory for 72 industrial plants in the city.

Source: Jurado, interview, 1992.

The DCCA has produced pollution emission and concentration estimates for Quito and four critical zones based on industrial and motor vehicle fuel consumption using WHO/PAHO rapid assessment models. The studies contain February 1990 and September 1991 estimates for lead, hydrocarbons, carbon monoxide, sulfur oxides, nitrous oxides, and total particulate matter. The DCCA required approval from the Office of Hygiene to release these studies; the Office of Hygiene, in turn, required a letter from the USAID Mission Director to the Mayor's office to release these documents.

Sources: DCCA, no date (a) and (b).

MAP calculated annual emissions of SO2, NOx, VOCs, CO, and lead from motor vehicles based on annual consumption of diesel and gasoline for the AMQ for the period 1970 to 1989.

Sources: Arcia, 1991; DNH, 1970-1989.

(14) Concentrations of Air Pollutants

Sulfur Dioxide (SO2)
Nitrogen Dioxide (NO2)
Total Suspended Particulates (TSP)
Carbon Monoxide (CO)
Ground-level Ozone (O3)
Lead (Pb), Other Toxics

Ecuador's 1976 Law for Prevention and Control of Environmental Contamination governs the protection of the country's air (and water and soil). The law is coordinated by the Ministry of Health through the Ecuadorian Institute

for Sanitary Works (IEOS). In 1991, the Ecuadorian government promulgated standards for air quality, covering sedimentable particles, suspended particles, SO2, CO, O3, NO2, and Pb.

Source: Gobierno del Ecuador, 1992.

In 1992, the Quito city government adopted an ordinance to prevent and control air (and water) pollution from industrial sources. It promulgated standards for air quality based on the 1991 national standards. The ordinance authorizes the city to restrict circulation of vehicles and operation of industrial facilities when air pollution norms are exceeded. It also commits the municipality to periodically publish indexes of contamination in the mass media. However, the city lacks the monitoring network to determine exceedences or pollution levels. And the IEOS network may be inadequate for this task.

Sources: Concejo Municipal de Quito, 1992; Paz 1992.

Under the Municipality's 1992 ordinance, 527 large-scale industrial plants (those worth more than 100 million sucres) must file Environmental Compliance Plans. Of 1,200 small industrial plants (those worth less than 100 million sucres), some 200 are potentially contaminating and must also file Environmental Compliance Plans. To date, of the more than 700 plants covered by the ordinance, 40 have been registered by the Municipality.

Source: Jurado, interview, 1992.

IEOS operates three air quality monitoring stations in Quito (stations are located in the center, southern and northern parts of the city). These monitor three pollutants: anhydrous sulphur, suspended particles, and sedimentable particles. These stations were originally set-up by PAHO's "PANAIRE" Air Quality Monitoring Network Program that ended in Ecuador in 1986. There are concerns that the stations are not properly located for representative sampling and that the equipment lacks proper maintenance.

There are several stations monitoring meteorological conditions in the city: Civil Aviation's at the airport; the Observatory of the Polytechnic School; INAMHI's station; and a new station installed with assistance from the Getty Foundation on the roof of the Planning Department building in the city center. In all, there are 10 stations in the metropolitan area and 130 stations in Pichincha Province. The mayor has signed an agreement to promote sharing of

information between the institutions that manage these stations. Nationally, other stations are operated by INAMHI, IEOS, INERHI, the Civil Aviation Authority, and the Universities.

Technicians from Mexico's environmental protection agency recently conducted studies for the design of a monitoring network for the city. Also, USAID and the Getty Foundation are considering a proposal to donate air quality monitoring equipment. The Swedish development agency has offered to train technicians in the use of the equipment.

A 1991 analysis of data from the three IEOS monitoring stations indicates that average levels of anhydrous sulphur were below Ecuadorian norms in the 1979-1990 period, while average levels of suspended particulates exceeded the norms at two of the three stations. The number of exceedences per year appears to have risen during the study period.

Source: Espin, 1991(c).

A 1991 study used emissions coefficients for industrial fuel consumption to estimate concentrations of pollutants in the El Inca area. The study showed concentrations 3.5 to 38 times higher than Ecuadorian norms, depending on the pollutant measured. It showed concentrations for particulates and Sulphur Dioxide that were 10 and 120 times higher respectively than concentrations measured by the IEOS network.

Source: Zubkova, 1992.

A 1992 study found that lead levels in Quito's air averaged 0.67 ug/m3. The study found that 8 percent of total air samples showed lead levels exceeding the Ecuadorian air quality standard of 1.5 ug/m3. However, two districts, one in the central city and the other in the south of the city, produced readings well in excess of the standard.

Source: IEOS, 1992.

III. WATER

A. Water Resources and Use

1. Water Supply and Demand

(15) Volume of Water Withdrawal/Day (for domestic and

industrial uses)

In 1989 in the AMQ, the Municipal Potable Water Company - Quito (EMAP-Q) produced 111,416,250 cubic meters of water, or 250 liters per capita per day.

Source: Arcia et al, 1991.

In the Canton of Quito, commercial users consumed 29,971.77 cubic meters per day, residential users 189,452.71, government 15,534.74, for a total of 234,959.22 in 1990.

Source: EMAP - Q, 1991.

B. Domestic Water Supply and Sewerage

1. Water Supply Coverage

(16) Percentage of Dwelling Units, Households or Population with Piped Water Connections, Communal Standpipe, and Other Water Sources (MN)

The percentage of the population with piped water connections increased from 57 percent in 1970 to 83 percent in 1989. The WASH/PRITECH project provides additional figures on water service.

Source: Arcia et al, 1991; Arcia et al, 1992.

In marginal neighborhoods surveyed, only 39.2 percent of households are connected to the public water network, 31.1 percent obtain water from trucks, 14.6 percent are served by a public standpipe, 7.1 percent obtain water from a river, 5.6 have access to a well, and 2.4 percent use other sources. Castro et al 1992 offer different figures.

Source: CEPAR, 1990; Castro et al, 1992.

EMAP-Q serves the Canton of Quito, an area of 492 Km2. In 1990, it served 1,067,742 people out of a total population of 1,238,967 or 86 percent.

Source: EMAP - Q, 1991.

(17) Percentage Water Loss from the Distribution System/Day

In 1989, EMAP-Q produced 111,416,000 cubic meters of water, or 250 liters per capita per day. Only 83,562,000

cubic meters of this, 208 liters per capita per day, was consumed. The difference, 27,854,000, 42 lts per capita, was lost from the distribution network.

Source: Arcia et al, 1991; EMAP - Q.

(18) Quality of Water Consumed by City Residents (MN)

A 1991 study by Fundacion Natura collected available data on water quality in Quito. Test data covered 18 physical-chemical parameters, 3 microbiological parameters and chlorine residuals. The Municipality's Hygiene Department has information on water quality in home cisterns and from street vendors. Although the city's water quality is considered generally good, the Fundacion Natura data indicated a potential problem with microbiological contamination.

Sources: E. Espin, 1991(a); Direccion de Higiene.

2. Sewage Disposal Coverage

(19) Percentage of Population with Sewer Connections, Communal Sanitation, On-Site Sanitation (MN)

In the Canton of Quito, 1,000,000 of roughly 1,300,000 have some sort of sanitation service. Of those with sanitation, the Municipal Sewerage Company - Quito (EMA - Q) connects 700,000 (54 percent) to the sewer system, 100,000 (8 percent) have septic tanks, and 200,000 (15 percent) use latrine pits. 300,000 (23 percent) have no service. The WASH/PRITECH study offers different percentages, possibly based on a different geographic unit.

Source: EMA Q, 1991; Arcia et al, 1992.

C. Wastewater Treatment

1. Domestic Treatment

(20) Percent of Population Served by Sewage Treatment (by kind of treatment: primary, secondary, tertiary and no treatment)

There is no sewage treatment.

Source: EMA - Q, 1991.

2. Industrial Treatment

(Table 5 - continued)

(21) Percent of Total Industrial Discharges Treated

A 1992 study of industrial liquid discharges in the El Inca Area showed that only 6 or 7 of 24 plants surveyed (mostly in the chemical industry) pre-treat their wastes.

Source: DCCA, 1991(a).

D. Downstream Water Quality: Rivers, Streams and Coastal Waters

Laws and Regulations. Under Ecuador's 1976 Environment Law, IEOS has national responsibility for the quality of water used for human consumption and for control of domestic and industrial waste water. INERHI has principle responsibility for the quality of fresh water bodies.

In 1989, the Ecuadorian government promulgated national standards for liquid effluents and for water quality depending on intended uses. INEN determines technical criteria for water quality standards.

Source: Gobierno del Ecuador, 1989.

In 1992, the Quito city government adopted an ordinance to prevent and control water contamination from industrial sources (and to control air pollution). It promulgated standards for industrial liquid effluents and for water quality based on the 1989 national standards.

Under the Municipality's 1992 ordinance, 527 large-scale industrial plants (those worth more than 100 million sucres) must file Environmental Compliance Plans. Of 1,200 small industrial plants (those worth less than 100 million sucres), some 200 are potentially contaminating and must also file Environmental Compliance Plans. To date, of the more than 700 plants covered by the ordinance, 40 have been registered by the Municipality.

Source: Jurado, interview, 1992.

(22) i. Pollutant Discharges

Biochemical Oxygen Demand (BOD)
Total Suspended Solids (TSS)
Phosphorus
Organic Nitrogen
Other Chemicals and Metals

In 1989-1990, the Department of Environmental Control

(Table 5 - continued)

(DCCA) conducted a preliminary survey of emissions from 70 representative major industries in Quito. It followed up with a survey of 80 major industries to determine industrial processes, identification of effluents, and polluting substances, the identification of treatment processes, the determination of pollution loadings, and emissions coefficients. This second survey yielded estimates of gas and solid wastes, as well as liquid, emissions. The National Politechnical School was to be contracted to execute a program of sampling and analysis of wastes from a sample of industrial facilities. (WRI did not determine whether this part of the program was executed).

Source: Jurado, 1990.

From March 1991 to March 1992, the Municipality conducted an Environmental Assessment Study for 24 plants in the Industrial area of El Inca. The study was conducted in collaboration with the Pichincha Chamber of Industry and with World Bank funding. The project focused on industrial water use. Samples of liquid discharges were taken at 6 points of the industrial sewer system. The study found that only six or seven plants (mostly in the chemical industry) pre-treat their wastes. Sewage Authority (EMA) officials said that there is no inventory of pollutants discharged into the sewer system. However, they know from routine inspections that industrial discharges have damaged the sewer system.

Source: DCCA, 1991(a).

The Office of Hygiene is currently preparing a liquid discharge inventory for 72 industrial plants in the city.

Source: Jurado, interview, 1992; DCCA, 1991(b); Departamento de Plan Hidraulico, 1986.

(23) 2. Water Quality

Total Suspended Solids (TSS)
Biochemical Oxygen Demand (BOD)
Dissolved Oxygen
Phosphates
Organic Nitrogen
Coliforms
Parasites
pH
Metals
Organic Micropollutants
Pesticides

(Table 5 - continued)

The Hygiene Department monitors water quality in the Machangara and Monjas rivers, sampling water quality at six sites at regular intervals and using its own laboratory to conduct the tests. Parameters measured include: microorganisms (total coliforms, fecal coliform, v. cholera), physical parameters (conductivity, pH, temperature, turbidity), and chemical parameters (alkalinity, cyanide, cobalt, copper, chromium-VI, BOD, COD, detergents, dissolved solids, phenols, lead, mercury, nickel, nitrates, nitrites, nitrogen, ammonia, dissolved oxygen, organic nitrogen, phosphates, sulfates, and zinc). Samples taken do not show pesticides or mercury in either river.

Source: Jurado, interview, 1992.

INERHI is responsible for water-quality monitoring nation-wide and manages several GEMS water stations, none of which is located in Quito. These measure up to eighteen water quality parameters.

A 1991 6 volume, water quality study sponsored by the German Technical Cooperation Agency (GTZ) measured 15 water quality parameters in the Machangara, Monjas, and Guayllabamba Rivers and in the El Inca Industrial Area. It determined that pollution levels exceeded Ecuadorian standards for any use, including human consumption, irrigation, livestock, recreation or the general preservation of nature. GTZ concluded that the rivers are being used as a "natural wastewater sewer."

Source: GTZ, 1991.

IV. LAND

A. Urbanization

Extensive information on Quito is compiled in a Geographical Information System, the so-called "Infographic Atlas of Quito", developed by the French Scientific Research Institute for Development and Cooperation (ORSTOM) in collaboration with the National Geographic Institute of Ecuador. The Atlas provides geographically-ordered information on land use, population, natural risks, water, sewerage, transport, and communications networks and other matters.

Source: ORSTOM, 1992.

(24) Land Area by Uses (Agricultural, Forest,

(Table 5 - continued)

Vegetated, Residential, Commercial, Industrial, Vacant, Transportation and Communications)

Quito's Planning Office and RTI used SPOT and LANDSAT satellite imagery to determine changes in land use for the AMQ. Satellite images show a 15.2 percent increase in built-up area matched by reductions in agricultural, forested, vegetated, and eroded lands for the period 1986 to 1989.

Source: Arcia et al, 1991.

(25) Area of Marginal Neighborhoods

A 1992 study sponsored by the Office of Planning contains information on area of Quito's marginal neighborhoods in the central historical district and on the city's periphery.

Source: Castro, 1992.

B. Solid and Hazardous Wastes

The 1992 Solid Waste Master Plan for Quito, managed by the Office of Hygiene and sponsored by The World Bank and the Inter-American Development Bank, provides extensive information on solid and hazardous waste. The main components of the Plan are the conversion of the city's one operating dump site into a transfer station, construction of a new sanitary landfill 30 km outside the city, and increased efficiency in the solid waste collection and transportation system. Plan implementation is expected to begin in 1993. At present, no waste treatment facility or recycling program exists in the city, nor is there separate collection or disposal of hazardous wastes.

This Plan and a data base maintained by the Hygiene Department contain information on trends in solid waste generation, collection and disposal divided by neighborhood.

Source: Direccion de Higiene 1992; Direccion de Higiene 1991.

(26) 1. Waste Generation (Municipal, Commercial, and Industrial Solid and Hazardous Waste) (MN)

The AMQ generates about 723 tons of solid waste per day or an average of 0.66 kg of solid waste per person per day. Another study (Espin) shows that Quito generates 642.2 tons of solid waste per day, or .77 kg per person per day. This

is divided: 0.6 kg per person per day of domestic waste, 0.12 kg per person per day of commercial waste, and 0.05 kg per person per day of industrial waste. Arcia et al offer somewhat different figures.

Sources: Espin, 1992(b); Dirección de Higiene, 1992; Dirección de Higiene, 1991; Arcia et al, 1992.

(27) 2. Waste Collection

Volume and Percentage of Municipal Waste Collected Daily (MN)

Espin indicates that, in 1991, 507.7 tons per day or 79 percent of municipal waste generated was collected and disposed of in one of two controlled landfills. The remainder is dumped in the rivers and streams or in open lots. The Office of Hygiene has data on collection broken down by neighborhood.

Sources: Espin, 1992; Arcia et al, 1992; Dirección de Higiene, 1992; Dirección de Higiene, 1991.

Percent Municipal Solid Waste Recovered (through recycling, scavenging, and conversion)

Source: Dirección de Higiene, 1992.

Total Commercial Solid Waste Collected

Source: Dirección de Higiene, 1992.

Total Industrial Solid Waste and Hazardous Waste Collected

Source: Dirección de Higiene, 1992.

(28) 3. Waste Disposal

Espin indicates that, in 1991, 507.7 tons per day or 79 percent of municipal waste generated was collected and disposed of in one of two controlled landfills. The remainder is dumped in rivers and streams or in open lots. Arcia et al offer somewhat different figures.

Sources: Espin, 1992(b); Dirección de Higiene, 1992; Dirección de Higiene, 1991; Arcia et al, 1992.

Amount of Municipal Solid Wastes Disposed, by type: open dumps, sanitary land fill, municipal

dump site, incineration.

Source: Dirección de Higiene, 1992.

Amount of Industrial Solid Waste Disposed, by type: sanitary land fill, municipal dump site, incineration, open dumps.

Source: Dirección de Higiene, 1992.

Amount of Industrial Solid and Hazardous Waste Disposed, by type: sanitary land fill, municipal dump site, incineration, treatment, containment, open dumps.

Source: Dirección de Higiene, 1992.

Population Scavenging at Dumpsites

The Hygiene Department has this information.

Source: Dirección de Higiene, 1992.

V. Economy

A. Level of Economic Activity

(29) Per Capita Income

A 1985 source gives 1980 data on per capita product for Quito and for Pichincha Province in local currency.

Source: Dir. de Planificacion, 1990.

B. Transportation

(30) Number of Motor Vehicles (by vehicle type: cars, diesel buses and trucks, other buses and trucks, two and three-wheel vehicles, bicycles)

INEC publishes data on the motor vehicle fleet in its Annual Transportation Statistics survey. The survey includes province-level data on registered motor vehicles broken down by fuel type and by vehicle size. Using INEC data, MAP estimated the motor vehicle fleet in Quito grew from 17,000 in 1970 to 111,000 in 1989, more that a 500 percent increase. More than 95 percent of these vehicles use gasoline.

Source: Arcia et al, 1991; INEC, 1987.

(31) Vehicle-km per day (by vehicle type: cars, diesel buses and trucks, other buses and trucks, two and three-wheel vehicles, bicycles)

Source: Direccion Nacional de Transito

(32) Average Commuting Time to Work (by private motor vehicle, by public transportation, and by other means)

WRI did not identify a source for this indicator.

C. Industry

(33) SIC classification of industries and annual production

A 1989 study provides SIC classifications of industries for Pichincha Province and the Canton of Quito broken down by parish.

Source: Direccion de Higiene, 1989.

D. Energy

(34) Total Fuel Consumption by Type (fuel oil, gasoline, diesel, kerosene, LPG, natural gas, coal gas, coal, soft coke, charcoal, firewood, other)

Source: Direccion Nacional de Hidrocarburos.

(35) Fuel Quality

Lead content of gasoline

The standards for gasoline lead content established by INEN is 0.84 grams per liter. Actual gasoline lead content in Ecuador ranges from .53 to .84 grams per liter.

Source: IEOS, 1992.

Sulphur content of coal

Sulphur content of diesel

The sulphur content of gasoline is 0.2 percent; the sulphur content of diesel is 0.58 percent.

Source: Arcia et al, 1991.

(Table 5 - continued)

(36) VI. Ecosystem Type

Upland/Arid

Upland/Humid

Lowland/Arid

Lowland/Humid

With an altitude of 2,800 to 3,000 meters, relatively high annual precipitation of 500 to 1500 mm and annual average temperatures of 12-14 degrees centigrade, Quito's microclimate is mostly temperate humid, with a small temperate semi-arid zone in the north. Thus, Quito fits most comfortably into upland/humid category.

Source: Dir. de Planificaion, 1980.

VII. Natural Disasters

(37) Built Up Area and Population on Hazard-prone land (risk of volcanic activity, seismic activity, flooding, storms and typhoons, landslides and mudslides, other) (MN)

Arcia et al, 1991, published a map showing the location marginal neighborhoods on "unstable" lands characterized by risk of erosion, landslides, flash floods, and volcanic activity.

Sources: Arcia et al, 1991; Orellana et al, 1989; Ministero degli Affari Esteri-DGCS, 1989; Peltre, 1989; ORSTOM, 1992.

---------- **End of Table 5** ----------

C. Institutional Issues

The Municipality's planning process has produced a wealth of information on Quito's environment. The Paz administration was uniquely committed to using a science-based planning process to impart order and continuity to the city's development. In an introduction to Medio Ambiente y Poblacion, Fernando Carrion, Quito's Director of Planning observed, "Urban planning is not exhausted by one municipal administration or another in its four years in office. It is essential...to get rid of short-run improvisation; modern technology and science must play a major role in the administration and evolution of Latin American

cities." (Arcia et al, 1991)

Nevertheless, WRI found serious problems with data generation and reporting on environmental issues. First, WRI found that availability of information was sensitive to political pressures. Visiting Quito on the eve of local and national elections, the Municipality did not wish to release several documents without a request from the AID Mission Director to the Mayor. Also, local officials observed that changes of administration disrupt the planning process and, as a result, data generation and reporting.

Second, information is not harmonized between different government agencies. INEC publishes data at the level of the canton. The independent municipal service agencies, EMA and EMAP, also provide data at the level of the canton. However, until 1990, the municipality's main planning and information units were the city and the metropolitan area, subsets of the canton. Designers of Quito's GIS reported that one of the main obstacles to their work was harmonizing for geographic scale information obtained from various government sources.

Third, although the city has a wealth of environmental information, much of it is published in studies and analyses sponsored by international donor agencies. Consultants and other expatriates are among the key consumers and the principal producers of statistical data. Although outside experts can strengthen analysis and transfer skills to local counterparts, the local decision-making process requires that understanding of environmental and other issues be widely dispersed among policymakers and in society; it is unclear how effective outside studies are in achieving that goal.

Fourth, information is difficult to access. After conducting several studies on the urban environment, Fundación Natura reports that it has had difficulty obtaining information from both private and public sources. Industrial information has been particularly hard to obtain. Quito's pollution control ordinance, requiring industries to disclose information on production processes and emissions, has not be thoroughly implemented.

Fifth, WRI found there is no mechanism in place for systematically publishing information on environmental conditions in the city. Recognizing this need, the Department of Environmental Control at one point began collecting and evaluating available information on Quito's environment in order to develop "the first report on the current situation on environmental quality in Quito." (Jurado, 1990) WRI does not know what became of this effort. Fundacion Natura prepared a series of studies on urban environmental problems in Quito and various other cities that could provide a useful model of data

collection and reporting. These studies include short descriptions of a problem -- air quality, solid waste, quality of potable water, and noise -- present a focused set of indicators and then briefly analyze the situation in each city. Data is presented in a format useful for general consumption. For example, the air pollution paper presents a simple performance indicator showing that air pollution in Quito has worsened even though on average it remains within acceptable limits; a table shows that the number of days with exceedences of suspended particulates increased from 14 in 1980 to 76 in 1990. It is unclear, however, to whom or in what format these studies were distributed. (Espin, 1991(a)(b)(c))

Sixth, WRI found that overlap in the regulatory responsibilities of local and central government agencies may complicate policymaking. This is exemplified by the "turf" problems existing between the Municipality's Department of Environmental Control and IEOS. According to IEOS officials, the city's ordinance for controlling industrial pollution is not valid because it hasn't been officially approved by the central government. This jurisdictional dispute could slow implementation. According to Hygiene Department officials, a pollution prevention program in the El Inca area, promoted by the Municipality, has been weakened by the central government's lack of authority (and willingness) to impose penalties or incentives.

D. Conclusions

The Quito Case study suggests the following conclusions:

1) Extensive data that provide the basis for environmental indicators are available for Quito. These data cover 36 of 37 indicator groups in the core list.

2) Although Quito and Ecuador have extensive capacity to generate data on the environment, much of the data is of uneven quality and many are not generated or reported at regular intervals. Quito has yet to fulfill the call in Ecuador's National Plan for Social and Economic Development for a consistent, systematic "policy of social communication and information."

3) Data cover the entire causal framework spelled out in part II of this report, including pressures, state, impacts, response, and performance. Indicators of pressures, drawn mostly from information on economic development, are easy to obtain, although they are widely dispersed. State of the environment indicators were more difficult to obtain. For example, although good water quality information is available, not all air quality parameters are measured. Impact indicators are even more difficult to obtain. Suarez, 1992, and Arcia et al, 1992,

indicate difficulty in connecting specific health outcomes to environmental conditions. Response indicators are fairly easy to identify; the government has implemented a host of programs to improve Quito's environment. Finally, since the national and local governments have adopted environmental control regulations, including air and water quality standards, some performance indicators are also easy to identify.

4) To sustain Quito's commitment to environmental issues over the long run, an effort must be made to strengthen the capacity of local decision-makers and the public to understand the city's environmental problems. The availability of environmental information in Quito reflects the unique commitment of the Paz administration, Fundacion Natura and international donor agencies to addressing the city's environmental problems. As a result, many of the most useful indicators are found in studies sponsored by international agencies. These studies harmonize and analyze a great deal of what would otherwise be widely dispersed data. They provide models that could presumably be duplicated by local experts. However, if an administration came to power with less commitment to the environment or foreign support were reduced, the city might not maintain the same high level of interest in environmental issues.

5) In few other developing world cities will municipal governments or international agencies give so much support to urban environmental issues. Simple and effective ways must be found to encourage in other cities the level of understanding of environmental issues accumulated in Quito.

6) Despite the city's great advances, lack of access to both public and private information in Quito impedes understanding and analysis of environmental problems. Key problems include the lack of access to industry information, the lack of a periodic public reporting mechanism, and the lack of coordination and information-sharing between different government agencies and between different levels of government.

7) Conflicts between central and local government authorities impede solutions to Quito's environmental problems. These conflicts might be overcome by a clearer understanding of common interests in urban environmental issues: the whole country gains from healthy, efficient cities. Moreover, developing city-level indicators could help strengthen the municipalities hand in addressing its own problems.

IV. RECOMMENDATIONS

A. What AID Should Do

On the basis of the Phase I experience and the Quito case study, WRI proposes that APRE/H adopt a strategy for developing urban environmental indicators for third-world cities. The purpose of the strategy would be to support the establishment of a process for collecting and reporting urban environmental indicators that facilitates problem-solving in ways appropriate to the capacities and needs of developing world cities.

AID could provide support for the following activities:

First, develop criteria for identifying a city's likely environmental problems a priori based on a country's per capita income level and the city's ecozone location. Such criteria would help orient data generation and collection in cities where information may not exist or may be poorly organized and where there is no clear prioritization of environmental problems.

Second, build city-level data bases around a framework that analyzes problems into causally-linked categories. In this way, data collection would be organized in ways that strengthen understanding of cause-effect relationships, identify stakeholders, and suggest a basis for public and private responses.

Third, identify a local NGO or municipal agency to gather and report environmental indicators on a periodic basis in the form of a State of the Urban Environment (SOUE) Report. This agency could be identified through discussions with other interested actors to win support for what should be a joint, cooperative effort. Although one group would be responsible for the SOUE, others would be asked to assist by offering perspectives on priority problems, sharing primary data and reviewing the report's analysis. Participatory urban appraisal techniques could be used to identify problems in local communities and in the workplace. An international NGO could provide technical support for data collection and analysis.

The SOUE could consist of three sections: (1) tables of time-series indicators, including those in the core list identified in this report as well as indicators that reflect other local priorities; (2) an analysis of environmental conditions and trends based on the data tables; (3) a special section in each issue devoted to local problems or achievements. The report would be widely distributed to the general public, to local and national government officials, to international agencies and to other developing world cities.

Fourth, build an international network of SOUE reporting organizations. Starting with the RHUDO cities, a network of such reporting groups would help improve understanding of urban environmental issues among urban decision-makers in developing countries and help to improve the quality of data collection, reporting and analysis. The network would increase the chances that data collection, reporting and analysis would be sustained over time. Sharing information and experience among cities would help strengthen international urban environmental policymaking. The reports would help attract resources for urban environmental activities in cities that prepare them.

Fifth, use the reports to create a central, harmonized data base on urban environmental issues to support cross-city comparisons and donor agency investment decisions. The central data base, combined with enhanced local expertise in data collection and analysis, would facilitate such efforts to analyze and prioritize environmental problems as environmental profiles and environmental risk assessments.

The approach to urban environmental information recommended here meets USAID strategic objectives. It would provide a relatively inexpensive way to give greater attention to urban environmental issues. It would improve the quality and availability of information on the environment in developing world cities. It would strengthen local capacity for data collection and analysis. Broad participation of both governmental and nongovernmental organizations would build awareness of the links between environmental protection and economic and social development and would foster public concern for environmentally sound programs and policies. Finally, this approach would help developing country cities contribute to solving global and regional environmental problems while working to meet their own development objectives.

Quito could be the first city approached to adopt this reporting mechanism. Sufficient data exists and is publicly available for the purpose. Fundacion Natura has the capacity to gather, analyze and publicize these data. Based on campaign commitments, the new municipal administration is likely to be highly committed to pursuing environmental goals.

B. What WRI Should Do

In support of this effort, WRI could assist in the preparation of an environmental profile for Quito, Ecuador. The urban profile outlined in this report suggests that such an effort would be feasible and useful.

WRI could provide technical guidance to developing world cities on preparing State of the Urban Environment Reports

(SOUEs) and developing better indicators. As part of this technical support, WRI could prepare a handbook on urban environmental indicators that could serve as a guide to data collection and indicator use. In addition, WRI could develop materials on using participatory urban appraisal techniques to help identify problems in local communities and in the workplace. It could provide information on international technical resources. And it could provide guidance on negotiating techniques to foster a cooperative spirit for the process of SOUE preparation.

WRI could work with USAID and other organizations to host an international workshop with experts from developing world cities to improve urban environmental indicators and strengthen environmental reporting at the city and metropolitan level.

WRI could also begin to compile a global urban environmental indicator database. Most international comparisons take place at the national or ecosystem level. Urban and metropolitan areas are not easily compared and few efforts are made to report environmental conditions and trends on a city-wide basis. Working with USAID, the World Bank, HABITAT, and other organizations, WRI could being to develop an internationally comparable set of indicators for the major cities of the world based on existing international sources and the growing number of urban environmental profiles.

ANNEX I

List of Persons Contacted in Quito

MUNICIPALITY OF QUITO

Office of the Mayor

Dr. Ramiro Viteri
Asesor Relaciones Internacionales

Dirección de Higiene

Ing. Francisco De La Torre
Director Unidad Administradora de Proyectos
Plan Director de Residuos Sólidos

Ing. Jorge Jurado M.
Jefe Departamento de Control Ambiental

Dirección de Planificación

Arq. Gonzalo Bustamante
Subdirector de Estudios

Empresa Municipal de Agua Potable - Quito

Patricio Ribadeneira
Gerente General

Empresa Municipal de Alcantarillado

Ing. Jorge Poveda
Sub-Director

CENTRAL GOVERNMENT AGENCIES

Instituto Ecuatoriano de Obras Sanitarias (IEOS)

Ing. Daniel Polo Yepez
Director Nacional del Medio Ambiente

Ing. Eduardo Espin
Division Impacto Ambiental

Instituto Nacional de Estadistica y Censos

Lic. Raul Sosa
Director de Censos y Encuestas

Instituto Panamericano de Geografía e Historia

Ing. Maria Augusta Fernandez
Directora Ejecutiva PREDUR
Atlas Infográfico de Quito/GIS

OTHER ORGANIZATIONS AND PRIVATE CONSULTANTS

Dr. Marco Encalada R.
Director EDUNAT III
Fundacion Natura

Ing. Julio Roberto Jimenez
Representante OPS

Arq. Roberto Samayoa
Coordinador GTZ
Programa de Desarrollo Municipal

Dr. Gunther Rèck
Decano de Ciencias Ambientales
Universidad San Francisco de Quito

Ing. Oscar Larrea
Consultor Privado
Ingeniería Sanitaria y Salud

Dr. Jose Suarez
Consultor Privado
Medio Ambiente y Salud

USAID/ECUADOR:

Bill Yaeger, Director, RHUDO/SA
George Deikun, Sub-Director, RHUDO/SA
Sonny Low, Housing Officer
James Stein, Housing Officer
Michael Jordan, Director, Office of Health
Ken Yamashita, Technical Advisor
Fernando Ortega, Health Officer
David Alverson, Director, Agriculture and Natural Resources
Howard Clark, Regional Advisor
Ron F. Ruybal, Natural Resources Officer
Fausto Maldonado, Natural Resources Officer

ANNEX II

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ANNEX III

MAPS

Map 1. Location of Quito

Source: INEC, 1990

Map 2. Quito: Relief Map

Source: ORSTOM, 1992.

Map 3. Quito: Political Boundaries of the Metropolitan District

Source: Direccion de Planificacion, 1990.

Map 4. Quito: Marginal Neighborhoods

Source: Castro et al, 1992.