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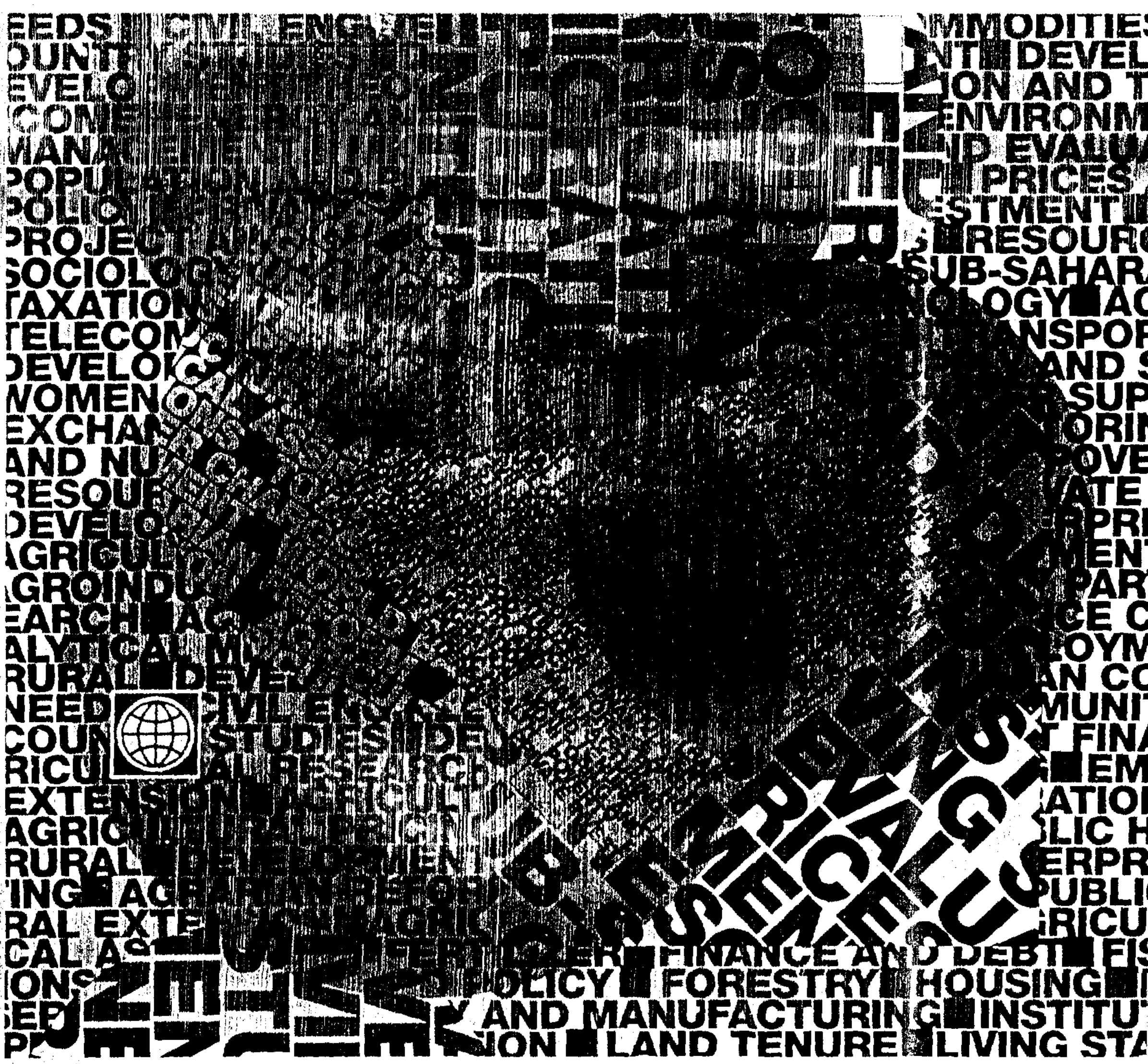
Managing Urban Environmental Quality in Asia

G. Thomas Kingsley, Bruce W. Ferguson, and Blair T. Bower
with Stephen R. Dice



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Foreword

According to U.N. estimates, 2.3 billion people will live in Asia's cities and towns in 2020—an estimated one-quarter of the world's total population then and a number almost equal to the entire urban population of the world today. If these estimates hold, Asian urban areas will have to accommodate an additional 1.4 billion people in the next thirty years (1990–2020); this is an average of 47 million new residents per year—more than twice the yearly addition of 19 million during the last thirty years (1960–90).

It is difficult to overstate the importance of the new urban development these statistics imply. Without substantial improvement in their management, many Asian cities could become the most polluted human settlements in the world, slow down much of the region's economic growth, and generate a major portion of the hydrocarbons and other pollutants responsible for global environmental degradation. However, Asia's rapid economic growth also offers the potential to solve many of the environmental problems. Thus, the situation presents extraordinary danger and opportunity.

This report is one of several sectoral reviews prepared for the Asia Region Technical Department to help it assess the effectiveness of Bank environmental initiatives in the region. The main report was prepared by G. Thomas Kingsley and Bruce Ferguson of The Urban Institute (Washington, D.C.); the appendix was written by Blair Bower. The task manager for the sectoral review project was Stephen Dice (ASTIN).

The report explores urban environmental quality management (UEQM), identifying the most severe of the environmental threats and proposing practical measures for addressing them. The report particularly focuses on World Bank activities and suggests needed policy or investments to address the most pressing issues in UEQM in Asia. These recommendations, however, are the views of the authors and do not necessarily reflect those of the Asia Region or the World Bank.

The report was commissioned and is presented here to stimulate discussion and to further clarify the serious issues involved, in order to assist the Bank's South Asia and East Asia and Pacific Regions in developing an environmental strategy for minimizing the dangers and maximizing the opportunities in its urban investment programs. Bearing in mind the huge numbers of people that may be affected by the projected rapid urban growth in Asia, we invite your participation in this important discussion by commenting on the views and proposed strategies presented here.

Daniel Ritchie
Director
Asia Technical Department

Abstract

The Bank has markedly strengthened its capacities and approaches over the past four years to deal more effectively with Asia Region environmental issues in all sectors. This is particularly true for urban development. Without substantial improvement in their management, many Asian cities could become the most polluted human settlements in the world, slow down much of the region's economic growth, and generate a major portion of the hydrocarbons and other pollutants responsible for global environmental degradation. However, Asia's rapid economic growth also offers the potential to solve many of the urban environmental problems. If substantial further growth of Asia's cities cannot be avoided and if the environmental disasters that could be associated with that growth are to be prevented, urban environmental quality management (or, UEQM) must be substantially improved throughout the region. This paper offers practical suggestions for improving UEQM through building institutional capacity and establishing best practice in major urban sectors.

Abbreviations, Acronyms and Data Note

ADB	Asia Development Bank
AEQ	area environmental quality
BAPEDAL	Environmental Impact Management Agency (Indonesia)
BAPEDALDA	Regional or District BAPEDAL
BOD	biological oxygen demand
Cd	cadmium
CIDA	Canadian International Development Agency
CO	carbon monoxide
CO_2	carbon dioxide
EA	environmental assessment
ECE	Economic Commission for Europe
EMS	environmental management strategy
EPA	U.S. Environmental Protection Agency
GAP	Ganga River Action Program (India)
GEF	Global Environment Facility
GEMS	Global Environment Monitoring System
GIS	Global Information Systems
HC	hydrocarbons
Hg	mercury
IIEC	International Institute of Energy conservation
MEIP	Metropolitan Environmental Improvement Program
MRF	materials recovery facility
NEAP	National Environmental Action Plan
NGOs	nongovernmental organizations
NH_4	ammonium
NPO	nonproduct output
PC	personal computer
PPP	polluter pays principle
SLIs	Service Level Indicators
SO_2	sulphur dioxide
UEQM	Urban Environmental Quality Management
UNCHS	United Nations Center for Human Settlements
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Improvement Programme
USAID	United States Agency for International Development
VIP	ventilated improved pit (sewerage)
WHO	World Health Organization

Data Note

Dollars are U.S. dollars unless otherwise specified.

Executive Summary

This report is one of several sectoral reviews prepared for the World Bank's Asia Region Technical Department to help it assess the effectiveness of Bank environmental initiatives in the region. It focuses on urban environmental quality management (UEQM).

Chapter 1 discusses urbanization in Asia and its implications for the environment. Chapter 2 reviews efforts the Bank has made since 1987 to respond to environmental challenges created by urban development in the region. Chapter 3 then offers suggestions for addressing the most serious threats to the establishment of effective UEQM in Asia: sectoral fragmentation and the lack of an institutional framework strong enough to motivate resources and political will. Finally, Chapter 4 reviews recent thinking about best practice in each of five key elements of UEQM, and in particular how they might operate within a strong institutional framework.

The review makes it clear that the Bank has strengthened its capacity and approaches in Asia over the past four years to address environmental issues in all sectors more effectively. This is a notable achievement but it is just a beginning, considering the scope of the environmental problems. This is particularly true for the urban sector.

Without substantial improvement in their management, many Asian cities could become the most polluted human settlements in the world, slow down much of the region's economic growth, and generate a major portion of the hydrocarbons and other pollutants responsible for global environmental degradation.

However, Asia's rapid economic growth also offers the potential to solve many of the urban environmental problems. Thus, the situation presents extraordinary danger and opportunity. The main findings and conclusions of the review are summarized in the following discussion.

Asian Urbanization and Implications for the Environment

According to U.N. estimates, 2.3 billion people will live in Asia's cities and towns in 2020—an estimated one-quarter of the world's total population then and a number almost equal to the entire urban population of the world today.

It is difficult to overstate the importance of the new city building implied by these estimates. Asian urban areas will have to accommodate an additional 1.4 billion people between 1990 and 2020—an average of 47 million new residents per year (up from the 19 million yearly over 1960–90). This 1.4 billion growth in the cities will be somewhat larger than the region's total population growth during the period; that is, Asia's rural population is expected to decline slightly. By far, the largest part of Asia's development in the future is going to occur in its cities and towns.

Environmental Impacts

Concerns about the extent of environmental degradation in Asia associated with this rapid urbanization are based on three propositions. First, the amount of energy and materials used and the amount of waste generated in cities, per capita, is several times higher than in the countryside. Second, because the discharges of pollutants in cities are so concentrated, they are potentially more dangerous to human health than if they were spread more evenly over the national terrain. Third, the institutions, technologies and infrastructure available in Asia are at present woefully inadequate to help control these problems (according to urban standards in most industrial countries).

The first point implies that while the rate of urban population growth is high, the rate of growth in discharges will be higher still. For example, whereas the urban population growth rate over the next few decades is estimated at 3.3 percent per year (or a doubling every 21 years), the estimated growth rate for nitrogen oxide emissions in the region is 4.9 percent (or a doubling every 14 years). And air pollution in many Asian cities is already high by world standards. The average number of days per year in which the number of micrograms of sulfur dioxide per cubic meter exceeds the World Health Organization (WHO) maximum of 150, is 87 in Seoul, 68 in Beijing and 25 in Calcutta compared to 8 in New York, 8 in Frankfurt and 6 in Milan.

Trends with respect to other types of wastes are similarly frightening. Waterborne diseases are already among the leading causes of death in Asia in cities. Yet the volume of liquid and solid wastes discharged in urban areas without proper treatment is also growing dramatically, and the provision of safe piped water to urban residents lags far behind demand. Hence, high rates of infant mortality continue in many major Asian cities despite economic growth.

Unplanned urban development, spreading into wetlands, watersheds and other environmentally sensitive lands, already has destroyed valuable ecosystems. The demand for biomass fuels in many Asian cities further causes deforestation, soil erosion, poor groundwater recharge, loss of agricultural productivity, and in some cases desertification in the surrounding areas.

In short, adding 1.4 billion people to Asia's cities without marked improvements in current technologies and techniques for environmental management could create urban living environments unimaginably bleak and life-threatening for their inhabitants. This is to say nothing of the impact those people and the economic activities that support them, would have on world environmental problems, such as greenhouse gasses and acid rain. Again, the growth in emissions would be proportionately much larger than the growth in urban population.

The Role of Cities in Development

As disturbing as these prospects may be, recent research suggests that rapid urbanization in Asia cannot, and should not, be stopped or even substantially curtailed. There may be some realistic possibilities for shifting some of this growth away from the largest metropolises toward intermediate centers, but even if policy gives the edge to rural development, it is doubtful that the urban forecasts cited above will be far off the mark.

Why is this the case? Primarily, because economic development and reduction of poverty requires a shift in employment toward higher productivity (higher wage) occupations (that is, away from agriculture and toward manufacturing and services); and to be competitive, non-farm economic activity must nearly always locate in urban areas. For most manufacturing and services, the efficiencies of urban locations (agglomeration economies) are significant, and they are likely to remain so. It makes little sense to force businesses to locate where they cannot be competitive.

This increasing acceptance of urban growth has been supported by findings that regions experiencing dramatic increases in agricultural productivity over the past two decades have also normally experienced accelerating urbanization; successful agriculture has created more demand for urban products and the resulting growth in urban economies has in turn created demand for yet more growth in agriculture. It has also been supported by findings indicating that the burgeoning informal sector in cities is substantially more productive than had been previously thought; urban unemployment and underemployment, while far from trivial, are much less devastating than 1970s models had predicted.

Adequate urban infrastructure (previously thought to be financially out of reach) is also now known to be affordable and to be largely self-supporting if appropriate cost recovery programs are applied. Furthermore, the urban biases that significantly and unfairly benefitted cities in the past (for example, major subsidies for, or price controls on, urban consumer goods and padded government payrolls in the capitols) have been largely curtailed by structural adjustments programs. (In these programs, urban incomes may fall drastically in the short term, but not enough to offset the long-term benefits of sustainable urban growth.)

How to Manage Development

If substantial further growth of Asia's cities cannot be avoided and if the environmental disasters that could be associated with that growth are to be prevented, there is only one policy alternative: UEQM must be substantially improved throughout the region. Primarily, this will entail: (a) instituting major reforms in the technologies and processes of urban activity (ranging from cooking meals to producing machinery) to reduce materials and energy consumption per unit of output and thereby reduce the volume of residuals discharged into the environment; (b) significantly enhancing the means of treatment and disposal of the residuals that remain; and (c) markedly improving the effectiveness of urban land policy to avoid unnecessary loss of ecosystems.

Although this represents an enormous challenge, there are indications that it may not be an impossible one. It may also help to remember that higher per capita energy and materials use and wastage, by activities in cities does not occur because they are located in cities but because of what they are. Higher productivity yields more wealth but also uses more energy and materials in the process. More wealth generally implies more waste. Clearly, it would not be economically feasible to spread the same activities evenly across the countryside, but if it were, the same volume of residuals would be discharged and because of the dispersal, they might be even more difficult to manage and control. Reduction of poverty requires economic development which in turn implies more residuals to manage—regardless of the spatial pattern. Few policy makers are likely to see keeping people in subsistence agriculture as a viable alternative.

Asia Region Response to Date

Virtually from the first stages of involvement in the 1970s, the Bank's urban sector programs in Asia concentrated on environmental improvements: investments in basic water supply, sanitation, drainage and solid waste systems as part of slum improvement projects and sites and services schemes, along with supportive citywide distribution, collection and treatment facilities. Thus by 1987 when the Bank began focusing specifically on the environment, its urban sector programs had already devoted considerable effort toward solving the most damaging human health problems in Asian cities—the lack of safe water and sanitation in settlements of the poor.

It was quickly recognized, however, that direct Bank projects alone could never address the problems of urban environmental degradation in Asia at scale, given the magnitude of expected urban growth in the region. By 1987, the strategy had already shifted to the development of stronger in-country incentives and institutional improvements to spur system-wide solutions.

Country Environmental Strategies and Environmental Impact Assessments

The region has devoted substantial resources to two of the most basic requirements of UEQM: the preparation of environmental assessments (EAs) for proposed Bank projects and the development of country environmental strategies.

With respect to the former, all projects are screened for their potential environmental impacts at the project identification stage and then, where required by Bank policy, are examined through performing EAs. Forty-six EAs for Category A projects had been completed or were in process as of late 1991. Because urban sector projects in Asia are likely to be beneficial or at least neutral environmentally, EA is not obligatory up-front for most. However, even in these projects, the Asia Region increasingly requires environmental analyses for sub-projects that are developed by local and regional officials.

With respect to strategies, country orientation papers have been prepared for all Asian countries and substantial strategic assessment studies have been prepared for many. In most, strategy documents and environmental action plans either have been developed (in collaboration with borrower governments), or are in process. Some of the strategies contain comprehensive environmental analysis and prioritization of actions across sectors (for example, in China, Sri Lanka and India). More often, they have focused on individual sectors in which the Bank has already built considerable leverage with the country, thereby allowing more serious action on the environment in the short term. This approach is understandable but future strategies should seek a broader range; and in particular explicitly address UEQM, which has received serious attention in only a few country strategies to date.

Projects Focusing on Urban Environmental Issues

Perhaps most important among the region's efforts in the urban sector are several projects that focus solely on environmental issues. These include a number of multi-country initiatives. The most prominent is the Metropolitan Environmental Improvement Program (MEIP) that focuses directly on environmental management with five of the region's largest metropolitan areas. The project emphasizes developing institutional capacity and combining economic and environmental analysis, and it will also lead to specific projects in each of the cities. Noteworthy in the multi-country group are the proposed Asian Urban Air Quality Strategy and Action Plans project and strategic studies on the environmental impact of urban transportation systems.

Innovative projects related to UEQM within individual countries span a broad range. First, there are regional studies that examine the environmental implications of the growth of cities and towns within the framework of regional resources and constraints (for example, the Singrauli Development and Environmental Strategy Study). Also, there are projects that give special focus to environmental issues in a nation as a whole (the India Industrial Pollution Control Project and the Environmental Impact Management Agency of Indonesia (BAPEDAL) Project, for instance).

Some of the most forceful guidelines for future UEQM strategies in Asia may be found in projects that recognize the need to balance and prioritize environmental management activities across sectors within individual urban areas. These include the Beijing Environmental Project, the Third Jabotabek Urban Development Project and the East Java-Bali Urban Development Project. These projects are also important in that they involve, and depend directly on, the decisionmakers with the most power to affect environmental quality in their cities (for example, agencies that provide and manage infrastructure) rather than relying solely on special environmental agencies.

While these projects focus primarily on environmental issues, it should also be noted that for virtually all borrower countries, the Asia Region has substantially expanded the scope of environmental management components in its regular flow of sectoral projects with other objectives; for example, transportation, power and industrial development. In fact, this may be the largest component of environmental work in the Asia Region. These efforts range from transportation projects for which the reduction of emissions is a major project objective, to energy projects for which energy conservation is the focus.

An Institutional Mechanism for UEQM in Asia

The Bank's 1991 Policy Paper on urban development has identified environmental management as one of three major agenda items in its suggested urban program for the 1990s. How can the Bank best implement this mandate in Asia? This review suggests that while many sound individual project ideas have been proposed, the most serious threat to effective UEQM at present is the lack of an institutional mechanism that will be coherent and compelling enough to generate the resources and political will that the challenge demands and to coordinate the response efficiently. While there will have to be country variations, there are four themes to such a mechanism that should be applicable everywhere.

Recommendation 1. Make UEQM operational by linking it directly to the institutions and people with the most power to determine environmental quality.

UEQM will never become operational until it is built into the day-to-day decisions of the many people that can have direct influence. These people will be found in agencies that range from the builders and operators of water supply systems and hospitals, to regulatory agencies and associations of private entrepreneurs.

Thus, while it will be difficult, ensuring this institutional shift as rapidly as possible should have highest priority. The first step would be to encourage borrower governments to take a hard look at possible linkages: starting with a list of institutions ranked according to their direct influence on the environment, and then devising strategies for involving them directly in UEQM.

Recommendation 2. Focus on the local leadership (private as well as public) in each urban area, particularly in the agencies providing and operating infrastructure and basic urban services. In this context, recognize that governance is the starting point.

In much of the country work on environmental issues, dialogue has not moved beyond negotiations with national ministries. Yet this review suggests that in most countries, those with the most influence on the urban environment are to be found at the local or, in some cases, the provincial or state level.

The agencies that plan and operate infrastructure and urban service systems for individual cities stand out in this regard. They have a strong direct effect through the design, construction and ongoing management of water supply, sanitation, storm drainage, road, and solid waste disposal systems. Also, these activities give them a potentially unique opportunity (compared to other public administrators) to influence the waste-related behavior of households and private firms. Finally, although they are seldom thought of in this way, they have greater influence than the regulators on shaping urban land-use patterns, as the placement of new major roads and water supply mains is the key determinant in the location and timing of urban fringe expansion.

In this context, UEQM is not a goal that can be left to the workings of the private market to resolve, but it must be started with governments. It must begin with what is inherently a public sector decisionmaking process and the specific actions of setting standards, monitoring, enforcement and record keeping must remain in the public sector throughout. This being said, however, there are strong reasons to involve the private sector in UEQM and to do so much more actively and positively than has generally been the case. Private sector leaders can participate in the process of planning and setting standards by making recommendations, and they can play an active role as partners through educating the public about a new strategy. Private institutions (for example, firms, nongovernmental organizations (NGOs), community groups and households) can also take on a much larger share of the work in implementation.

Recommendation 3. For individual urban areas, establish strategic planning processes that balance and prioritize environmental *management activities across sectors; build them in directly as part of ongoing multisector capital planning and budgeting processes; and involve NGOs and other private sector leaders.*

Single-sector programs (particularly those planned by central governments) are prone to major error when they try to apply uniform strategies to localities that have very different needs, opportunities and resources. One of the key contributions of the Beijing project is that it begins with an analysis of UEQM priorities across sectors, and then examines the cost-effectiveness tradeoffs of alternative strategies based on those priorities.

A major contribution of the East Java-Bali project is the recognition that planning exercises, no matter how well conceived, can easily be ignored by the implementers. Effective planning requires that the implementers themselves play roles in formulating the plans and then must build the plan directly into action programs. Even excellently developed UEQM strategies could well go the way of the urban master plan (that is, be ignored) if there is no direct link to action. Local capital budgeting processes, which are expanding in many Asian countries (usually with Bank encouragement) are the only existing processes for cities that meet this requirement. They require administrators with power to consider a city's future jointly and to prioritize program alternatives according to some analysis of real budget constraints. For example, the East Java-Bali project requires that all local capital plans (for Bank support) include an environmental analysis and an institutional development component for building UEQM capacity.

Infrastructure planning has traditionally been viewed solely as a function of government, but as broader goals are attached to it, it will have important implications for private activity and will need private participation and support. There should be many benefits from involving NGOs and representatives of the private business community directly in this process.

Recommendation 4. Provide support for building local capacity to monitor environmental trends and for developing and using an appropriate (and simplified) computational framework for strategic UEQM planning.

Approaches to UEQM planning that are linked to action are being developed by MEIP and serve as good models. They start with the recognition that in tough-minded debates (in capital budgeting and other local policy formulation processes), environmental aspects will not get the attention they deserve unless their impacts are quantified. Cities need to begin by monitoring indicators of environmental quality over time, and this is most likely to succeed if it is begun with only a limited number of straightforward measures at the first and then expanded later as capacity permits.

When some measures are in operation, the next step should be a study of environmental quality to permit establishing priorities among environmental goals. This can be accomplished through exposure analysis and cost-effectiveness analysis.

The computational framework then is built on conditions in a base year: the spatial pattern of activities, estimated discharges, estimated environmental quality and other factors. Proposed projects and projected population and economic growth (by sector) would be imposed on that base for target years, and then environmental as well as cost and spatial pattern effects would be estimated and evaluated. Ideally, this sort of framework should first be used to analyze alternatives for regional development (for example, of river basins), that would in turn provide valuable information for planning cities. Intensity measurements of local resource use and Service Level Indicators (SLIs) also could be extremely valuable in these analyses.

However, research and analysis must not become too complex and time-consuming (again, one of the drawbacks of urban master plans). A simple and understandable framework should be the goal. The process will not be perfect the first time (many information, and perhaps conceptual, gaps will remain), but it can be improved incrementally as it is repeated in the future.

One way to develop such capacity would be to set up a number of "flying squads" of UEQM technical assistance experts who would go from urban area to urban area to assist in the development of institutions around local capital budgeting processes, the building of analytic capability, and the installation of monitoring and analytic software; and who would then return every so often to review results and provide further advice. Over time this idea could develop into a permanent indigenous UEQM extension service that would train new staff and offer assistance to local leaders on a regular basis.

Best Practice in the Key Elements of UEQM

Although there are other related activities of interest, in the institutional context this review proposes, there are five major factors that UEQM must address: (1) water supply, (2) household wastes, (3) industrial wastes, (4) transportation, and (5) land. There is cause for optimism here in that Bank operations in most of these sectors are well advanced, and since at least the mid-1980s, have addressed squarely the environmental concerns they raise.

Water Supply

Contaminated water probably is Asia's most serious health problem, and ensuring an adequate supply of clean water to the growing populations in its cities must be a primary environmental goal. Affordability studies suggest that most of those populations have the income needed to support the attempt, but there are three key principles also that are necessary for success. First, a mix of services that match customers willingness and ability to pay must be provided, and then full costs must be recovered. Doing so will not only meet financial needs but will also provide strong incentives for conservation. It is also important to apply this theme across sectors. In Asia now, most water produced is used for irrigation at highly subsidized rates. It has been estimated that improving the efficiency of irrigation by only 10 percent would save enough water to meet all residential needs worldwide.

Second, it must be recognized that the most cost-effective way to provide water for new populations is to cut down on waste in current water usage. This can be accomplished through better maintenance and repair to reduce leakage; sensible recycling (for example, reusing partially treated wastewater for irrigation, industrial cooling, toilet flushing and so forth); and demand management techniques (including technological improvements such as water-saving showerheads, as well as financial incentives such as fees for disposal of industrial wastewater).

Third, the current institutional framework for water supply should be reformed. For instance, public institutions that set water tariffs and formulate and enforce regulations should not have direct production and distribution responsibilities themselves, rather they should establish the guidelines and oversee the work of a variety of competitive providers. Private firms can participate either by competing from time to time to operate citywide systems or to perform sub-functions for public agencies. NGOs and community groups should also be encouraged to take on more responsibility for water distribution in specific communities.

Household Wastes

The share of the Asia's urban population with access to basic sanitation is much lower than that with adequate water supply. Only 70 percent of municipal solid wastes are collected—much of the rest is dumped in drainage canals. Of the sewage that is collected, only about 5 percent is treated before disposal, and a significant percentage of existing treatment plants are no longer functional.

Themes for improvement here parallel those for water supply: recover a most of the costs from users (although it is recognized that some subsidization is warranted for treatment and disposal, if not for collection); recycle (some recycling is already being exploited by informal enterprises that could become stable and efficient businesses); and change institutions (involving community groups in responsibilities for intra-community collection systems is promising).

With regard to sanitation, there is a need to expand the range of technical options being applied. Realistically, collection by conventional piped sewers is the only option for the high-density cores of most Asian cities (and considering land values there, it should be feasible to require developers to provide them and occupants to pay the required cost), but most urban residents cannot afford this level of service. Low-cost on-site options such as ventilated improved pit (VIP) latrines and pour flush latrines can substantially reduce the negative health and aesthetic effects of untreated human waste, but these options are not satisfactory everywhere. A promising alternative is a less costly system, the small-bore sewer: solids are collected in an on-site tank before they reach the sewer connection, so that smaller pipes (laid at flatter gradients) and fewer manholes. Further savings are possible where households in a block run pipes from yard to yard before discharging into the street sewer (rather than the conventional approach of having each house independently connected to the street sewer) and where they assume joint responsibility for maintenance inside the block. Vacuum cartage systems offer another intermediate cost option that has been successfully applied in, for example, Japan.

Industrial Wastes

Asian countries have made little progress in controlling wastes generated by industry, largely because of lack of political will and the perceived high cost of industrial pollution control. And indeed cleaning up and treating industrial waste is expensive. In contrast, reducing wastes through recycling, process modification and other means is much less costly and offers a better alternative for many existing industries.

New industries should be required to use clean technologies, and the most effective inducement is through a combination of rewards (tax rebates, low-interest loans, accelerated depreciation, reduced excise taxes and lower customs duties, for example) and punishments (fines, user charges and intervention). Collective treatment at industrial estates can also contribute to making recycling and treatment economically feasible.

Small industries present special problems because they may lack the means to pay for pollution control and they are difficult to monitor. Indirect instruments such as taxation of inputs and deposit-refund schemes can induce these industries to comply, while demonstration projects can show them the feasibility of cleaner alternatives. These measures require better monitoring and analysis of industrial discharges and enforcement.

Thus, industrial control programs must invest in training staff and developing a career ladder for environmental technicians and managers, laboratories and equipment, and monitoring networks. Education of the public will help achieve greater scope.

Finally, the location (that is, the spatial clustering) of industry matters. Rigid zoning controls and estate plans have often failed in the past because they ran counter to market realities, however, some locational steering is necessary to avoid ecosystem loss. Solutions lie in the type of strategic spatial planning for cities (discussed earlier), that involves the active participation of the local governments.

Transportation

The growth in the sheer number of vehicles in Asia—at about 10 percent per year—will present a great challenge for air pollution control. Asian countries vary greatly in their efforts to meet this challenge: Japan's and Singapore's pollution control efforts are clearly ahead of the vehicle growth curve, but most others have made only modest efforts.

The pollution associated with transportation is not only from growth in the numbers of vehicles, but also from urban sprawl, dirty fuels, a high proportion of smoke belching vehicles such as 2-stroke motorcycles, and poor traffic management. Introducing cleaner fuels offers the greatest promise for short-term reduction of the most dangerous discharges. Road paving is also important since road dust is itself a major pollutant. Slowing vehicular pollution also requires control of the growth in total vehicle miles travelled, through land-use planning, public transport and other means.

Urban Land

This is one element in which the environmental dimensions of Bank activity are not well advanced, although some progress has been made as countries began to recognize the failure of public sector urban land development and to support market-oriented development processes. Efforts to improve land titling systems are important in this regard.

Nonetheless, little progress has been made in adopting workable mechanisms to ensure that sufficient land will be developed to keep up with urban population growth and that it will be developed at appropriate densities and in spatial patterns that promote resource conservation. The key to solutions here probably rests, once again, with the local capital budgeting process since the placement of major roads and water mains are the primary determinants of where land will be developed. Some efforts along these lines can be found in the planning process for metropolitan Jakarta. This work should be strengthened and similar themes need to be introduced in work with other Asian cities.

Cross-Cutting Themes

The paragraphs above discuss proven approaches specific to each of the key elements of UEQM, but there are other actions that warrant emphasis in all of them.

ECONOMIC INCENTIVES. UEQM managers should always be on the look-out for workable economic incentives to enhance environmental quality; for example, pricing strategies, user charges and other techniques that make the polluter pay. Tradeable pollution permits are a good example. These have a number of advantages over regulatory approaches—principally, they stimulate innovation in reducing pollution by thousands of households and other participants without requiring intensive government presence. Clearly, these economic techniques will not eliminate the need for regulations, but they should take some of the pressure off regulatory approaches in countries where enforcement capacity is likely to remain weak.

EFFECTIVE REGULATION. Many existing regulatory systems need to be streamlined, and where this is attempted, several principles apply: keep the rules simple and realistic, and do not bother to put a regulation on the books without a credible threat of enforcement.

ENVIRONMENTAL AWARENESS. A range of techniques to stimulate awareness of the importance of environmental issues and educate all segments of society about their potential role in support of UEQM. The techniques range from mass-media campaigns to building environmental issues into programs of community groups and other NGOs. There is much evidence that these approaches do change attitudes and, thus, they can make all of the other programmatic approaches discussed here work more easily.

Some economic incentives, regulations and awareness programs, of course, are most appropriately implemented at the national level, but the others should be incorporated into local

UEQM as emphasized in this report. Their forcefulness will be much enhanced if they emerge from the type of consensus-building process with public and private sector leaders (organized around the annual capital budgeting cycle) that we have proposed as the base for UEQM at the local level.

Next Steps for the Asia Region

This review has pointed out that, while the World Bank Asia Region has taken some important first steps, more forceful action will be required if it is to address the environmental problems of the region's cities. An institutional framework and specific programmatic themes for the key components of UEQM is presented here that could become a more coherent and focused approach, applicable in all countries of the region.

The next steps could be to build these approaches into the regular program activities of Country Operations Divisions. The issues and strategies would be incorporated into Country Economic Memoranda and Country Strategy Papers and thus achieve more prominence in Bank-borrower policy dialogues.

Also, a more definite posture along these lines could be taken in lending programs. Probably the most important would be the urban development program loans themselves, which could be conditioned more directly on the features of UEQM outlined here. Specifically, this would mean:

- Permitting the use of Bank loan funds only for projects developed as a part of local UEQM-enhanced multi-sector capital planning and implementation processes such as we have described above—processes involving a broad range of local leaders in consensus building around action programs and entailing explicit reviews of the cost and environmental and other tradeoffs implied by alternative courses.

- Focusing technical assistance resources on building the local institutional capacity to operate such processes and to monitor and control implementation in accord with them. This will also imply support for region-wide efforts to develop simplified manuals, personal computer (PC) support systems and other tools needed to make such processes operational in local environments.

The Country Departments also have the opportunity to use the newly created Institutional Development grant facility to support research and technical assistance for institution building—the foundation of any promising approach to UEQM. These efforts should also be facilitated by creative use of the Global Environment Facility (GEF), which can fund promising innovations that may not meet normal economic tests in the short run but have extremely positive environmental effects in the longer term.

Chapter 1

Asia's Urban Future and Implications for the Environment

This chapter addresses five questions: (1) What have been the trends in urbanization in Asia since 1960?; (2) What are the economic foundations of those trends and how are they now being interpreted in relation to productivity?; (3) What magnitude of urbanization is projected for Asia in the future?; (4) What are the environmental implications of urbanization at that rate?; and (5) What future actions will be required to guide Asia's rapid urbanization and to control its environmental impacts?

Trends in Urbanization in Asia Since 1960

Asian planners of the early 1960s hoped that the ensuing three decades would be a period dominated by rural development, and in many ways it was. The green revolution brought enormous increases in agricultural production to most countries of the region. One outcome, however, was unexpected. Even with improved conditions in the countryside, the period was marked by rapid growth of cities and towns.

Table 1.1 shows that in 1960, only 18 percent of the 1.5 billion people in Asia lived in urban areas. Yet from 1960 to 1990, a full 45 percent of all population growth occurred in cities and towns (Table 1.2). The region's urban areas had grown by an average of 19 million people per year, reaching a total population of about 854 million in 1990, over three times the 271 million of 1960.

Almost half (44 percent) of that growth occurred in China, another 26 percent in India, and the remaining 30 percent was scattered unevenly in the other twenty-four countries in the region. Major countries with annual urban growth rates above 4 percent included Afghanistan, Bangladesh, Indonesia, Korea, Lao Peoples' Democratic Republic (Lao P.D.R.), Malaysia, Mongolia, Nepal, Pakistan and Thailand. Sri Lanka and Cambodia were the only countries with sizeable populations that had urban growth rates of less than 3 percent annually.

Economic Foundations and Productivity

These trends seemed indeed disturbing to many of the region's policy makers a decade ago when, in relation to national development goals, cities were often viewed as inefficient and parasitic. With the fundamental shift toward market-oriented development strategies, however, there appears to be much greater acceptance among national leaders of urbanization as a natural and virtually unavoidable accompaniment of rapid national economic development. A growing body of research has given weight to the positive linkage between the development of cities and GNP growth and, thus, poverty alleviation (*see* discussions in the World Bank Policy Paper on urban development (1991a), and Peterson, Kingsley and Telgarsky 1991b).

One foundation for this linkage of urban and GDP growth is evidence showing that areas experiencing the healthiest rural development have often been those in which urbanization also has most accelerated. In India, for example, agricultural productivity increased rapidly during the 1970s in the Punjab and Andhra Pradesh while it contracted in Gujurat and West Bengal. Comparing the 1960s to the 1970s, the urban growth rate in the Punjab increased from 2.2 percent to 3.8 percent and

Table 1.1. Urban population, 1960–2020
(in area covered by World Bank Asia Region)

	Urban Population (thousands)			*Percentage of Total Population*		
	1960	*1990*	*2020 (projected)*	*1960*	*1990*	*2020 (projected)*
World Bank Asia Region						
Pakistan, Afghanistan	11,903	42,271	145,419	19.6	29.9	55.4
India	79,413	230,269	648,265	18.0	27.0	47.3
Bangladesh, Other	4,730	24,602	102,451	6.6	16.0	36.6
Sub. South Asia	96,046	297,142	896,135	16.7	25.9	46.8
Korea, Others	34,999	117,374	271,873	21.6	36.5	54.8
China, Mongolia	125,234	381,948	930,121	19.0	33.5	62.8
Indonesia, Pacific	14,254	57,390	154,619	14.4	30.2	54.7
Sub. East Asia	174,487	556,712	1,356,613	19.0	33.7	60.0
Total	270,533	853,854	2,252,748	18.1	30.5	54.0
World Totals						
Industrial	571,947	875,469	1,088,643	60.5	72.6	81.1
Developing	459,563	1,514,701	3,926,504	22.1	37.1	58.2
Total	1,031,510	2,390,170	5,015,147	34.2	45.2	62.0

Table 1.2. Urban population growth, 1960-2020
(World Bank Asia Region and the world)

	Annual Growth (000)		*Annual Growth (Percent)*		*Percentage of Growth*	
	1960-1990	*1990-2020*	*1960-1990*	*1990-2020*	*1960-1990*	*1990-2020*
World Bank Asia Region						
Pakistan, Afghanistan	1,012	3,438	4.3	4.2	37.7	85.0
India	5,029	13,933	3.6	3.5	36.7	80.6
Bangladesh, Others	662	2,595	5.7	4.9	24.3	61.7
Sub. South Asia	6,703	19,966	3.8	3.7	35.1	78.2
Korea, Others	2,746	5,150	4.1	2.8	51.7	88.5
China, Mongolia	8,557	18,272	3.8	3.0	53.2	161.2
Indonesia, Pacific	1,438	3,241	4.8	3.4	47.5	104.5
Sub. East Asia	12,741	26,663	3.9	3.0	52.1	131.7
Total	19,444	46,630	3.9	3.3	44.7	101.8
World Totals						
Industrial	10,117	7,106	1.4	0.7	116.0	157.3
Developing	35,171	80,393	4.1	3.2	52.5	90.5
Total	45,289	87,499	2.8	2.5	59.8	93.8

in Andhra Pradesh from 3.1 percent to 4.0 percent, while urbanization did not accelerate in the other two states (Mohan 1984; Mohan and Thottan 1988).

An explanation for this correlation can be found by examining urban-rural linkages as development proceeds. As increases in yields begin to taper off after surges in agricultural productivity, there is a drop in the demand for rural labor. A more productive agricultural sector generates more demand for urban products and labor shifts toward cities to respond. Higher urban wages, in turn, lead to more demand for rural output (Peterson, Kingsley, and Telgarsky 1991b).

The manufacturing and service sectors virtually always exhibit higher labor productivity than agriculture. Higher wages in these sectors attract those in rural poverty. To be competitive, the vast majority of firms in these sectors find it necessary to take advantage of the agglomeration economies only to be found in urban centers.

As these processes have evolved in Asia, cities have begun to dominate national economic growth. Even in the early 1970s, for example, it is estimated that Bangkok accounted for 37 percent of Thailand's GDP while incorporating only 11 percent of its population, and that all urban areas in India together accounted for 39 percent of national GDP in contrast to only 11 percent of national population (Kahnert 1987).

Perception of Urban Inefficiencies

While the role of cities in national economic development is becoming better understood, there has also been a shift in thinking about three important issues that contributed to the negative image of urbanization in the past.

First, there is little doubt that urban areas have historically benefitted from irrational support policies, such as high levels of subsidy for urban infrastructure and food and other products for urban consumers along with protected employment for concentrations of civil servants. But the structural adjustment programs of the 1980s have largely diminished these urban biases in many Asian countries.

Second, dual labor market theories of the 1970s asserted that urbanization was inevitably associated with high levels of unemployment and underemployment: the promise of higher wages draws people into the cities, but most are forced into unproductive informal sector activities because of the lack of adequate job growth in the formal sector. Recent research, however, suggests that the informal sector is much more dynamic, and under- and unemployment problems less severe, than had been supposed (Kahnert 1987; Kannapan 1985). One study showed that 94 percent of migrants from the Punjab to Delhi in 1970s found work within two months of their arrival. Studies in other Indian cities have shown that informal sector urban workers with traditional skills (tailors or carpenters, for example) often make more than mid-level workers in the formal sector (high-school teachers or clerical workers).

Finally, research in the late 1970s seemed to confirm the conventional wisdom that the high level of infrastructure required to support urban life would be prohibitively expensive, given the economic potential of most developing economies. Those studies, however, assumed high cost technologies and standards. More recent analyses for several Asian countries (for example, India, Bangladesh and Indonesia) indicate that efficiently designed infrastructure can be provided at affordable costs (Richardson 1987; Mohan and Acharya 1990). Furthermore, there is a greater recognition that urbanization is a wealth-generating process and that wealth can be tapped to pay for infrastructure improvements. Cost recovery and more efficient financing techniques, while difficult to implement, could make urban infrastructure in Asia largely self-financing.

Asia's Urban Growth

Of the world's 100 largest cities (based on population), 36 are located in Asia, including 3 of the 6 cities with populations over 15 million, 5 of the 15 above 10 million, and 15 of the 33 above 5 million. As rapid as Asia's urban growth has been over the past thirty years, however, according to the new United Nations' estimates it will be even more so over the next thirty. According to these estimates, 2.3 billion people will live in Asia's cities and towns in 2020, almost equal to the total urban population of the world today. In 2020, one of every four people in the world will live in an Asian urban area.

The region's urban growth rate will be lower from 1990 to 2020 than it was from 1960 to 1990 (an average of 3.3 percent annually, as compared to 3.9 percent), but the absolute growth—and therefore, the number of new residents Asia's cities will have to accommodate—will increase dramatically.

Whereas urban areas accounted for 45 percent of total population growth in 1960–90, they will account for just over 100 percent in 1990–2020 (implying some net reduction in the number living in the countryside). While the cities had to accommodate an average of 19 million new residents annually from 1960 to 1990, they will add about 47 million people per year (1.4 billion people in all) between 1990 and 2020. This is more than half the total estimated annual urban population growth worldwide for that same period, and it is enough to reproduce the total current population of the United States in less than six years.

It is estimated that China will account for 39 percent of this growth (slightly smaller than its percentage share over the preceding three decades); India is expected to account for another 30 percent; and the other countries will account for the remaining 31 percent.

Almost all countries in the region are expected to follow the same basic pattern: lower urban growth rates but much larger absolute growth increments. Korea, which developed most rapidly during the 1980s, is the only Asian country with absolute 1990–2020 urban growth estimated at less than that actually experienced over 1960–90.

Environmental Implications

The major urban environmental problems from rapid urbanization in Asia are pollution, due to the concentrated discharge of residuals (gaseous, liquid and solid wastes) into the environment, and destruction of ecosystems from urban development in environmentally sensitive areas. Concerns about the extent of these problems are based on three propositions.

First, while hard data on the differences are not available, it is generally accepted that the per capita amount of energy and materials used, and the amount of waste generated, in cities is several times higher than in the countryside. This implies that, while the rate of urban population growth is expected to be high, the rate of increase in wastes will be higher still.

Second, the discharge of pollutants in cities is potentially more dangerous to human health because they are concentrated rather than spread more evenly over a wider area.

Third, the institutional, technological, and infrastructure systems available to help control these problems in urban Asia are at present inadequate to the task.

To develop a sense of what things could be like in Asian cities in the future, it should be helpful to begin by reviewing the environmental conditions today. Table 1.3 presents an overview of rapid growth, poverty and environmental degradation in four Asian cities: Manila, Calcutta, Madras and Jakarta. Economic growth has been rapid in these cities, but it has also led to increased energy and resource use, more wastes and many different forms of pollution, such as industrial effluent and ambient air pollution from vehicles. Also, the low-income residential areas in cities such as these are among the most degraded and unhealthy living environments in the world.[1] In these four cities, the poor comprise 35 to 60 percent of the total population. These households usually must sacrifice environmental quality in housing because buying food or a secondhand sewing machine to earn a livelihood comes first. Shanty towns develop in the areas least suitable for human habitation—for instance, the flooded areas of Calcutta and Bangkok.

Before reviewing environmental conditions in urban Asia more broadly, it is worth emphasizing that identifying clearly the links between human activities and the urban environment is a complex and daunting task. Environmental analysis breaks down the process of urban environmental degradation into three steps: evaluation of the effects (a) of activities on residuals, (b) of residuals on environmental quality, and (c) of environmental quality on humans and other "receptors," including valuation of these effects.

The U.S. Environmental Protection Agency (EPA) and WHO have undertaken many studies to determine the type and amount of discharges of typical urban activities, and the cost of reducing them. However, coefficients developed for industrial processes, vehicle fleets, and households in industrial countries have limited usefulness for predicting outcomes in developing countries.

Nevertheless, estimating the residuals produced by activities is often straightforward and the easiest part of environmental analysis. Assessing the impact of residuals on the environment and on people presents a greater

Table 1.3. Economic growth, traffic congestion and air pollution in four Asian cities

Indicator	*Manila*	*Calcutta*	*Madras*	*Jakarta*
Average Annual GDP Growth of Country, 1965-89	4.0	4.7	4.7	6.4
Percent Population Below Absolute Poverty	35.0	60.0	45.0	60.0
Access to Water (House Connection)-percent	43.0	48.0	40.0	47.0
Percent of Garbage Collected Daily	70.0	55.0	78.0	25.0
Access to Human Waste Disposal System (percent)	60.0	45.0	58.0	42.0
Rush Hour Speed (miles/per hour)	7.2	13.3	13.0	16.3
Ranking of Rush Hour Speed on a 1-10 Scale Relative to World's 100 Largest Cities (1=worst, 10=best)	1	2	2	3
Ambient Air Pollution	24 days/yr over SO_2 standards	268 days/yr over particulate standards	n.a.	173 days/yr over particulate standards
Ranking of Air Pollution on a 1-10 Scale Relative to World's 100 Largest Cities (1=worst, 10=best)	6	1	n.a.	1
Change in Toxic Waste Generated by All Industry in Country, 1977-86	-7.5%	28%	28%	204%

Source: Population Crisis Committee 1988; World Bank 1991; Batstone and ENVAP 1991.

challenge.[2] Humans especially are complex receptors, and analyzing environmental impact of them is a complicated endeavor. They move over wide areas and may absorb pollutants in many ways. In normal circumstances, residuals follow many different pathways through the environment to finally have an impact on humans. Special conditions such as air inversions and slow stream flow can increase the threat to human health, and they require many measurements over a long period to estimate. Finally, placing an economic value on pollution raises many theoretical and ethical issues and, regardless, is hampered by lack of good data in Asian and other developing countries.

Shin (1991) explored the valuation of urban environmental degradation in Asia and concluded that various methods have some applicability, particularly in getting "macro scale magnitudes of economic costs" for various types of environmental impacts (air pollution and traffic congestion, for example). However, these valuation methods are based on free market economy principles and economic and physical data, and are therefore limited to use where these conditions are found.

In short, quantifying the path of environmental degradation is difficult. The fine-grained data across sectors that is necessary for such an effort are largely unavailable for Asian cities. However, sufficient data do exist to verify that severe environmental degradation seriously threatens human health. Indeed, the largest Asian cities already rank as the most environmentally polluted in the world in some respects. In the following discussion four types of residuals—gas, liquid solid and energy—and their effect on urban environments in Asia are examined.

Liquid Residuals and Water Pollution

Water-related disease is the leading cause of death in developing countries, and worldwide, it accounts for 80 percent of infant deaths and approximately 35,000 deaths among children each day. Most of these deaths stem from bacteria and viruses that spread through the environment, due in large part to inadequate sanitation and water treatment. In addition, toxic chemicals produce various long-term illnesses. The natural environment also is degraded by pollutants such as untreated sewage.

Water-borne pollution affects the poor much more than the well-off. In Manila, for example, diarrhea in shanty towns is twice as common as in the rest of the city (Shin 1992). The infant mortality rate in the poor areas of the old city of Kabul, Afghanistan, is 1.5 times that for the rest of the city. Studies of Delhi and Calcutta show higher rates of many diseases and longer duration per illness in slum areas. In general, "sickness impoverishes already poor households, which are plunged into a progressive spiral of declining health and economic status—a process called the 'poverty ratchet'" (Shin 1992).

Municipal wastes, domestic sewage and effluent from agriculture-related industries form the bulk of polluting matter discharged into water sources worldwide. In Asian cities, water pollution from uncollected and untreated sewage harms people more than any other environmental problem. Local governments, however, typically focus on water supply rather than sanitation or sewage treatment. Water supply is a more visible, more immediately felt need, and it is more politically popular. The high cost of conventional sewage treatment also contributes to low coverage. Cities typically install sewers after water supply systems (and even after paved streets, which they then must tear up to lay the sewer lines). Even when sewerage systems are installed, they frequently fail to cover a large share of the urban population.

For instance, of India's 3,119 towns and cities, only 8 have full sewage disposal and treatment facilities and only 209 have partial facilities. The River Ganges alone carries the untreated sewage of 114 cities, each with 50,000 or more inhabitants. In contrast, Beijing treats 12 percent of its collected sewage—a high percentage by Asian standards.

Table 1.4 presents the safe drinking water

Table 1.4. Access to safe drinking water and sanitation in urban areas in world regions and selected countries, 1988
(percent)

Region or Country	*Access to Median Safe Drinking Water*	*Access to Median Sanitation*
Africa	88	64
Central and South America	83	85
Asia	87	84
-China	87	66
-India	79	38

Note: These figures are medians of safe drinking water and sanitation coverage as estimated by WHO and the United Nations Children Fund.
Source: WRI 1992.

and sanitation coverage for rural and urban areas in many developing countries. Safe drinking water coverage in Asia as a whole (87 percent) and China (87 percent) roughly equals that in Central and South America (83 percent) and Africa (88 percent). That of India is somewhat lower (79 percent). Except in Central and South America, safe water coverage exceeds sanitation coverage, often substantially. Urban sanitation coverage also varies much more between regions than safe water coverage. Although the median urban sanitation coverage of Asian countries (84 percent) is about that of Central and South American countries (85 percent), coverage of the huge urban populations of China (66 percent) and India (38 percent) is much less. The very low figure for India indicates the appalling health conditions in which the bulk of its poor urban residents live.

Nevertheless, municipalities in developing countries have displayed some interest in extending sanitation to more affluent neighborhoods. They typically do not treat the sewage they collect, however, and dump untreated sewage into rivers or oceans, which carry the waste beyond municipal boundaries.[3] Thus, sewage becomes a problem for others to deal with.

The experience of Latin America cities in developing sewerage systems offers a lesson for Asia in how not to proceed. Relative to other developing regions, Latin American cities have made a much greater effort in extending sanitation services, principally in the form of urban sewers. However, they treat only approximately 2 percent of urban sewage (WRI 1990), and very serious health consequences, such as the return of cholera, have followed.

The best available data on water pollution, as for air pollution, comes from the Global Environment Monitoring System (GEMS). The GEMS water network consists of 350 stations in 42 countries; 52 of the stations are in Asia. However, these sites are not necessarily in cities, and information on human effects (for example, whether the station lies upstream, downstream, or in the middle of an urban, industrial or agricultural area) is unavailable.[4] Forty-two of the Asian sites are trend monitoring stations, a subset of GEMS stations that are located where human activities are known to affect water quality. This inexactness regarding location and a number of other problems make interpreting GEMS water quality data difficult.[5]

Most of the problems with GEMS data can be attributed to the lack of adequate funding. For instance, calibration and reporting are problems and often the measuring instruments remain unchecked for long periods of time. Since participation of countries in the GEMS network is voluntary and uncompensated, only a few stations report regularly, while a considerable portion do not. Phase Two of GEMS for the 1990s emphasizes interpretation of data.

Table 1.5 presents data on water quality in Asia and other regions from the GEMS water network, including median dissolved oxygen, median biological oxygen demand (BOD), median pH value, median faecal coliforms, and median dissolved mercury and lead.[6] The number of faecal coliforms, largely from untreated

Table 1.5. Water quality at selected GEMS stations in world regions

	Median Faecal Coliforms		*Median Dissolved Mercury*		*Median Dissolved Lead*		*Median Dissolved Oxygen*	
Region	No. of Sites	No. per 100 ml	No. of Sites	No. per 100 ml	No. of Sites	No. per 100 ml	No. of Sites	Mg per Liter
Europe	61	1,775	n.a.	n.a.	n.a.	n.a.	15	10.1
Asia	26	500	8	.20	10	.002	28	8.0
South and Central America	31	117	n.a.	n.a.	n.a.	n.a.	19	7.5

Source: Calculated from GEMS data (WRI 1990).

sewage, is highest in European rivers. However, good water treatment and 100 percent safe water coverage virtually eliminates the health risk in Europe (Maybeck, Chapman and Helmer 1991). In contrast, the high levels in Asian rivers represent a major health problem. At a median of 500 per 100 milliliter, they far exceed the recommended maximum for human consumption (10 per 100 milliliter) and the level considered highly polluted (100 per 100 milliliter). The level of bacteriological contamination in Asian rivers is over four times that in Central and South American rivers.

The level of median dissolved mercury (0.200 per hundred milliliters) also far exceeds the recommended standard of 0.001 micrograms per liter. Fish and shellfish absorb substantial amounts of waterborne mercury, which eventually is ingested by humans when they eat the fish. High levels of mercury can cause neurological disease, as demonstrated by the outbreaks of "Minamata disease" near Minamata Bay in Japan from the 1930s through the 1950s, from mercury in fish. The levels of lead in Asian rivers are generally within health standards of 0.05 micrograms per liter. Dissolved oxygen generally exceeds the amounts needed to support scavenger fish (2 micrograms per liter) and game fish (4 micrograms per liter).

Individual cases support a conclusion suggested by the GEMS data: Asian rivers are highly polluted by untreated sewage from cities. For instance, in Delhi, the coliform count is 7,500 per 100 milliliters in the Jamuna, the main river entering the city, and 24,000,000 per 100 milliliters, leaving the city.

Industrial and mining wastes compound municipal and household waste disposal problems. Few industrial plants have installed waste treatment facilities. Despite a city moratorium on new waste-producing industry, the local river is virtually devoid of oxygen and untreatable by standard methods (USAID 1990). River water is even unusable by many local industries for the worst three months of the year, forcing some to shut down during this period.

Table 1.6 presents sanitation and water pollution data from the five cities participating in MEIP: Manila, Jakarta, Colombo, Bombay, and Beijing (*see* discussion of MEIP in Chapter 2). These cases paint a dark picture. Four of these five cities are national capitals and enjoy the best infrastructure and health services available in their countries, yet all show severe water pollution from inadequate sewerage systems.

Gaseous Residuals and Air Pollution

The most common air pollutants threatening human health in urban environments include

Table 1.6. Data on sanitation coverage, treatment, and water pollution in MEIP cities

City	*Sewer Coverage and Treatment*	*Water Pollution*
Manila Bay	Only 15 percent is sewered; septic tanks perform poorly; 70 percent of wastes dumped into main river comes from households, 30 percent from 300 industrial firms.	Rivers are biologically dead; Manila is threatened. 74,390 cases of gastro-intestinal diseases reported in one year. Infant mortality is 36 per 1,000 births.[a]
Jakarta	68 percent use septic tanks, which leach into groundwater, on which 40 percent of population relies for drinking.	All Jakarta rivers are and heavily polluted, and aquifer is turning salinated and contaminated. $20-30 m./yr to boil water for home use. Infant mortality is 45 per 1,000.
Colombo	60 percent connected to sewer over 50 years old; sewage largely discharged untreated into rivers or ocean. Compounded by industrial effluents. 73.6 percent receive pipe-borne water, 21.9 percent from protected wells and .2 percent from rivers.	All Colombo rivers are heavily polluted. Quality of pipe-borne water is satisfactory, but many households store water because of low water pressure in storage sumps, 25 percent of which are contaminated.
Bombay	Piped water covers 70-90 percent of city center but only 30-40 percent of slums. 60 percent is connected to sewers, 10 percent use community toilets, and the remainder use open areas. City has separate sewers for storm drainage and household waste, but the two mix.	All rivers heavily polluted. Infant mortality is 59 per 1,000.
Beijing	Daily municipal sewer discharge is more than 2 million tons, only 12 percent of which is treated; the remainder flows directly into rivers; industrial effluents account for 80 percent of total. Much of city relies on groundwater for drinking. A combined sewer system for waste and rainwater in much of the old city threatens to make achievement of adequate water quality impossible for certain periods, despite planned addition of 1 million tons of sewer processing capacity. However, water scarcity makes preservation of quality essential.	Drinking water sources are threatened by excess exploitation of groundwater, which untreated sewage is polluting. Rivers downstream are intensely polluted. Infant mortality is 11 per 1,000.

a. Infant morality figures compare to 10 for New York, 5 for Tokyo and 122 in Recife per 1,000 births.
Source: MEIP country profiles.

suspended particulate matter (SPM), lead, carbon monoxide (CO), SO_2, ozone, nitrogen oxides (NO_x), and toxic substances.[7]

The most comprehensive data on air pollution, as for water pollution, are available from GEMS. There are some deficiencies, however, in the GEMS experimental techniques used. For instance, measurements are not taken often enough or from enough different locations or altitudes, or they are taken too close to known point sources of pollution (for example, major roads) to assure a general sampling. Fifty countries collect this data, and thirty-five report GEMS data for major urban areas. Levels of

SO_2 and SPM are the most commonly measured and widely reported pollutants.

Table 1.7 presents data from the GEMS air network for SO_2 and SPM for selected cities. These figures give the number of days per year that levels of these pollutants exceeded WHO standards.

Figure 1.1. presents WHO data on levels of SPM in forty-one of the world's largest cities. Twelve of the fifteen cities with the highest levels are in Asia.

The Population Crisis Committee (1988) collected data on a wide range of socio-economic and physical indicators from a survey of local authorities and environmental experts in the world's hundred largest cities in 1988. Of the seven cities that receive the worst ranking for air pollution (one on a ten-point scale), five are in Asia: Calcutta, Jakarta, Delhi-New Delhi, Beijing and Shenyang.

The major sources of air pollutants in cities are urban transport, industry and biomass or coal for fuel.

URBAN TRANSPORT. Globally, Asia is a relatively minor source of air pollution from vehicular emissions. Although 56 percent of the world's population live in Asia, it has only 11 percent of the world's cars and 28 percent of its trucks and buses, and they generate less than 20 percent of the common types of vehic--ular emissions, including CO, hydrocarbons (HC) and NO_x, and only about 10.5 percent of carbon dioxide CO_2) (Midgley 1991).

Table 1.7. Air pollution in selected cities of world regions

	Sulfur Dioxide		*Suspended Particulate Matter*	
Region or Country	*Number of Cities in Sample*	*Median Number of Days Over WHO Standard* [a]	*Number of Cities in Sample* [b]	*Median Number of Days Over WHO Standard*
United States and Canada	8	5.5	10	.5
South America	5	0	2	5.5
Asia	17	20	15	153
China	5	68	5	219
Europe	15	13	5	12
Australia and New Zealand	4	0	2	1.5

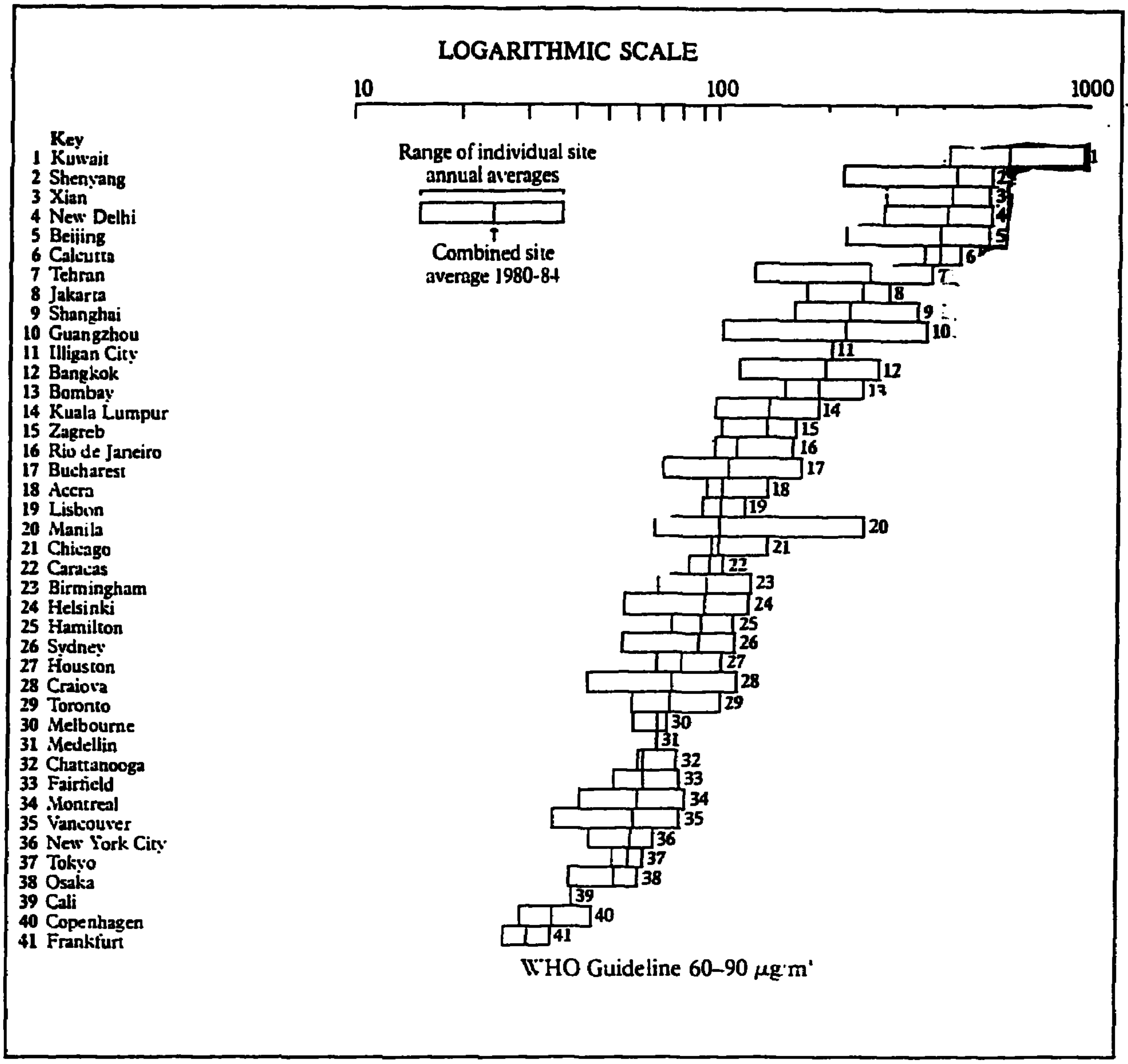
Note: In this table, gravimetrically determined suspended particulate matter measurements are shown and compared with the WHO guidelines of 230 micrograms per cubic meter

a. The WHO standard for sulphur dioxide (SO_2) is a maximum of 150 micrograms per cubic meter for no more than 7 days per year. This figure is the median of the average number of days that measurements of sulfur dioxide exceeded 150 micrograms per cubic meter at the sample sites in the region or country.

b. The WHO standard for SPM is 230 micrograms per cubic meter. This figure is the median of the average number of days that measurements of SPM exceeded 230 micrograms per cubic meter at the sample sites in the region or country.

Source: Calculated from GEMS data (WRI 1990).

Figure 1.1. Levels of SPM in selected cities, 1980-84



Source: WHO and UNEP 1987.

Within Asia, however, motor vehicles account for a substantial part of air pollution in most urban areas (75–90 percent of CO_2 emissions, 55–95 percent of CO emissions, 30–70 percent of NO_x emissions, 90 percent of lead, up to 60 percent of particulate matter, and considerable ozone (Faiz 1990; Midgley 1991). Vehicular emissions pollute water and food also. Box 1.1 describes the many problems probably caused by vehicular emissions in Bangkok.

Vehicle production has grown rapidly throughout Asia, expanding by 10 percent each year, and as elsewhere, urban residents own the overwhelming share of vehicles. Contributing to the emissions problems are various characteristics of vehicles in Asia that cause particular harm to urban air quality. For instance, the proportionate number of motorcycles is higher in Asia than in other areas of the world, and much greater than that of 4-wheel vehicles. In addition, a large number of these motorcycles are 2-stroke engines of old design. These 2-stroke motorcycles emit as much as ten times more HCs and smoke than do 4-stroke motorcycles or even cars.

The proportionate number of diesel vehicles in Asia also exceeds that of the rest of the world. These heavily polluting vehicles are concentrated in Asia's many megacities and they produce great amounts of toxic emissions. Further compounding air pollution problems are the tropical climates and long commutes of many Asian cities and the prevalence of dirty fuels, among the dirtiest in the world.

Decentralized and inefficient land use in Asia also plays an important part in increasing vehicular emissions in the growing urban areas. Typically, land development occurs at the urban edge, increasing the distance between residential areas and the city center or other work centers, and creating greater need for motorized travel. Declining population densities away from urban centers reduce the economic viability of mass transit, and increasingly private vehicles replace traditional modes of travel, such as walking, bicycle, water travel or public transit. Traffic speeds drop and commute times lengthen, and more vehicular emissions are poured into the air.

INDUSTRY. In some heavily industrial cities, industry, rather than vehicles, produces most of the ambient air pollution (SO_2, NOx and SPM). Delhi is one such city. Table 1.8 presents the main types of air pollutants in Delhi by source.

Delhi industry discharges 75 percent of the city's total SPM, the largest share of total CO

Box 1.1. Vehicular emissions in Bangkok

A recent USAID study by Abt Associates and Sobotka and Co. (1990) reports that vehicular emissions may be the main source of two of the three most serious environmental threats in Bangkok, SPM and lead, and of one of the two "medium" risk problems, CO. Concentrations of SPM in Bangkok's ambient air substantially exceed both Thai and U.S. health standards, and levels have worsened in recent years. The authors estimate that SPM costs 9 to 51 million total days per year of restricted activity because of respiratory illnesses and up to 1, 400 deaths per year among Bangkok residents. Lead also has been measured at dangerous levels in air, drinking water and food, and in the blood, body tissue, hair and urine of the city's residents. Lead pollution causes an estimated 200,000-500,000 cases of hypertension, 300-900 cases of heart attack and stroke, and 200-400 deaths per year among adult males. For children, the effects include loss of three to five IQ points by each child in Bangkok through age seven—a loss that can be calculated not only in terms of personal ability but in terms of future resources for the community as well.

This study illustrates the difficulties of tracing the causes and effects of environmental degradation in developing countries. For example, the authors state regarding lead, "The exact sources of human exposure to lead in Bangkok are uncertain. Our calculations suggest that each of three sources, ambient air, water and food, is likely to be important for both children and adults....The likely contributors to lead in ambient air are combustion of leaded gasoline and lead smelting....Our analysis suggests that food may be the primary pathway for human exposure to lead. How the lead gets into the food is uncertain. There are numerous possibilities, including deposition of airborne lead onto soil and plant surfaces, naturally high lead content in soil, irrigation of crops with contaminated water, deposition of lead onto food sold at roadside markets, or various sources in the food transport and processing system. We have no definitive information on the relative importance of these possibilities. We suspect that the combination of heavy traffic, substantial lead content in gasoline, and extensive consumption of food from roadside food sales may be particularly important."

Table 1.8. Air pollutants in Delhi by emitting sector, 1985-86
(tons and percent)

	Sector (tons and percent)				
Pollutant	*Residential*	*Transport*	*Industry*	*Commercial and Services*	*Total*
SO_2	7260	646	4883	3002	15,791
	46	4	31	19	100
CO	42,729	31,606	50,728	3,361	128,424
	33	25	40	3	100
NO_x	87,717	7,103	4,873	2,558	23,281
	37	31	21	11	100
SPM	10,507	681	44,930	3,746	59,864
	18	1	75	6	100

Source: Modified from Bose 1990.

(40 percent), and significant shares of SO_2 (31 percent) and NO_x (21 percent). Both large and small industrial plants are responsible for these figures. Although large plants discharge many times the amount of emissions from individual small plants, clusters of small-scale plants operate obsolete equipment and generate unregulated emissions that can generate "heat islands" in the surrounding areas. In fact, point sources of air pollution, such as large industries, in general produce a small fraction of total industrial pollution in developing countries.

Industry in Asia also contributes large amounts of greenhouse gases. Table 1.9 shows the percentages of greenhouse gases (CO_2, NO_x and CO) worldwide that are attributed to Asian countries. In Asian countries, industry is the chief producer of CO_2 (44 percent), the main factor in global warming, and a major source of NO_x (33 percent). As discussed later in this chapter, rapid urban and industrial growth may make Asian cities the principal source of global increases in greenhouse gases.

BIOMASS FUEL. Even more harmful for residents in poorer urban areas is indoor air pollution from burning coal and other biomass (wood, dried dung, agricultural wastes). Coal smoke pollution is the main ambient air quality problem in Beijing and many other Chinese cities. It comes smoke pollution is the main ambient air quality largely from use of industrial boilers and stoves for home heating. These circumstances will be discussed further later in this chapter.

Ambient and indoor air pollution together cause much human suffering, especially in low-income Asian cities. For instance, lung cancer mortality is from four to seven times higher in Chinese cities than in the nation as a whole. Sixty percent of the people who live in Calcutta and 30 percent of those living in Delhi suffer from serious respiratory diseases, compared to the national average of 2.5 percent (Shin 1992).

Solid Residuals and Solid Waste

Data on solid waste in Asian cities is widely available from local governments. Shin (1992)

Table 1.9. Share of greenhouse gas emissions generated in Asian countries by sector (percent)

Sector	CO_2	*NOx*	*CO*
Electric Production	21	26	1.1
Industry	44	33	3.5
Transport	11	30	55.7
Other	24	11	39.7
Total	100	100	100.0

Source: Calculated from World Bank data.

reports that low-income residents of Asian cities generate about 0.4–0.7 kilograms/capita/day of solid waste, middle-income residents 0.5–1.0 kilograms, and high-income residents 0.8–1.5 kilograms. UNCRD reports a range of .5–2.80 kilograms/capita/day (*see* Table 1.10). The total amount of solid waste is astonishing: 1,150,000 tons per year in Bombay; 3,850,000 tons per year in Beijing; and 10,512,00 tons per year in Seoul.

Urban income largely determines disposal methods, which range from none, to landfills, to composting and recycling plants and incinerators. All of the solid waste collected in Bombay, Colombo, Manila, Kuala Lumpur, and Beijing go to landfills. Singapore, Tokyo, Nagoya, and Kitayushu incinerate their waste.

Many poor people in cities earn a living by scavenging waste. About 200,000 Jakartans pick out the useful materials from the city'slandfills and sell them. Until recently, each city block in Shanghai bought cans, glass and other garbage from residents and sold them to city government. The city, in turn, sold these materials to industries at a profit that formed a major revenue source for local government. An estimated 20,000 people live around a dump called "Smokey Mountain" in Manila and resist relocation. But rising incomes make scavenging a less attractive occupation,and rising costs make it a less competitive business. For example, the waste economy of Shanghai has largely disappeared because the city cannot afford to pay rising prices for scavenged material.

Households and industry dump whatever solid waste is not collected as garbage into waterways. This dumping contributes to water pollution and causes drains to block and flood. Even when dumped at landfills, solid waste creates problems, including odors, smoke from fires, leaching of chemicals into surface and groundwaters, and breeding of rats, flies, and mosquitos. Incinerators also create problems of air pollution and ash disposal.

The location of industries in relation to residential areas usually determines their environmental impact, including solid waste pollution. If they are nearby, and increasingly this is the case, residents suffer not only from loud noise and vibrations, but from more severe air and solid waste pollution as well.

Table 1.10. Solid waste generation in selected Asian cities

	Waste Generated	
City	*Thousands of tons per year*	*Kilograms per capita per day*
Seoul	10,512	2.80
Tokyo	4,491	0.54
Beijing	3,580	1.59
Singapore	1,873	0.98
Bangkok	1,800	0.88
Jakarta	1,800	0.75
Manila	1,380	0.5
Bombay	1,150	0.55
Nagoya	890	1.14
Kuala Lumpur	730	1.29
Kitayushu	405	1.06
Colombo	160	0.75

Source: UNCRD 1989.

Hazardous wastes, such as heavy metals and pesticides, cause special difficulties. By one estimate (Abt Associates and Sobotka and Co. 1990) manufacturing plants generate 100 tons of hazardous waste for every $1 billion increase in GDP. Cities usually lack the ability to manage hazardous wastes adequately. Municipal garbage companies often dump them into regular public sites or waterways.

Energy Residuals and Pollution from Energy Generation and Domestic Cooking

Energy use has special importance for the urban environment: total per capita energy consumption is higher, and growing much more rapidly, in cities than the countryside; energy use in cities casts a shadow of environmental impacts over nearby areas;[8] and urban energy production and consumption are commercial activities sensitive to market-oriented policies.

An "energy ladder" characterizes the choice and use of fuels in Asia and elsewhere. Low-income people tend to use wood, coal and other biomass. As incomes increase, people use less biomass and more modern fuels such as LPG and electricity. People take various factors into account in choosing fuels: price, custom, the availability of the fuel appliance and time. For instance, a recent study of cooking fuels in Bangkok shows choice highly correlated with women's time. As more women enter the work force, they prefer easy-to-use fuels such as LPG over wood, coal and other biomass. Figure 1.2 documents the decrease in the use of biomass for fuels with an increase in household income (in India, Pakistan and Brazil), and the shift in the use of different fuels with economic growth (in South Korea).

This shift has important consequences for pollution. The burning of biomass creates severe indoor pollution in many lower-income Asian countries, such as China, India, Indonesia and Bangladesh. Biomass and fossil fuel combustion release a number of potentially harmful compounds: particulates, polycyclic organic matter such as benzopyrene (a cancer-producing HC), CO and other chemicals. The use of biomass ranges from 23 percent of primary energy supplies in Malaysia to 45 percent in India, Pakistan and Indonesia (Imran and Barnes 1990).

Often, the health damage from burning biomass far exceeds that caused by ambient air pollution, particularly in cold climates in which people stay indoors. Health effects may be acute, subacute or chronic. Acute effects include smoke inhalation and acute carbon monoxide poisoning. Subacute effects result from irritation or inflammation of the respiratory tract. Chronic effects include pulmonary and cardiopulmonary conditions, cancers and other diseases (WRI 1987).

Poor indoor air quality damages the health of women and children, in particular. Measurements in kitchens in homes of four Indian villages showed particulate levels 35 times the 1-hour standard and nearly 100 times the 24-hour standard recommended in most industrial countries (Leitmann 1991b). Although some studies exist, no large-scale, comprehensive data is available on indoor pollution in Asian countries.

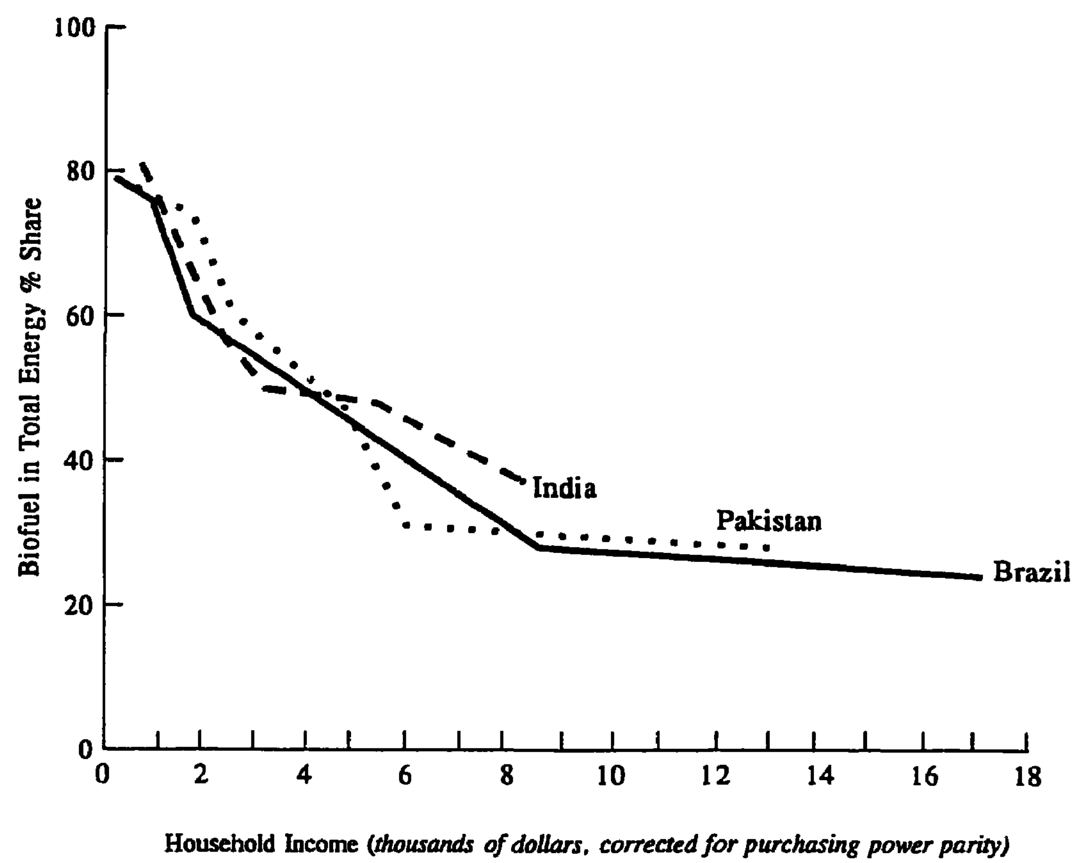
At the regional level, consumption of biomass fuels causes considerable environmental problems. These include deforestation, soil erosion, poor groundwater recharge, loss of agricultural productivity, and in some cases desertification. Typically, these consequences damage the areas around major roads leading to cities most, casting an "urban shadow."

Future Actions

Although the available data are insufficient for clearly identifying all the pathways and impacts of pollution, they leave no doubt of the severity of environmental degradation in Asian cities, and its high cost in suffering and death. There also is no doubt that for many Asian cities, environmental degradation is doubly burdened by both widespread poverty and rapid economic growth.

What of the future? Those knowledgeable

Figure 1.2. Shift in biofuel share of total urban energy use, with increasing urban household income (includes energy consumption by household members and servants)



Source: Leitmann 1991b.

about Asian urban environments hesitate to make predictions. The experience of Singapore shows the risks of environmental prophecies. Thirty years ago, this city-state had appalling environmental conditions, but economic growth, a massive public housing program and good planning have made the city an environmental model (*see* Box 1.2).

Singapore's turnaround shows that environmental deterioration is not inevitable. However, Singapore enjoys a key advantage over most other Asian cities. Since 1959, immigration has been limited, and largely as a result, annual population growth has averaged a low 1.2 percent (ADB 1987; MacAndrews and Sien 1978). In this and some other respects, Singapore differs from other Asian cities. Projections suggest a dismal future for many other Asian cities if population and environmental problems are not brought under control.

An indication of increasing problems is the growing energy use. Table 1.11 shows projected figures for energy use in 1990 and 2010 for the seven largest consuming countries in Asia

Box 1.2. Singapore: an environmental success story

Singapore is a small nation consisting of the island of Singapore and some fifty isles within its territorial water. In 1959, more than a quarter of a million people were crammed into the Central City Area of Singapore, which suffered from overcrowding, filth and lack of sanitation, and chaotic traffic. Water bodies such as the harbor were severely polluted. These conditions contributed to diseases such as tuberculosis, which was rampant, and high rates of infant mortality.

Since then, these conditions have virtually been eliminated. Industrialization spurred economic growth at an annual average rate of over 9 percent from 1960 to 1980. The Housing Development Board constructed 180,000 dwelling units from 1961 to 1985, most of which have been sold to their occupants, transforming Singapore into a property-owning society; 84 percent of the population now lives in publicly constructed apartments. These developments include not only housing but also social services, open spaces and recreational facilities. Government agencies have carefully planned the use of this island's scarcest resource, ianJ. In the mid-1960s, the State and City Planning Project, consisting of a team of U.N. consultants and local planners, collected data, developed strategies and a "concept plan," and assisted the Public Works Department in applying this plan. Specific environmental control legislation followed, beginning in the 1970s.

Together, these measures eliminated the environmental threats to human wellbeing that are largely caused by poverty. Singapore has not only halted the degradation of its physical environment but has also achieved a "clean and green city" image. A recent study ranks Singapore as one of the most liveable of the 100 largest cities in the world based on a wide range of economic, social and environmental criteria. Infant mortality is 7 per 1,000 live births, below that of New York and London. Air quality, crime rates, rush-hour traffic speeds and secondary school completion rates also rank among the best in the world's 100 largest cities.

(Imran and Barnes 1990). These seven Asian nations account for roughly one-half of energy use by developing countries, whose share of total world energy use rose from 20 percent in 1970 to 33 percent in 1988, and is projected to rise to 40 percent by 2000. Developing countries are expected to account for two-thirds of energy use in the world by the year 2000.

The rapid increase in, and the composition of, energy use in these Asian countries has fundamental importance for urban environments. Although coal use has increased more slowly than other energy sources, it continues to be the main single source of energy, and this relatively dirty fuel is expected to produce almost half of all energy in Asia by 2030. China accounts for about 75 percent of this coal use, and India for about 20 percent. Neither China nor India has other fuel alternatives at present and their pollution problems are compounded by the inefficient stoves and burners still prevalent in each country. Other countries are moving toward cleaner-burning fuels, such as gas. Increased use of gas forms part of the energy strategies of Indonesia, Malaysia, Thailand and Pakistan. Choice in the production and use of fuels is highly sensitive to the cost of fuels, equipment that burns these fuels and other inputs. The environmental impact of various fuels depends on the technologies available and the extent of substitution. Shifting to natural gas and using clean coal technologies can reduce particulate and CO emissions by 99.9 percent, and SO_2 and NO_x by 90 percent. Without such actions, however, the air quality in many cities, particularly in China, is likely to worsen drastically.

These air pollutants also have a global impact. Asia, primarily its cities, is thought to generate close to one-half of the increase in the world's greenhouse gases, and Asia's share is rapidly rising. For total global emissions of CO_2, Asia's share was 17 percent of in 1985 and is projected to reach 28 percent in 2025.

Table 1.11. Future primary energy supply and demand by sector in Asia's largest consuming countries *(in thousands of mb/doe)*

	1990	*2010*	*Increase in usage (percent)*
Primary Energy Supply			
Oil	4,792	10,082	110
Coal	12,144	22,449	85
Gas	1,083	6,390	490
Nuclear	32	670	1,993
Hydro, etc.	1,242	6,218	400
Total	19,293	45,809	137
Energy Demand by Sector			
Transport	2,130	5,232	146
Industry	6,357	16,322	157
Residential and Services	3,901	6,784	74
Total Direct	12,388	28,341	129
Electricity Generation	5,457	18,687	242

Note: These projections are based on World Bank forecasts of economic growth and take into account the changing relationships between growth and energy demand, structural change, and the potential for fuel substitution.
Source: Calculated from Imran and Barnes 1990.

Studies also project a doubling of the Asian automobile fleet by 2000 (Midgley, 1991). The environmental impact from this increase in vehicles will be compounded by a number of factors. For instance, the proportion of highly polluting 2-stroke engine motorcycles and 3-wheelers is likely to remain the same. As Table 1.12 illustrates, even if governments are able to control vehicle growth, the outlook for many of the most polluted cities is dismal. The table presents data on total vehicle emissions for Bangkok and Surabaya in 1985 and projects the effect of reducing vehicle growth from current annual rates of above 10 percent to 5 percent until the year 2005. Even at the reduced rate, vehicles in Bangkok are projected to generate two to three times the 1987 levels of CO, HC, and SPM; the increase ranges from 140 percent for CO and particulate to 180 percent for HC. Surabaya vehicular emissions also rise substantially and would worsen already appalling conditions. The sheer volume of annual vehicular emissions is frightening: 3 million tons of CO per year in Bangkok by the year 2000.

To avoid such outcomes, improved fuel quality, vehicle maintenance, enforcement programs and emission-reducing technologies are necessary. The cost of these measures, however, is likely to continue to hinder their adoption in Asian countries.

Gridlock is likely to worsen substantially in Asia's largest cities, where traffic flows are already bad. In the absence of more effective urban planning, urban sprawl appears likely to continue, forcing longer commutes. Again, many levers exist for reducing the environmental impact of growth. In their absence, appalling conditions appear likely.

The prospects for solid waste are equally troubling. Solid waste generation rises substantially with economic growth. High-income cities generate various multiples of low-income cities with comparable populations. The city of Bombay produces almost 1.2 million tons of solid waste per year, while Tokyo, with nearly the same population, generates 4.5 million tons.

Industrial toxic waste is most serious, both because of its impact on human health and the high cost of cleanup. Table 1.13 presents the number of pounds of toxic waste discharged for each $1,000 in GDP in thirteen Asian countries in 1977 and 1986. This figure decreased significantly for only two of these countries, Japan and China; increased for seven; and stayed roughly the same for four. As China's toxic waste levels continue very high, only Japan is a clear success story.

Other data indicate that industrial emissions tend to rise with output until incomes reach

Table 1.12. Annual vehicular emissions in Bangkok and Surabaya for 1987 and projections for 2005 *(in tons)*

	Bangkok			*Surabaya*		
Emission	*1987*	*2005*	*Increase (percent)*	*1987*	*2005*	*Increase (percent)*
CO	1,250,000	3,000,000	140	320,000	510,000	60
HC	250,000	700,000	180	100,000	140,000	40
SPM	33,000	79,000	140	11,500	15,500	34

Note: The projections for 2005 assume a 5 percent per year growth in number of vehicles (a reduction from 10 percent per year in 1987).
Source: Calculated from Midgley 1991.

$2,000-4,000 per capita, and then start to decline, reflecting the modernization of industry and shift away from heavy industry typical of higher-income countries. During the transition, however, toxic wastes represent a great threat to human health. The mercury contamination of Minamata Bay by a Japanese chemical factory that caused severe neurological disorders in hundreds of residents in a nearby town illustrates the dangers of this interim period. Many low- and middle-income Asian countries are undergoing strong industrial development without the technologies and pricing strategies necessary to reduce toxic emissions and waste.

Often, governments hesitate to apply sanctions to the polluting companies because they also create many jobs, have considerable political power, and generate much foreign exchange. In the absence of least-cost strategies for reducing industrial discharges, the prospects for balancing environmental and economic values are dim, and the danger of terrible toxic pollution great.

Compounding these very serious urban and industrial waste problems are inadequate water and sanitation coverage. The number of world population without adequate water provisions is projected to rise from 1.3 billion in 1990 to 3 billion by 2030, with 57 percent of this growth

Table 1.13. Industrial toxic waste releases in selected areas or countries in Asia
(pounds per $1,000 of GDP at 1989 prices)

Area or Country	*1977*	*1986*
Bangladesh	0.91	0.93
China	5.72	4.68
Hong Kong	2.21	2.18
India	2.19	2.80
Indonesia	0.42	1.28
Japan	3.62	2.85
Republic of Korea	2.91	3.26
Malaysia	1.68	3.04
Pakistan	1.17	1.80 [a]
Philippines	1.75	1.62
Singapore	3.43	3.94
Sri Lanka	0.67	0.76
Thailand	1.24	1.41

Note: U.S. EPA coefficients were applied to the industrial mix of these countries to arrive at these figures, hence, they represent rough estimates.
a. For 1984.
Source: Batstone and ENVAP 1991.

in Asia, mostly in cities. The number without adequate sanitation is projected to increase from 1.8 billion to 3.2 billion, again with over half living in Asian cities. Providing adequate sewer, water and other services is therefore an urgent environmental issue; however, there are many obstacles, including the weak financial and institutional capacity of local governments.

Many other environmental problems tend to worsen geometrically with further pollution. The Asian Development Bank (ADB) predicts a fivefold to tenfold increase in regional air and water pollution over the next fifteen years because of an expected 300 percent increase in the number of motor vehicles and a 150 to 200 percent expansion of industrial and mining activity (USAID 1990; Hufschmidt and others 1983).

Overall, the picture that emerges shows possibilities for both appalling consequences and for opportunities to find lasting solutions. Technologies and planning strategies can deal with the environmental problems resulting from the economic growth under way in many Asian cities; however, whether they will be applied is far from certain. In this context, there is clear and urgent need for action to promote the principles of urban environmental quality management.

Notes

1. For a discussion of these "environments of poverty," see Hardoy and Satterthwaite 1985.

2. Assessing the impact of wastes on ambient environmental quality typically is done through the use of models—such as an atmospheric dispersion model or an oil spill dispersion model. These models range from an extremely simple calculation to a sophisticated equation of the inputs to and outputs of an environmental system—called a "mass and energy" approach. However, the timing and spatial pattern of discharges, and the complexity and size of the ecosystem involved, make constructing models difficult. Although models of ecosystems as large and as complex as the Chesapeake Bay have been developed in industrial countries, data and resource limitations have to date precluded such sophisticated efforts in developing countries. (See Hufschmidt (1983), Chapter 5 "Analyzing Effects on Natural Systems and Receptors.")

3. The bias toward water and sanitation and against disposal may also have resulted from the United Nations International Drinking Water and Supply and Sanitation Decade, which set ambitious global goals for the extension of water and sanitation services in the 1980s. The resulting surge in installing water and sanitation systems far outpaced gains in wastewater treatment and disposal.

4. This is true even in industrial countries. For example, in 1980, Austria, Norway, Portugal, Belgium and Japan treated less than 50 percent of their sewage. Largely for this reasons, European rivers have as high a level of bacteriological contamination as any region in the world, but the high coliform counts there have less significance than for those in developing countries because virtually all municipal water supplies in Europe are treated and disinfected, which is not the case for large parts of the developing world. See Maybeck, Chapman and Helmer 1991.

5. Interview (February 29, 1992) with Robert Bisson, international liaison officer for GEMS water.

6. Interview with Eric Rondenburg, World Resources Institute, February 25, 1992.

7. BOD represents the biodegradability of the total organic matter dissolved or suspended. Sewage or other organic pollutants can lead to severe oxygen depletion with adverse impacts on aquatic life. The pH value is a measure of the acid-base equilibrium of water. The lower the number the more acid; pH of most natural water sources varies between 6.5 and 8.5, which is the suggested guideline for drinking water. Faecal coliforms are associated with the faeces of animals and humans. Water for human consumption should usually contain zero faecal coliforms per 100 milliliter sample. Over 100 faecal coliforms per 100 milliliter sample indicates highly polluted water. Drinking water should contain no more than .001 milligrams per liter of mercury and .05 milligrams per liter of lead.

8. SPM has been associated with the need for restricted activity for those susceptible and an increase in mortality. Lead in air has been shown to have a strong correlation with levels of lead in blood, and is associated with neurological damage *in children and heart disease and stroke in adult men. CO combines with hemoglobin in the blood and decreases its oxygen-carrying capacity. Higher levels can lead to brain injury and death, and even lower levels appear to increase the incidence of angina in persons with cardiovascular disease. SO_2 is associated with respiratory irritation, and threatens young children particularly and people with chronic respiratory problems. NO_x is associated with many health problems: increasing susceptibility to respiratory infection, exacerbating asthma and decreasing pulmonary functions, particularly in children. Ozone—the most widespread air pollution problem in areas with temperate climates—causes eye irritation, coughing and chest discomfort, headache, upper respiratory illness, increased asthma attacks and reduced pulmonary function, and affects even healthy adults significantly. Toxic air pollutants such as benzene, formaldehyde, cadmium, and diesel particulates are believed to be associated with lung cancer.*

9. People in rural areas pump crude oil, fell trees and mine coal to provide fuels for urban energy. These processes often damage large areas. The hillsides for many miles around Seoul are bare of trees, which have been used for heating. Transforming raw materials into fuel (refining oil, generating electricity from fossil fuels, and carbonizing wood into charcoal) also affects rural environments.

Chapter 2

Urban Environmental Quality Management in the World Bank Asia Region

Urbanization and industrial growth in Asia pose formidable environmental challenges. This chapter reviews World Bank efforts toward addressing them, focusing on strategies and actions taken since 1987 and on Bank environmental policy. Even prior to 1987, however, urban sector initiatives in Asia contributed to environmental improvement, and these activities are discussed to provide background to current efforts.

Urban Sector Initiatives Prior to 1987

Bank urban investment programs in Asia concentrated on environmental improvements virtually from the first stages of Bank involvement in the sector. As early as the 1960s, squalid informal settlements began springing up in and around Asian cities at a rapid pace. Crowded, and without decent water supply and basic sanitation, these settlements presented serious health hazards in the urban areas, and it soon became apparent that the typical government programs for addressing these problems were not working. Government slum removal and public housing schemes were expensive and highly subsidized and could at best reach no more than a small fraction of the areas in need.

Recognizing this, World Bank strategy in the 1970s focused on low-cost infrastructure improvements to address the most serious health hazards rather than on trying to build new housing for the poor.[1] The strategy was implemented through three types of programs. One was slum upgrading, where basic water supply, sanitation, drainage, and other infrastructure were installed in existing slums without altering the buildings. Another was a sites-and-services scheme, where new land was subdivided and provided to poor families with infrastructure but without housing. (Experience had shown that the poor could provide their own shelter, even if crude at first, and that they would enhance its quality over time.) The third were programs that made citywide improvements to water, sewerage and drainage systems. Emphasis on cost recovery in these programs increased as it became clear that limited government resources would necessitate dramatic reductions in services to each household if these approaches were to reach a large part of the burgeoning urban populations.

Some of the Bank's largest and most effective lending programs that followed this strategy were implemented in Asia, particularly in India and Indonesia. Probably the most successful was Indonesia's slum upgrading effort, the Kampung Improvement Programme, that had been implemented in over 200 cities by 1983 (*see* Cohen 1983a).

The Bank's overall assessment of the approach in the early 1980s, however, was mixed (*see* Cohen 1983b). These projects generally did what they were intended to do, were substantially more efficient than other more costly techniques, and were serving a much larger share of the urban poor than had been served in the past; but total numbers still were small in relation to the need. It had become clear that separate projects, no matter how effective, could never adequately address the problems of urbanization in Asia. Broad reforms of the local systems and institutions of Asian countries were needed to create the incentives and capacity necessary for cost-effective and sustainable urban development. This history and its conclusion remain highly relevant for the design of broader urban environmental quality management strategies today.

World Bank Support for the Environment

Several important actions in the late 1980s gave emphasis to environmental issues in Bank activities. A major step was the establishment during reorganization in 1987 of four environment divisions within each region's technical department. Two policies from this period also are important: first, that environmental strategies be prepared for all borrower countries and second, that environmental impact assessments be prepared for certain Bank projects.

Country Strategies and Action Plans

The Bank has long prepared economic development analyses and strategies to support policy dialogue with borrowers. The 1987 initiatives established a parallel track for environmental management. First, an analytic review for the country, an Environmental Overview Paper is prepared. Next, development of a Country Environmental Strategy Paper, is developed to establish broad environmental priorities given the country context. Finally, this strategy is expanded into a more definite and detailed National Environmental Action Plan (NEAP). In 1990, completion of an NEAP became a requirement for IDA support, and country departments are required to develop NEAPs with all borrowers by 1993.

Environmental Impact Assessments

The new policies are designed to make Bank investments more environmentally beneficial over time and to ensure in the short term that all Bank projects will at least be environmentally neutral. Guidelines have been developed for both individual projects and regional or sectoral loans. When a new individual project is identified, it must be screened and classified according to its probable environmental impacts. Projects classified as "A" have potentially harmful effects, and a full environmental assessment must be prepared and presented to the Board by the borrower prior to appraisal. Category B projects may have some negative environmental impacts but they are judged to be minor and a full assessment is not required. However, Bank staff are obligated to pay attention to any environmental problems that may arise and to address them effectively in further planning and implementation. Category C projects are considered environmentally neutral, and special assessments or mitigation measures are not required.

Regional and sectoral EA guidelines also were developed. Regional EAs may be used where a number of small similar projects are planned that might have significant cumulative impacts in a localized area. Sectoral EAs are similar but are designed for a specific type of lending: for reviewing alternatives in sector investment, assessing the effect of sector policy changes, and so forth. Either of these broader EAs may be used in financial intermediary lending where the exact nature of the sub-loans may not be known at the time of loan approval.

Requirements relating to environmental assessments were formally stated in Operational Directive 4.00, Annex A (October 1989). Guidelines for preparing EAs were later formulated in the Environmental Assessment Sourcebook (World Bank 1991b and 1991c). In October 1991, OD 4.00, Annex A, was revised and reissued as OD 4.01, which clarified the Bank's expectation for consultation with affected peoples and for public disclosure to them of the findings of the EA.

Other Bank-Wide Support for Environmental Management

Several other Bank-wide activities supporting environmental management can be useful to regions in developing environmental strategies.

THE URBAN MANAGEMENT PROGRAM. The Urban Management Program has run for nearly two years and is jointly sponsored by the United Nations Development Programme (UNDP), the U.N. Center for Human Settlements (UNCHS) and the Bank (Urban Management Program 1991). The Sector and Operations Policy Department represents the Bank in this activity and in a new element of the program, Urban Management and the Environment, established in 1990. Table 2.1 summarizes the first stage of the program. Three of the city case studies have resulted in environmental profiles—in Jakarta, Tianjin and the Singrauli region of India. The environmental profile of Jakarta, for example, includes useful data on both environmental quality and health and on the institutional framework for environmental quality management. An important component of the first stage of this program is the effort to develop a framework for understanding urban environmental problems. A second stage of the program is in preparation.

URBAN POLICY PAPER. A Bank policy paper on urban development (World Bank 1991a) gives substantial emphasis to urban environmental quality management. UEQM is identified as one of three major objectives of the urban agenda for the 1990s.

SERVICE LEVEL INDICATORS. Another effort of direct relevance to UEQM plans in the Asia region is the Service Level Indicators (SLI) project in the International Economics Department of PRE (Stevens and Cook 1991a and 1991b). SLIs estimate benefits from time streams of capital and operation and maintenance expenditures of specific projects or sets of projects. This methodology could be extremely useful in producing environmental assessments and developing UEQM strategies, as well as in conducting project appraisals.

THE GLOBAL ENVIRONMENT FACILITY (GEF). The GEF (established in 1990) is a new multi-donor supported facility administered by UNDP, the United Nations Environmental Improvement Programme (UNEP) and the

Table 2.1. Summary of activities: Urban Management Program, Urban Management and the Environment (INT/89/052)
(first stage)

Background Studies and Discussion Papers

- Alternative approaches to pollution control and waste management: regulatory and economic instruments.
- Priorities for urban waste management and pollution control in developing countries.
- Linkages between energy and the environment in the urban sector.
- Environmental issues in urban land management.

Research

- Health impacts of environmental problems in urban areas of developing countries.
- Economic valuation of environmental problems in urban areas.
- Urban environmental indicators.
- Satellite remote sensing and global information systems (GIS) analysis for urban applications.
- Small-scale and cottage industry wastes.

City Case Studies

- Environmental profiles of Accra, Ghana; Jakarta, Indonesia; Katowice, Poland; Sao Paulo, Brazil; the Singrauli Region, India; Tianjin, China.

Strategic Framework Papers

- Environmental strategies for cities.

Source: Urban Management Program 1991.

Bank. It focuses on: biodiversity, the marine environment and global warming. Although the GEF does not directly emphasize urban issues, research arising from it can be expected to have relevance. For example, a study on the reduction of vehicular emissions (for global warming issues) would be useful to urban planning. The GEF may also be able to fund some forms of environmental work in cities that cannot be justified by normal rate-of-return calculations. For example, a recent application by Surabaya, Indonesia, proposes GEF funding to support the development of air-powered trains and other technological innovations that require testing before potential rates of return can be reliably assessed.

Asia Region Performance

The Asia Region has devoted considerable effort to helping formulate Bank guidelines on the environment. Two of the main requirements coming out of this recent Bank policy, the preparation of country strategies and environmental assessments, are reviewed below.

The Asia Region has also made notable innovations in the urban sector. Urban and industrial activity in Asia since 1987 shows increasing attention being paid to environmental management. In addition, a series of recent projects focusing on the environment in cities have made important contri-butions to UEQM issues and hold promise for future strategies.

Country Strategies

Environmental orientation papers have been prepared for all borrower countries in Asia. A number of detailed assessments (most focusing on specific environmental subsectors) also have been prepared as a basis for further strategy formulation.

Strategy documents and NEAPs, developed in collaboration with borrower governments, are now either completed or in preparation for most Asian countries. NEAP preparation is under way in sixteen countries (only Cambodia, Myanmar and Afghanistan are not yet included).[2] Some countries (for example, Sri Lanka and China) have devoted considerable attention to this planning process and the results have featured prominently in policy dialogues with the Bank.

A review of NEAPs in process reveals their sectoral focus. Where the Bank has already been working in a sector within a country, a knowledge base has been established and points of leverage identified. The strategies make use of this experience by emphasizing areas that are already focal points for Bank-borrower dialogue; for example, tropical rain forests and rural development in Indonesia and forestry and fisheries in the Philippines. In this way, a long-term agenda toward environmental management can be built on the successful short-term experience.

Nonetheless, broader analysis and prioritization across sectors should be attempted. This is particularly important for the urban sector. Only the NEAPs for China and India, and to a limited extent Sri Lanka, place emphasis on the environmental effects of rapid urbanization. The strategy for China, in fact, is based on the approach recommended in the Beijing project (discussed later in this chapter).

Environmental Assessments

Table 2.2 lists Bank projects in the Asia Region that have been classified as Category A and for which full environmental assessments have either been completed or are in process, as of November 1991. Of the forty-three listed, very few are urban sector projects, as most Bank urban sector work has been considered either environmentally beneficial or benign. Only major urban projects with environmental implications have required EAs (for example, the Bombay Sewage Disposal project or the large-scale port improvements and major power generation facilities in several countries).

However, urban infrastructure projects in the Asia Region that are classed as Category B also receive environmental assessment. In the East Java-Bali urban project, for example (see further discussion below), local governments

Table 2.2. Project environmental assessments, Asia Region
(Category A in preparation or completed, November 1991)

BANGLADESH — Jamuna Bridge (4BANPA176)

CHINA — Tarim Basin Irrigation (4CHAPA150); Xiaolangdi Multipurpose (4CHAPA156); Daguangba-Hainan (4CHAPA083); Zouxian Thermal Power Station (4CHAPA096); Yanshi Thermal (4CHAPA098); Ertan Hydro (4CHAPA099); Shikou II (4CHAPA120); Gungdong Phosphate (4CHAPA142); Cement Sector Study (4CHAPA171); Shanxi Coal Conservation and Environment (4CHAPA219); National Highway (4CHAPA097); Shanghai Port II (4CHAPA105); Guangdong Provincial Transport (4CHAPA112); Zhejiang Provincial Transport (4CHAPA128); Shanghai Metro Transport (4CHAPA159); Shanghai MTP II (4CHAPA216); Fujian Provincial Transport (4CHAPA220).

INDIA — Subernarekha, Orissa (4INDPA295); Subern II, Bihar (4INDPA427); Bombay Sewage Disposal (4INDPA441); Bihar Power Project (4INDPA390); Renewal Energy Development (4INDPA449).

INDONESIA — Transmigration, 2nd Stage Development (4INSPA177); Integrated Swamps (4INSPA238); Watershed Conservation and Management (4INSPA286); Outer Islands Power (4INSPA211); Surabaya Thermal Power (4INSPA217); Semarang and Surakarta Urban Development (4INSPA189).

KOREA — Gas System Expansion Project (4KORPA162); Solid Waste (4KORPA120).

MALAYSIA — Power System Development (4MAYPA089); Port Kelang II (4MAYPA116).

MYANMAR — Tank Irrigation II (4BUAP041)

NEPAL — Hydro Power (Arun) (4NEPPA076)

PHILIPPINES — Casecnan Transbasin (4PHLPA175); Leyte Geothermal (4PHLPA179).

THAILAND — Third Power System (4THLPA102); Bangkok Gas Transmission Project (4THLPA118); MAE L-B Water Diversion (4THLPA146).

(sub-borrowers) are required to submit environmental assessments to the central or provincial governments as part of their application for financial support for their proposed capital improvement plans.

Asia Urban and Industrial Project Activity and the Environment

A recent review examined characteristics of all Bank Asia Region projects with loans becoming effective in fiscal years 1987 through 1991 plus those in the planning pipeline for 1992 through 1994, in three categories: (1) urban infrastructure projects (other than transport); (2) urban transport projects (excludes projects dealing with inter-city highways and railroads); and (3) industrial projects (includes all such projects, most of which are located within urban areas). The review found the following distribution:

- Urban Infrastructure Projects.
  1987-1991: 32 projects with a total project cost of $7.1 billion ($1.4 billion per year).
  1992-9494: 30 projects.[3]

- Urban Transport Projects.
  1987-1991: 13 projects with a total project cost of $3.0 billion ($0.6 billion per year).
  1992-1994: 5 projects.

- Industrial Projects.
  1987-1991: 28 projects with a total project cost of $10.9 billion ($2.2 billion per year).
  1992-1994: 7 projects.

For the 1987-1991 infrastructure and transports projects, the review further classified project subcomponents as to whether they either contributed directly to the betterment of environmental and health conditions (for example, sewerage and other sanitation, flood control, solid waste management, slum upgrading) or were environmentally neutral (for example, road building). It found that 53 percent of the costs of the infrastructure projects, and 23 percent of the costs for the transport projects, could be classified as directly beneficial to the environment or human health.

More important, the analysis showed a trend, particularly in the past two years, toward the inclusion of explicit environmental management components in project plans, including most sectors in the regular project pipeline (for example, industry, transportation and power). These efforts range from transportation projects that make the reduction of emissions a major project objective to energy projects in several countries that focus on energy conservation.

In addition, there is increasing emphasis in project funding toward institutional strengthening and support to make environmental strategies work. Relevant activities include the establishment of pollution control boards, river basin management authorities, and land use-planning agencies; training for monitoring and enforcement; and assessments, extension services and research.

The Metropolitan Environmental Improvement Program (MEIP)

Purpose and Overview

UNDP and the World Bank established MEIP in 1989 to help Asian cities tackle their rapidly growing environmental problems. The program is funded by UNDP and executed by the World Bank. In 1990, the MEIP central office was organized at the World Bank and five national governments endorsed the program (China, India, Indonesia, the Philippines and Sri Lanka). Work programs began in five cities: Beijing, Bombay, Jakarta, Metro Manila and Colombo.

MEIP also emphasizes the sharing of environmental management experiences among Asian cities through research on topics of common interest and regional workshops. A workshop in Hawaii in 1990 helped establish the framework of the MEIP program in each participating city. Discussion among city delegations at this meeting outlined the initial MEIP city work programs. In turn, the city work programs led to intercountry research on the institutional and community requirements for environmental management.

A workshop in Beijing (October 1991) examined the status of each city work program, shared reports on case studies and demonstration projects, and laid the groundwork for development of multi-city initiatives such as air quality monitoring and community-based solid waste efforts. A workshop is planned in Colombo (December 1992) on environmental management strategy (EMS) outputs, city and intercity work program development, and intercountry research findings.

Organization

Because environmental problems are connected and cross many sectors, MEIP has attempted to address environmental deterioration resulting from these links, especially between industrial and urban development. City regions are viewed as spatial systems in which development planning, programs and monitoring must focus on impacts across the natural resource base of air, water and land.

A Steering Committee guides MEIP work in each city region. These committees consist of representatives from government agencies concerned with the environment, sectoral development, intergovernmental affairs, economics, land use and urban planning. Working groups oversee the technical aspects of specific MEIP activities, and a National Program Coordinator (a local environmental professional) coordinates these functions.

MEIP focuses on the development of an EMS for each city region, built on analysis of the costs of environmental degradation and the benefits of cleanup. The EMS then is used to develop sectoral action plans and investment programs. MEIP helps carry out these plans by strengthening the capacity of pollution control and environmental protection agencies, which are often new, to work with powerful economic planning and sectoral agencies at the local and national levels.

The connection of the MEIP central office to the World Bank lending program encourages action on high-priority pollution problems. Often, MEIP can help develop an EMS and feasibility studies for pollution abatement investments through Bank environmental, urban and industrial projects. MEIP central office staff also help design and supervise the parts of Bank projects that carry out MEIP activities.

NGOs, industry and academic institutions participate in MEIP working groups and on some steering committees. The National Program Coordinator also tries to build a network of government officials, advocacy organizations, private sector representatives, the media and community groups, to work together on studies, demonstration projects and workshops.

MEIP's regional strategy in general seeks to address the concentrations of industry and population in large metropolitan areas, but variations among the city regions require different emphases and have produced many models and initiatives. The economic, institutional and socio-cultural settings of the five MEIP cities shape the specific response.

- Beijing has a well-established institutional structure for environmental protection with widespread monitoring and numerous professionals at the national and local level. Through the Beijing Environmental Project, MEIP builds on these strengths by assisting Chinese counterparts and Bank task managers to develop an environmental master plan. The master plan strengthens economic and technical analysis and defines a strategy for energy generation, municipal and liquid waste management, industrial restructuring and land use planning.

- In Colombo, the MEIP steering committee became the National Environment Committee. Located in the lead cabinet ministry, the Ministry of Policy, Planning and Implementation, it coordinates international donor initiatives in urban and industrial management. The strategic location of the committee helps inject environmental criteria into national plans for rapid industrialization.

- Bombay industry must expand and modernize while dealing with massive pollution that affects residential areas. MEIP-Bombay focuses on environmental management and waste collection and treatment in the Chembur and Thane-Belapur industrial areas.

- MEIP Metro-Manila is preparing an EMS based on a study by ADB. Institutional strengthening and industrial waste abatement is also promoted through an Industrial Efficiency and Pollution Control Project. At the community level, MEIP Metro-Manila contributes to developing a demonstration project on solid waste recovery and a program for community management of public sanitation facilities.

- In Jakarta, the Jabotabek Urban Development Project III provides the framework for many MEIP efforts, including support for joint wastewater treatment, institutional strengthening of provincial pollution control authorities, environmental improvement in low-income settlements, and community composting and recycling enterprises.

In these ways, an active Steering Committee working with the National Program Coordinator has laid the foundation for development of comprehensive programs. MEIP can thus work toward long-term goals through immediate actions and build environmental networks in each city linking the highest levels of government, the private sector, NGOs and low-income communities. This broad participation is time consuming, but the consensus building has resulted in a high degree of support and sense of ownership of MEIP efforts in the participating cities.

Regional Air Quality Project

An activity within MEIP that deserves special mention is a proposal to establish "Asian Urban Air Quality Strategy and Action Plans." This project is patterned on that being used in the Beijing Environmental Project. It will analyze all major sources of gaseous discharges (vehicles, industrial operations, energy production facilities, space heating, residential cooking and non-point sources of particulates) in a number of cities throughout the region, to determine the least-cost strategy to achieve various levels of ambient air quality. Alternative strategies and their costs and consequences will be developed.

Ganga Action Program (GAP)

The Ganga River extends 2,525 kilometers from the Himalayas into the Bay of Bengal. About 37 percent of India's population (242 million) live in the Ganga basin. Roughly 100 cities with a combined population of 15 million discharge liquid and solid waste into the river, usually with no prior treatment. The consequences include: (a) pollution of the river water beyond the river's regenerative capacity, and therefore of the water used in cities along the Ganga; (b) contamination of vegetables and infection of farmworkers from untreated sewage dumped onto farmland; and (c) severe risk to the millions of pilgrims who visit the Ganga and bathe in its waters.

The Government of India established the Central Ganga Authority in 1985 to develop a plan for preventing pollution, in tandem with efforts of the state of Uttar Pradesh. The Central Ganga Authority is chaired by the prime minister of India, and the Ganga Project Directorate, which is responsible for the implementation of the plan, is well-managed and headed by a senior civil servant.

The GAP applies a least-cost calculus to a number of key issues in water quality. A fundamental one is the balance between standards, costs and coverage. A model is used to calculate the degree of pollution the river can accommodate at various points and to incorporate this information into effluent standards. In general, the GAP focuses on primary treatment on a very large scale as more cost effective than small-scale secondary and tertiary treatment.

The various sewage treatment alternatives also must be examined and chosen. The choice is influenced not only by technical characteristics but also by the availability of land in the cities where plants are to be located (Allahabad, Haridwar and Kanpur). There is a large demand for sewage to fertilize farmland, and the GAP expects substantial recovery of operation and maintenance costs from this market. Finally, cost-effective programs require that adequate data be available promptly to decisionmakers.

The Ganga Component of the Bank's Uttar Pradesh Urban Development Project supports GAP through providing consultant services and training, pollution monitoring and maintenance equipment, and priority pollution control works. The Bank's investment of $48.5 million is for sewage treatment facilities (land, civil works and design), river monitoring and sewer cleaning equipment, and technical assistance and training.

Asia Region Projects Focused on Individual Cities

As has been discussed, World Bank investment for urban environmental management is fairly recent. Three of these early Bank projects that have incorporated environmental considerations from the first are noteworthy and are presented here.

Beijing Environmental Project

One of the best examples of a multi-sectoral strategy focused on the environment is the Beijing Environmental Project (Environment, Human Resources and Urban Development Operations Division 1991a). When Beijing municipal authorities approached the World Bank with several proposed investments related to the urban environment, they had little information on alternatives and costs, and some of the investments called for exotic and expensive technologies, while neglecting simpler, less costly options. There was also no planning or study component. The need for a strategy to make informed investment decisions led to a two-pronged project: a program of investments and a program of studies to integrate environmental management into the municipal planning process. The World Bank funds nearly half of the total project cost of $304.5 million, with local counterpart sources supplying the remainder.

The investment component, over 95 percent of total project cost, supports public works, including sewage and wastewater treatment, solid waste collection and disposal, heating and industrial pollution control, and hazardous waste infrastructure.

The study component, the "Beijing Environmental Master Plan Studies," has five objectives. Foremost is producing an integrated plan for air and water quality, and urban refuse management in Beijing until the year 2015. The plan will cover the entire geographic area of Beijing including eight urban districts, two suburban districts and eight rural counties. The studies also seek to modify sector plans to reflect the new integrated plan, mesh environmental analysis with Beijing's planning process, and train a local group of experts in environmental quality management.

The Beijing Municipal Planning Commission has the lead role in performing the study and applying its recommendations. Three teams—in air quality, water quality and urban refuse management—do the major work of the study:

- Set environmental targets.

- Work with and coordinate various ministries, commissions and other bureaus to develop plans.

- Prepare management plans for air quality, water quality and urban refuse management.

- Prepare management strategies to meet targets. Identify least-cost strategies for achieving environmental targets.

- Assess the economic, financial and institutional feasibility of the least-cost strategies.

- Develop regulations, enforcement procedures, economic and financial incentives, and administrative procedures for implementing the strategies.

- Redesign plans in other sectors to mesh with the least-cost strategies.

The study component of the Beijing Environmental Project represents a new approach to managing the urban environment, both for China and for the Bank. Previously, Chinese municipal authorities had planned only in short-term increments, usually of five years corresponding with the five-year period of national plans. This study extends the planning horizon nearly twenty-five years, to 2015.

A more fundamental difference is the introduction of least-cost analyses to urban environmental management in each of the key sectors—air quality, water quality and urban refuse management. Previously, Beijing authorities had selected investments without a framework for comparing costs or results with other alternatives.

For the Bank also the study represents a new approach in focusing on environmental issues even before individual investments are decided. The Beijing Environmental Project is the first environmental project of the Bank in Asia, but the approach will also be applied to other areas, including Changzhou, Liaoning, Shanghai, Shanxi and Tianjin.

The Beijing Environmental Project has importance for UEQM for three reasons. First, it balances environmental management across sectors, thus incorporating UEQM into the local planning process. Second, it develops least-cost strategies for comparing the cost and results of different sets of solutions or management strategies for environmental problems. Third, it recognizes that environmental studies have meaning only for a particular urban area or region and that the metropolitan region is the appropriate unit of analysis for UEQM rather than the nation. Because environmental determinants and action opportunities of various urban areas will differ, so should environmental management priorities. The Bank's Urban Policy Paper therefore calls for city-specific strategies for environmental management; the task cannot be accomplished meaningfully at the level of a national plan.

The China Environmental Strategy Paper has contributed to and borrowed from the Beijing approach. It provides an overview of: (a) the environmental problems facing various regions of a country, and their relative importance; (b) the institutional structure and capability for UEQM; (c) the existing pollution control strategy, including regulations, environmental assessments, permits and economic incentives; and (d) a possible multi-year Bank program of financial assistance for environmental projects.

The multi-year lending program would consist of environmental sector studies, technical assistance to UEQM institutions, and lending for specific projects to improve environmental quality. The environmental strategy paper identifies specific measures for strengthening institutions at all levels of government and expanding the effectiveness of the pollution control strategy.

Jabotabek Urban Development Project III

The Jabotabek Urban Development Project (JUDP) III builds on two other efforts by Government of Indonesia that have great importance for the environment: the Jakarta Metropolitan Development Plan (JMDP) and the Kampung Improvement Program (KIP).

Previous to the JMDP, Jakarta had expanded south into aquifer recharge areas and north into environmentally sensitive wetlands and poor soils. The Plan sought to re-orient growth along an east–west axis and had mixed success in achieving these goals. The plan emphasized water supply, sanitation, kampung (shanty town) improvement and flood protection. Population growth and failure to update this plan have now made JMDP outdated.

The Kampung Improvement Program is the main community infrastructure program in urban Indonesia. DKI Jakarta began KIP in 1969 because national sectoral agencies had failed to provide services to dense, low-income areas with serious environmental problems. KIP now emphasizes community participation and social development in providing and maintaining infrastructure in low-income communities. Two five-year national plans (Repelita III and IV) spread KIP to more than 800 towns and cities, benefitting roughly six million people. Despite its great popularity, the pace of KIP, too, has slackened since 1982.

JUDP III seeks to reinvigorate KIP, update JMDP and incorporate more environmental concerns into the planning process. A number of national and local governments jointly designed the program: Cipta Karya (Directorate of Human Settlements, Ministry of Public

Works), the provinces of DKI Jakarta and West Java, and the local governments of Bogor, Tangerang and Bekasi. The major components are kampung improvement, solid waste management, environmental protection and pollution control.

KAMPUNG IMPROVEMENT. Ninety-five districts in the Jakarta region, covering 40 percent of all existing and recently settled low-income kampungs requiring upgrading, will receive support under the KIP component. The project provides basic infrastructure including water supply, drainage, sanitation, collection of household refuse, and access roads and footpaths. Building on the experience of the earlier KIP, JUDP III uses a community-based approach, working with local organizations to construct and maintain physical investments. In addition to financing infrastructure, the KIP component supports health education (women's health, in particular), strengthened land tenure, small-scale credit, small-business management and training, and literacy programs.

Funding under JUDP III for physical infrastructure is roughly the same as that of KIP before 1982. At $74.8 million, the KIP component represents about 75 percent of total project cost.

SOLID WASTE MANAGEMENT. This component supports improvements in collection of wastes and cleanup of dump sites in eighty-three districts, covering about 70 percent of the population in these areas. Neighborhoods have previously dumped much of their waste in informal or temporary dumpsites, drains, canals, and open or vacant land, causing serious health problems. Under the JUDP III system, neighborhood supervisors organize collection of garbage with handcarts. The waste management component finances: containers, container-sites and vehicles for secondary collection; cleanup of informal dumps; closing down unsuitable existing landfills; and recovery of waste material through sorting of residential waste at the household level, training of scavengers, and assistance to small-scale industries using salvaged materials. Thus, the KIP and solid waste management components of JUDP III deal with the greatest environmental problems of kampung residents—contaminated water and inadequate sanitation.

ENVIRONMENTAL PROTECTION. The Environmental Protection and Pollution Control component seeks to renew environmental planning efforts. It funds (a) training, institutional strengthening and equipment for provincial agencies involved in monitoring ambient water and air quality and waste discharges; (b) development of a natural resources inventory and formulation of a pollution reduction strategy for the Jakarta area; and (c) environmental feasibility studies, including industrial waste treatment and pollution control for small-scale industries.

POLLUTION CONTROL. The fourth major component, Urban Spatial Management and Monitoring, takes up where JMDP left off. It will update JMDP, establish a development monitoring system, expand existing base maps for environmental, physical and fiscal planning, and fund studies of fringe areas.

JUDP III exemplifies the importance of linkages between infrastructure provision and environmental quality, placing even greater emphasis on the environment than either of its predecessors, JUDP I and II. JUDP IV, which is in preparation, continues this emphasis, with a focus on air quality.

East Java and Bali Urban Development Project

In this project, the World Bank lends funds via the Government of Indonesia to forty-five local governments in East Java and Bali. The bulk of these funds are invested in small urban infrastructure "sub-projects," such as equipment for water supply, urban roads, kampung improvement, public markets, solid waste management, and drainage and sanitation. Capital grants complement loan funds as needed. Local governments must qualify financially to borrow, and sub-projects must meet financial, economic and engineering criteria.

The project innovates in applying the cooperative effort of two Indonesian planning programs—Integrated Urban Infrastructure Development Program (IUIDP) and Indonesia's environmental assessment process (AMDAL) —to urban infrastructure.

IUIDP is a framework for improving government programs in urban infrastructure by shifting relevant responsibilities from the national to the local level. IUIDP was originally designed in 1984 to link many aspects of kampung improvement and determine the financial capacity of local governments to share project costs and assume debt. From the beginning, IUIDP has been an efficient vehicle for dispensing donor funds to urban issues.

Now, IUIDP also deals with broader issues, including the strength of local governments, the division of responsibilities between levels of government (local, provincial and national) in urban infrastructure, and the training of local government officials. Under IUIDP, local governments are responsible for preparing the initial environmental assessment of their sub-projects. Financing plans also must be drawn up for the capital programs that are developed, thus helping local governments address resource constraints. Provinces then provide technical support to local governments, and appraise and help prioritize the subprojects.

As established by law in 1986, the AMDAL defines which activities require environmental assessment, makes project approvals contingent on approval of environmental management and monitoring plans, and directs ministers and provincial governors to establish an environmental review commission in their ministry or province. Under AMDAL, the provincial governor has authority over local environmental management and review. Until the East Java–Bali project, Government of Indonesia had applied AMDAL only to large infrastructure projects, never to small urban investments.

The East Java–Bali project coordinates the work of IUIDP and AMDAL in infrastructure, program management and institutional development components. The total investment of the project is $340.2 million, with nearly half from the Bank and the remainder from local counterpart funding and a Japanese grant of $4.2 million. The infrastructure component (94 percent of total projects costs) supports forty-five participating local governments in completing five-year infrastructure programs. The program management component funds central, provincial and local governments to administer the program and help local governments with sub-projects. The institutional development component supports national efforts to strengthen local governments in East Java and Bali, including training in the AMDAL and IUIDP process, and preparation of future projects. Two powerful committees, an inter-ministerial coordinating team (TKPP) and the ministry of planning (BAPPENAS), play key roles.

The East Java–Bali project is one of the first decentralized urban development projects to fuse environmental concerns into sub-project preparation from the beginning. In the past, these projects have specified financial, engineering and economic criteria, but rarely explicit environmental criteria, to prepare and evaluate roads, sewers and other small civil works. In the East Java–Bali project, local governments must use these environmental criteria in preparing sub-projects, and municipal credit intermediaries at the state or national level must appraise them in on-lending for the sub-projects. To this end, the project supports environmental screening of investment programs; preparation of environmental assessments under the AMDAL process, primarily by local governments; review of these assessments by the Regional Environment commission; and appraisal of mitigation measures recommended by provincial appraisal teams.

Some of these procedures have already spread. The ministry of Public Works has begun to use similar environmental screening procedures elsewhere in Indonesia.

The model of the East Java–Bali project is similar to that for Beijing: city-specific assessment and priority setting across sectors and the recognition of real resource constraints. But it goes farther by linking UEQM to an established planning, budgeting and implementation process directly involving key decisionmakers, rather than setting it up as a separate (and therefore less forceful) process.

Projects with Regional Impact

While urban areas may be increasingly the focal points of human activity in Asia, each city exists within, and has strong interactions with, its surrounding region. The following project examines this regional context comprehensively (across sectors), looks specifically at region-city linkages, and uses this information to formulate strategies.

Singrauli Development and Environmental Strategy Study

Most urban environmental initiatives try to solve problems after they reach a crisis stage. The Singrauli study seeks to halt the environmental decline of a key region before it becomes so heavily urbanized that severe environmental problems emerge.

The Singrauli region, which straddles the boundary between Uttar Pradesh and Madhya Pradesh, contains the largest coal deposits in India and has key economic importance for the country. The availability of water from a large lake, Rihand Lake, and the abundance of power-grade coal have stimulated super-thermal power plants and other industries. These industries, in turn, have attracted many migrants. The population of the area increased from 234,000 in 1971 to 696,000 in 1991, and is projected at 1.4 million by 2001 if industrial investments continue at the current pace. These migrants live largely in rapidly growing company towns around the lake, while the original residents, including 100,000–200,000 people displaced by the reservoir that created the lake, live in 400 villages.

The area lacks an effective system of government. The power plant companies provide infrastructure in their towns; villagers largely do without. The perception that migrants have benefitted from development while the original residents have not has led to rising social tensions between these groups. Overall, the provision of basic services such as safe water, is highly fragmented.

This rapid urbanization and industrialization has led to a variety of environmental problems: deforestation of rural areas, pollution of Lake Rihand and air pollution from emissions of power, cement and aluminum plants, and dust from mining operations. Providing basic services, such as safe water, to the rapidly growing urban population and rural villages is difficult and is exacerbated by the lack of effective government in the region.

The World Bank has participated in twelve of thirteen studies on the environment and development in the Singrauli region. These include five environmental studies of point sources of pollution, such as coal mines and power plants, a study on resettlement, an environmental profile of the Singrauli region, and a \$4.5 million study on specific environmental problems in the area, sponsored by Electricite de France. These studies have concluded that environmental problems have not yet reached a critical level, but will if uncontrolled development continues. Given the crucial economic significance of this area, preventing its further environmental decline takes on special importance.

The World Bank and the Ministry of Urban Development are preparing a framework for Bank and government action in the Singrauli region—the Development and Environmental Strategy for the Singrauli Region. The study would analyze infrastructure and services needs, develop high priority infrastructure and service projects, and assess how to strengthen local institutions and government. Many groups of the region will be involved in the process—power companies, coal mining companies, NGOs and local communities. The Bank would execute this study for the Ministry of Urban Development. Financing in the amount of $945,000 would come largely from the Overseas Development administration of the United Kingdom.

Sector Projects and Studies

In this final discussion are projects or studies that operate within the confines of a single sector, but also have important consequences for environmental quality in urban areas.

Environmental Impact Management Agency of Indonesia (BAPEDAL)

Indonesia has had a legal framework for sustainable development and environmental protection for many years, but recently, government has developed procedures for putting these principles into practice. In early 1989, Indonesia requested World Bank support for a new national agency for environmental pollution control, the Environmental Impact Management Agency. A general mandate for pollution control and oversight of the AMDAL process was established, but it did not resolve completely the scattered and overlapping jurisdictions for pollution monitoring and control.

Thus, BAPEDAL's mission remains somewhat unclear. Some want it to become the core of an environmental protection agency for Indonesia; others favor a smaller role. A rough consensus is that the agency should have sufficient power to make progress, within two or three years, in its two immediate tasks—pollution control and administration of the AMDAL process.

Japanese and Canadian funds are supporting the development of a five-year environmental program by a team of consultants and BAPEDAL staff. The Bank is processing a technical support loan of $15 million for BAPEDAL, but more donor support depends largely on the outcome of the initial programs.

Government of Indonesia views BAPEDAL as a complement to key local projects; thus, its promise is best appreciated in a project context such as that of the East Java–Bali Urban Development Project. For example, a provincial BAPEDALDA could assume responsibility for appraising sub-projects, presently a task of a provincial committee. In time, a provincial BAPEDALDA could also develop environmental management plans and strengthen local governments. It could provide further services necessary to UEQM, such as issuance of environmental permits and regulation of discharges, that could not be assumed by projects.

The creation of BAPEDAL shows the importance of environmental issues to Government of Indonesia and demonstrates that Indonesia recognizes the need to build institutional capacity if the tide of environmental degradation is to be stemmed and reversed.

India Industrial Pollution Control Project

Since the early 1970s, India has passed laws for environmental regulation, including the Water Act of 1974, the Air Act of 1981 (amended in 1987), and the Environment Act of 1986. The government has also initiated incentives to promote control of industrial sources of pollution, including fiscal measures (such as accelerated depreciation, direct subsidies and tax exemptions), pollution charges, and enforcement provisions (including the shutting down of offending plants).

Unfortunately, pollution from industrial and urban growth has outstripped much of the gain from these controls. Industrial pollution, in particular, causes serious problems, especially from small plants that have difficulty affording the pollution control measures now common in large plants. Chemical and related industries are among the worst industrial polluters. These industries include dye, leather tanning, pharmaceutical, pesticide and insecticide, pulp and paper, sugar and distilleries, fertilizer, and petrochemical plants.

The Industrial Pollution Control Project (Industry and Finance Division 1991) is the first loan by the World Bank to India dedicated to the environment. This pioneer project defines broad action to reduce industrial pollution and integrate enforcement of legislation, financial assistance to industries (particularly small industries) for complying with regulations, and support of research on mitigation measures. The project focuses on chemical and related industries in four Indian states: Gujarat, Maharashtra, Tamil Nadu and Uttar Pradesh. The first three states contain the bulk of the chemical and related industries in India, while the fourth is larger and more urbanized with a large number of small and medium-size industrial plants.

The project has institutional, investment and technical assistance components. The institutional component seeks to strengthen the State Pollution Control Boards through technical training in pollutant monitoring and laboratory management, and provision of laboratory facilities and monitoring, laboratory and other supplies. The investment component, over 90 percent of total project funding, finances (a) the design and construction of central treatment facilities for waste from industrial estates; (b) waste minimization and pollution abatement plans at individual plants; and (c) sub-projects that demonstrate innovative techniques in waste minimization, resource recovery and pollution abatement. The technical assistance component funds pre-investment studies of sub-projects and research and development on environmental issues.

Three aspects of this project design make it a pioneer effort. First, it achieves economies of scale by funding joint facilities at industrial estates for many small and medium-size plants; collective materials recovery and processing; and treating wastes from one activity to produce inputs for another activity. Second, it provides a basis for analyzing and addressing the interactions between different residuals. For instance, reducing one type of residual often adds to another; this project looks for the least damaging mix. Third, the project uses market mechanisms (for example, pricing of water, energy and wood) to affect which industrial technologies and raw materials are selected, in order to minimize environmental damage.

Thailand Highway Sector Project

Bangkok has some of the worst air pollution in Asia and vehicular pollution is so bad that pedestrians can feel variations between different streets. High levels of lead in the tissues of Bangkok residents also can be traced to this pollution. The numbers of all kinds of vehicles are growing rapidly in Bangkok, including those that produce most of the particulate emissions—two-stroke motorcycles and three-wheel taxis and diesel trucks.

The Bank's Fourth Highway Sector Project and an action plan by the Royal Thai Government will address these and other highway pollution problems. The Office of the National Environment Board will expand its network of monitoring sites to include 15–20 roadside stations in and around Bangkok and in a number of other cities. Four new automated signs have been set up to display ambient pollutant concentrations to the public.

The Thai Institute of Standards is drafting emissions standards, which will start at Economic Commission for Europe (ECE) levels, and increase. Laboratories to measure emissions from gasoline vehicles will be set up by the end of 1992. A facility for testing diesel engines and motorcycles is scheduled for completion in 1993. Unleaded fuel was introduced in Bangkok in May 1991 and is scheduled to become available nationwide by June 1992. Regulations have reduced lead concentrations in gasoline to 0.4 grams per liter in 1990 and to .15 grams per liter on January 1, 1992, equal to the present ECE standards but considerably below those of the United States. The Petroleum Authority of Thailand is increasing imports of low-sulfur diesel and "light" diesel fuel, although current Thai standards allow 2–3 times the sulfur content of most developed countries.

The Bangkok Metropolitan Transit Authority has commissioned a bus fueled by compressed natural gas and plans a demonstration project to operate a fleet of 200 such buses; if successful, the fleet will expand to 3,000. The Land Transport Department plans to expand its program of emission checks on buses and commercial trucks to all vehicles by licensing a network of private-sector inspection facilities. The municipality will install an area traffic control system for Bangkok at 143 intersections by the end of 1993, and at an additional 92 intersections later.

This concerted effort to reduce emissions, however, has revealed some of the difficulties of vehicle pollution control programs in developing countries: diffuse and multiple authority, low technical capacity and little data. Thirty-four agencies have some role in air pollution control in Thailand. Effective strategies will need to provide greater authority to a small number.

Transportation and Energy Studies and Projects

Multi-country studies in the transport sector include the vehicle transportation studies by Faiz (1990), Walsh (1991), Imran and Barnes (1990), and projects of the International Institute of Energy Conservation (IIEC).

Faiz evaluated the impact of various types of motor vehicles on air pollution in developing countries, and concluded that "if unchecked, these trends could lead to severe air pollution problems... comparable to [that] presently observed in Mexico City." The study presents impressive evidence useful for planning Bank investments in urban management.

Walsh provides background for the Bank's *Urban Transport in Asia Strategy*, which is currently under preparation. This study surveys current knowledge about transportation-related environmental problems in Asian cities, identifies actions under way or planned to address these problems, and charts future trends. The study concludes that although Asia is a minor source of vehicle emissions globally, these pollutants cause severe damage to the environment and human health in Asian cities.

Imran and Barnes developed models for energy use in eight developing countries (Brazil and seven countries in Asia). They find that, as could be expected, increased use of motor vehicles and urbanization are the main factors in rising energy consumption, nevertheless their study is useful for projecting future environmental problems resulting from energy use.

The IIEC was established in 1984 to help developing countries improve their energy use. The organization works with the Bank, the U.S. Agency for International Development (USAID), the Canadian International Development Agency (CIDA), the U.S. Department of Energy, the U.S. EPA, and the private sector. IIEC has a regional office in Bangkok and is establishing offices in other developing country regions. It disseminates information, advises governments on energy policy, and collaborates with the private sector.

One of IIEC's projects focuses on the environmental consequences of energy use in Asia. "Assessment of Transportation Growth in Asia and its Effects on Energy Consumption, the Environment, and Traffic Congestion" has two phases. In the first phase, the transportation systems in four Asian cities—Bangkok, Islamabad, Surabaya and Varanasi—are examined. The study attempts to identify conditions causing transportation problems and to propose strategies for improving energy efficiency. IIEC plans to finish these four studies, analyze policy options, and publish a report by early 1993. The World Bank has partially funded the studies of Surabaya and Bangkok, and in Surabaya has incorporated many of the findings into prefeasibility studies for projects and proposals to the government. The second phase includes a regional conference of countries and donors to develop an agenda for actions needed.

In addition, IIEC's office in Bangkok works closely with the Thai government to apply demand-side management for Bangkok's utilities. Currently, IIEC-Bangkok provides technical assistance to these utilities to analyze the environmental impacts of energy use in order to manage energy demand more efficiently and sustainably.

Notes

1. This basic approach was probably first advocated in the Ford Foundation-supported planning effort for metropolitan Calcutta in the mid-1960s (Calcutta Metropolitan Planning Organization 1966).

2. The countries are Bangladesh, Bhutan, China, India, Indonesia, Republic of Korea, Lao People's Democratic Republic, Malaysia, Mongolia, Nepal, the Pacific island nations, Pakistan, Philippines, Sri Lanka, Thailand, and Viet Nam.

3. The analysis also found some decline in total activity levels in the infrastructure category, 1987-1991. This reflects the temporary declines that occurred after the 1987 reorganization in which separate urban departments were abolished. Pipelines are now being built up again.

Chapter 3

Building Institutional Capacity in UEQM

Chapter 2 showed that the Asia Region of the World Bank has taken important steps to address environmental degradation in Asia's cities by supporting investments in basic infrastructure systems (primarily safe water supply and sanitation), and by giving priority to environmental impacts in its project planning and policy dialogues. This chapter seeks to identify the most vital features of institutional support for UEQM in order to suggest how they can be built in various urban areas and countries.

The Bank's Policy Paper on urban development, which identifies the environment as one of the three main urban agenda items for the 1990s, urges five types of actions: (1) increase awareness of the urban environmental crisis; (2) develop an information base on urban environmental deterioration; (3) develop city-specific strategies for environmental management; (4) establish preventive policies and incentives; and (5) maintain regulation and enforcement.

The Policy Paper itself offers little guidance on how these themes are to be made operational. It would have been inappropriate to try to go into such detail in a document at that level. More importantly, formulating general guidelines for carrying out these principles is difficult, because making a process operational means defining how it will be linked to institutions, and institutional arrangements vary dramatically across countries. Are there then no general principles that can be applied throughout the region? There are and they are not primarily technical.

The most serious hindrance to effective UEQM at present is the lack of institutional mechanisms strong enough to mobilize the resources and political will necessary for coordinating UEQM activities efficiently. While there will have to be country variations in developing the mechanisms, there are four general principles that should be applicable everywhere.

Link UEQM to Decisionmaking Institutions

The fundamental principle is that the responsibility for UEQM must reside in institutions that actually make decisions affecting environmental quality. This may seem obvious but it does not characterize the reality today, and it is a crucial concept in building effective strategies.

Dangers of Environmental Separatism

Over the past two decades, it was natural for environmentalists to assert their independence from "the system," especially from systems that caused environmental degradation. Distancing itself from and often acting in direct opposition to development was a way the environmental movement got itself heard. The movement called for separate ministries, commissions and task forces for the environment. These efforts were successful and the message has been heard. Now, there are indications that this attitude of separateness has become a threat to the movement's own objectives.

This view is derived from analyzing the failure of earlier after-the-fact environmental assessments. In the traditional project planning and design process, developers and design teams (public and private) make decisions through a complex series of tradeoff analyses. Some are explicit and quantified, most normally are not. A particular site or route design is put forward and then evaluated, balancing the quality of the product in relation to specific project objectives against its cost. This may occur solely within the mind of the principle designer or as a part of a team decision or, most often, as a mix of both. In all cases, many adjustments are made as the work proceeds.

The process takes time and resources, and the participants build strong allegiance to what they have created along the way. Naturally then, when a group of outsiders assess the design from an environmental point of view and recommend changes, the design team is likely to resist. And they can be very powerful in doing so, as the evidence from the 1970s and 1980s proves. Consider as an example an architect designing a tourist resort. If the architect places high value on environmental impacts as well as on costs and other design requirements while design alternatives are first being considered, it is much more likely that solutions will be found to achieve a reasonable balance between all relevant objectives. Clearly, there are situations in which value tradeoffs cannot be avoided; for example, where protecting the environment will cost more; but this is not the typical case. More often, creativity at the outset has led to solutions that have avoided environmental problems and achieve substantial cost savings. Such solutions are not likely to be searched for, however, if value is not placed on environmental objectives in the design process itself.

Understanding the value of this sort of early collaboration has led the Bank to push environmental analysis farther forward in project preparation and appraisal. For example, in the Bank-supported Bali Tourism Project (Indonesia), when developing the Nusa Dua hotels, infrastructure designers worked closely with local residents as well as the hotel developers, from the beginning, to find cost-effective solutions that minimized dislocation and adverse environmental impacts. Concerns continue to be expressed, however, that often the product quality/cost tradeoffs are still being made first, with environmental assessment at least somewhat after the fact.

The point to stress is that environmental issues need to be considered at the very time that other tradeoffs are being assessed. Every trial design needs to be considered from the point of view of product quality in relation to project objectives, cost and environmental impact—at the same time.

This does not mean that there will be no continuing need for institutional support. Regulations, taxation, fees and other techniques will always be important to create strong incentives for design teams to give sufficient weight to environmental impacts, or the longer term objectives of sustainable development, rather than to short-run outcomes alone. Nonetheless, UEQM goals will not be achieved by such secondary support alone; environmental considerations must be brought inside the initial decision processes.

Institutional and Professional Development

To achieve these goals of making UEQM operational at the outset of development plans, what kinds of institutions should receive the focus of efforts? In general, the emphasis should shift to building environmental capacity in those institutions that make and implement the key decisions for development and maintenance in urban areas.

A shift should occur as well in the focus for technical assistance and training. It does not make sense to have an environmentalist sitting beside each of the key planning and management professionals—architects who lay out resorts and factories or engineers who design water and sanitation systems—second guessing them each step of the way. These technical and management professionals themselves must learn to think about environmental issues throughout the planning and implementation process if outcomes are to improve. Thus, a shift in education is suggested as well. Today, support is needed for teaching environmental analysis in departments and schools of architecture, engineering, planning and management, rather than for continued emphasis on separate environmental programs.

Recommendation 1. Make UEQM operational by linking it directly to the institutions and the people that most determine environmental quality in urban areas.

UEQM is being talked about in Asia more than ever before, but mostly by environmental groups and agencies such as Ministries of the Environment—institutions that do not have direct responsibility for the actions that will determine environmental outcomes. But, until UEQM is built into the fabric of day-to-day decisions by people having direct influence, it cannot become operational.

Thus, while it will be difficult, the highest priority is ensuring that this shift in focus occurs as rapidly as possible. A sensible first step toward this goal would be to encourage governments to take a hard look at possible linkages, starting with a list of institutions ranked according to importance for environmental impacts, and then devising strategies for involving them directly in UEQM decisions.

Focus on Individual Urban Areas

If making UEQM operational means building it into systems where real decisions are made, how can this be accomplished? First, operational objectives of UEQM and their relationships to the institutions influencing their attainment must be identified.

As discussed in Chapter 1, UEQM mainly involves improving residuals management related both to front end objectives (revising production processes and human activities to reduce per-unit waste generation) and to back end objectives (properly treating and disposing of the wastes that are generated). Actions under each can be further subcategorized depending on the type of waste in question: gasses, liquids or solids. There is a further environmental objective that does not involve residuals: avoiding the depletion of resources and unnecessary destruction of ecosystems by the process of urbanization itself. For example, urban expansion into wetlands or watersheds destroy resources irrespective of waste generation. Thus, three types of environmental objectives pertain to cities: waste reduction, proper waste treatment and disposal, and prevention of inappropriate land development.

Waste Reduction

One of the most important goals of UEQM, but also one of the hardest to achieve, is waste reduction. It depends not only on innovation (technological and sometimes institutional) but also on success in influencing the public and private sectors to apply those innovations. In some critical areas, the requisite innovations have yet to appear; for example, new methods for cooking and for propelling vehicles that will markedly reduce energy use and the discharge of pollutants into the air. Developing these merit support, but the task is probably beyond the scope of a single UEQM strategy.

More often today, however, the innovations exist but are not being applied. Both public and private enterprises typically do not operate at the least-cost point of their production scale. This has been shown in responses to changes in energy prices and sewer charges. In this situation, there is more scope for in-country actions.

Governments can press directly for change in their own agencies and apply the techniques at their disposal (again, education, price incentives and regulation) to influence the private sector through a wide variety of institutional arrangements (for example, with industrial associations). It is most likely that campaigns here would be spearheaded by the national ministry of the environment, which could in turn involve city governments for reinforcement and support. One attractive approach would be to establish urban extension services that would provide technical assistance to individual firms, or industry groups to make them aware of the benefits of various waste reduction innovations and show them how savings could be achieved in their own operations.

Clearly, all countries in the region should be encouraged to campaign for resource conserving innovations. However, the institutional variations for these efforts are too numerous and too broad in scope to be described here as a single urban policy. Working out how each of these campaigns could be made operational should be a case-by-case exercise.

Two other types of actions for reducing per-unit resource use in order to reduce waste, however, are squarely a part of UEQM in every country in Asia. The first is in the provision of water supply in urban areas. Wastes can be reduced through demand management (influencing methods and standards of use) and by improving the efficiency of the production and distribution of water in urban areas. The Bank has already produced a much needed work in this field, and the guidelines are discussed further in Chapter 4 (World Bank 1990). These guides explain the practical steps necessary for designing new capital facilities and for the subsequent maintenance to reduce unaccounted for water. (An estimated 30 to 50 percent of the water produced in Asian cities never reaches the user because of leakage and other causes.) The guidelines propose pricing and other means to encourage conservation of the water that does reach users.

The second strategy for reducing per-unit resource consumption is to influence urban land use patterns (*see* discussion of spatial patterns in the Appendix). Compact and efficiently organized land use patterns tend to reduce water and energy use and air pollution, because in them, for example, people generally drive shorter distances to work and shop, and there is less opportunity for leakage in the water distribution systems. The institutions of relevance to this strategy are the agencies that build trunk infrastructure (for example, main roads and water systems) and those that regulate land use. An interesting and now generally accepted point is that the infrastructure providers are much more influential in land use patterns in developing countries than the regulators. The placement of new roads and trunk water mains has a strong effect on where firms and households develop, whereas regulations are normally weak due to inadequate enforcement and other factors. (*See* further discussion in Chapter 4, and Dunkerly 1978 and Courtney 1978).

Waste Treatment and Disposal

Gaseous wastes in cities represent a serious problem. Local agencies can be set up to try to control air pollution, but they are inherently limited by the nature of the emissions: gaseous wastes are difficult to collect at a central point. Pricing and other mechanisms can be used to motivate large institutions (for example, industries, hospitals and universities) to clean gasses before discharge (in coordination with waste reduction strategies and institutions such as discussed above). Emission control devices on motor vehicles can be required, or where physical conditions offer alternatives, urban growth can be steered into the most suitable paths environmentally (for instance, where natural wind patterns are more likely to help clean the atmosphere). But major breakthroughs here await new technologies.

Because of these physical and technological complications, local agencies can have a more direct role in handling liquid and solid wastes. Key institutions here are the agencies responsible for the collection and treatment of sewage, the management and disposal of solid wastes, and the building and maintenance of storm drainage systems. The Bank has developed many guidelines for helping such agencies achieve more effective performance (*see* further discussion in Chapter 4, and Kalbermatten and others 1982a and 1982b). One suggestion has been to integrate sanitation functions with water supply agencies instead of trying to make each of them separate self-financing enterprises. These agencies, along with the road builders, also can have an impact on how land use patterns are shaped, as noted earlier. Compact and efficient layouts can reduce disposal costs.

Prevention of Inappropriate Land Development

In most Asian cities at present, the provision of good land for expansion on the urban fringe is running far behind population growth (*see* Leitman and Narody 1991). The key step in opening up new urban land is the provision of trunk infrastructure. In conditions of considerable pent-up demand, putting a major road and a water main into a fringe area totally transforms the land market in that area, and development occurs rapidly, unless severely repressed by regulations. But today, the funding (and sometimes the political will) needed to provide such infrastructure is in short supply.

With rapid population growth, new land has to be developed somewhere, and with better areas cut-off from their use, the poor typically move out into marginal lands closest to the city center. Although in many Asian countries there are stiff development regulations, enforcement is typically weak; and poor households and small businesses tend to avoid the formal approval process altogether. Squalid informal settlements proliferate and environmental degradation almost always results. These new settlements also are often forced into environmentally sensitive areas—for example, wetlands where they destroy the natural ecosystem and hillsides where they destroy the watershed. Again, the local agencies providing roads, water mains, and other infrastructure are the key actors for preventing these outcomes, under this objective.

Priority of Government Institutions

Because of the failure of many public sector attempts to deliver goods and services, there has been a tendency of late to shift functions to the private sector where possible, and Bank strategies now emphasize private sector initiatives in urban development. However, several considerations must be kept in mind:

- The Bank deals directly only with governments.

- UEQM does not typically receive adequate attention just through the workings of the private market.

- Because it guides both public and private institutions, UEQM must begin with public sector decisionmaking processes.

- Setting standards, monitoring, enforcing and granting certification are activities that must always remain government controlled, if not always government performed.

Therefore, early efforts in UEQM should focus on influencing governments to incorporate UEQM objectives in planning, and helping them improve their capacity to do so. Then, efforts can be devoted to assisting governments in influencing the private sector through education, price incentives, regulations and so forth.

This said, however, there are strong reasons to involve the private sector in UEQM, and more actively and positively than in the past. The private sector can participate in planning and setting standards and they can play an active role in educating the public about new strategies. Private institutions (NGOs, community groups and households) also can take on a much larger share of the work in implementation.

Recommendation 2. Focus on leadership in each urban area, particularly in the agencies providing and operating infrastructure and basic urban services. In this context, recognize that governance is the starting point.

In much Bank country work on environmental issues, dialogues have not moved beyond negotiations with national ministries. Yet the reviews suggested above are likely to indicate that, almost everywhere, many of the actors with potentially the most powerful influence on the urban environment are to be found at the local and, to some extent, provincial or state levels.

Among local agencies, those that plan and operate infrastructure and urban service systems stand out as potentially the most powerful for UEQM—not only because of what they do directly but also because of their influence on waste-related behavior of households and private firms. Also, although it is seldom recognized in urban management analyses, they have influence not only in their role in residuals management, but they are also influential in determining land use patterns (the intensity and character of public and private development). This argument strongly supports one of the key recommendations of the Bank's Policy Paper on urban development, to develop city-specific strategies.

It should be clear that making UEQM operational means building it into the regular decisionmaking processes of these agencies. Unless this is done, establishing a new environmental office in city hall will be only a symbolic act—and possibly a counterproductive one, if it is done in a way that perpetuates the separateness of environmental issues.

Use the Capital Budgeting Process as the Coordinating Mechanism

If UEQM depends most heavily on changing the behavior of the agencies that provide and operate infrastructure and urban services, how are relationships with them to be operationalized. It would hardly make sense for a municipal UEQM office to try to work with each of them one by one. The Bank's focus on city-specific strategies implies the necessity of looking at the urban area as a whole and assessing development alternatives across sectors. Priorities can be assessed only by looking at the whole—the entire urban area, land development patterns as well as the provision of infrastructure, and within the latter, storm drainage as well as water supply. Thus, UEQM implies the need for a coordinated, multisectoral process of analysis and planning in each city. Without a process of this kind linked to real decisions, implementing the computational framework discussed in the Appendix could be little more than a paper exercise.

At present, however, a multisectoral planning process to which UEQM could be attached does not exist in most Asian cities. In the 1950s and early 1960s, Master Plans were proposed as the primary mechanism for local coordination, but that approach has generally been regarded a failure. It is worth reviewing why Master Plans failed and what difference their failure made, before considering what options for coordination could be applied realistically in the 1990s.

Why Master Plans Did Not Work

Master plans were to contain maps and text describing future land use and infrastructure patterns for a city fifteen to twenty years in the future and to be backed up by more detailed sub-area plans specifying allowable land uses on a lot-by-lot basis. Once the plan was legally adopted, government agencies were to install infrastructure as called for in the plan and to use regulations to force the private sector to develop consistent with it.

By the mid-1970s, master plans were severely criticized because they took too long to prepare and be adopted and thus held back development. They also seldom offered guidance on the phasing or techniques of implementation; seriously evaluated the costs of the development they proposed or how they would be financed; were based on realistic appraisals of the city's economic potential; provided a compelling basis for detailed land use controls; and they were too infrequently updated. Also, community leaders and implementation agency executives were seldom meaningfully involved in the master plan process so they had little stake in them.[1]

McNeill (1983) states that overall "the single most crucial factor . . . has been the failure of implementation. Traditional master plans with a strong spatial/land-use bias, have simply had no significant effect on action . . . Whether or not the objectives of such plans were laudable, this type of planning is being abandoned because of its patent failure to achieve results."

Problems Without Planning

While few governments formally dismantled their master plan mechanisms in response, such plans were often tacitly ignored as the emphasis switched to identifying feasible projects and expediting their implementation. No one advocated that this be done in a haphazard manner. International donors urged that projects be carefully appraised, including subjecting them to cost-benefit analysis. Consistently thorough project-by-project review has hardly ever been achieved in practice, however, and even if it was it would not assure coordinated movement to address local priorities.[2]

At any rate, problems associated with uncoordinated project-by-project activity were becoming more apparent by the early 1980s: half-vacant housing projects and significantly under-utilized water capacity existed in parts of cities while severe infrastructure deficiencies existed in others; water providers focused on extending their networks in one area while road builders gave priority to another. These problems appeared more frequently where infrastructure was provided by central governments (rather than local governments), which typically had less incentive to coordinate or respond to local priorities.

The capital resource constraints that followed from the worldwide recession during the 1980s made such mismatches harder to tolerate, and concern was increasingly expressed. At a Bank conference in 1985, the central themes raised by developing country representatives were "the need to come to grips with the problems of the city as a whole and to strengthen the institutions that will be needed to manage unprecedented rates of urban growth in the coming decades . . . ." One participant noted that "urbanization is a process and there is no way you can deal with it exclusively on a project basis . . . we do want [urban] projects to continue, but we want their focus to be wider . . . ." (World Bank 1986).

Building UEQM into an Expanded Capital Budgeting Process

The most promising response to this situation in recent years has been the growing recognition that governments should at least decide across sectors what new infrastructure projects they will undertake in a specific city over the coming year (or several years)—that is, prepare a capital budget. At a minimum, multi-sectoral capital planning should force some coordination. Hopefully, it should also lead to analysis of financial plans and to prioritization of projects within real funding constraints. The Bank-supported "Capital-Folio" process in Manila was one of the first to build serious budget considerations into the planning process. City-specific capital planning processes are now being strengthened in a number of Asian countries.[3]

As a coordinating device, the multisectoral capital budgeting process directly addresses many of the faults of the master plan. Most important it is a direct plan of action that agencies are required to implement, not just a broad guideline that can be easily ignored. Second, implementing agencies as well as political leaders are typically more involved in its preparation. While the form of their involvement could be improved, they are likely to have much more at stake in capital budgets they have helped to formulate than they had in master plans that did not entail direct spending decisions and were developed without their meaningful participation. For these reasons, multisectoral capital budgeting appears much more likely to be sustained.

Adding Spatial Structure Planning and UEQM Strategies

The capital budgeting process offers perhaps the only forum in which decisionmakers are forced to sit together and plan future development seriously because budget decisions have to be made. In a paper prepared for the World Bank-UNCHS Urban Management Program (Peterson, Kingsley and Telgarsky 1990), it was suggested that the process could be incrementally expanded to accomplish a broader range of objectives. Why not add better analytic support and invite a broader range of participants (private sector leaders, for instance) to take part in the discussions (if not to vote on the outcomes)? An example of this expansion is recent legislation in the Philippines that requires growing involvement of NGOs and other private sector leaders in the committees that prepare local capital budgets (Kingsley and Mikelsons 1991).

One of the most important additions to the range of objectives would be consideration of the land development implications of infrastructure timing and placement decisions. To improve the functioning of urban land markets, the Bank has generally recommended streamlined regulations and more effective laws and processing systems pertaining to land ownership (*see*, for example, World Bank 1991a). These changes are indeed vital, but as implied by the discussion above, the capital budget is probably the most powerful tool in urban land management.

Consideration of land development implications requires some sort of spatial planning as part of the analytic back-up for capital budget deliberations. A promising device here is the structure plan, which is much more general than a master plan, with maps indicating only (1) the broad magnitudes and spatial directions for land development; (2) the routing of the major elements of transportation and other infrastructure networks; and (3) the placement of major facilities such as airports, hospitals and universities. Structure plans do not attempt to specify detailed lot-by-lot land use or local road configurations. However, they should indicate reasonable approximations of the amount of land to be provided and the approximate population to be accommodated on it. Density assumptions have a tremendous impact on costs and getting the infrastructure agencies to reach a common position is probably one of the keys to developing a cost-effective plan.

In a structure plan, alternative spatial development options would be described broadly, and the advantages and disadvantages of each roughly estimated and assessed. UEQM planning could (and should) also be naturally imbedded in this process. Environmental implications would be estimated and assessed along with costs and other development objectives. The staff for the process would be expanded over time to do more of the recurrent monitoring of environmental conditions, as well as of changes in land use and density, as needed for better estimates of impacts.

A good example of a structure plan is that prepared for metropolitan Jakarta in the early 1980s (Jabotabek Advisory Team 1981). Analysis showed that both infrastructure providers and private developers in Jakarta were incrementally moving into the worst areas environmentally—wetlands along the coast in the north and the watershed to the south. The plan contained an assessment of economic and demographic prospects and demonstrated that the estimated growth could be accommodated at lower cost while avoiding major environmental hazards, by shifting development to the east and west through the placement of major roads and infrastructure. Clearly, this plan has not fully rationalized the land development process in Jakarta. Nonetheless, major infrastructure elements are being built consistent with it, and the concept based primarily on environmental considerations is having an influence.

In this sort of planning exercise, the emphasis has to be on planning rather than the preparation of "a" plan that is supposed to remain fixed for a long period of time. The exercise should be quick and comparatively inexpensive and repeated at least annually to accommodate adjustments. The inability to be flexible and adaptable in this manner was one of factors that undermined the master plan concept. The literature on strategic planning management offers many more guidelines for realistic and flexible approaches (*see*, for example, Moskow 1978; So 1984; Hanna 1985).

Expansion to Achieve Broad Environmental Goals

The group of people assembled for making capital budget decisions will be an extremely important captive audience. Circumstance can make them more open than usual to thinking about the broad implications of those decisions, and the Bank has already used this opportunity to advantage. For example, in the urban loan for the provinces of East Java and Bali (noted in Chapter 2), the central and relevant local governments of Indonesia have agreed to provide in local capital budgets explicit funds for infrastructure maintenance as well as new construction. This project also specifies environmental assessment of alternative capital investments at an early stage in decisionmaking.

Strong local programs for waste reduction (as discussed above) should also be easy to promote in this situation. Interest should be at a peak when key decisionmakers have just been confronted with projections of the costs of sewage and solid waste collection and disposal.

This process could similarly be expanded to consider reforms in land development regulations. Environmentalists sometimes push for stronger environmental controls without explicitly considering either the implied cost tradeoffs in relation to other development objectives or the administrative viability of the standards and rules they propose. These issues must be carefully analyzed if the objectives are to be achieved.

In much of urban Asia, zoning, subdivision and building regulations now require unjustifiably expensive materials, technologies and land use patterns. Where this is true, most urban families cannot afford housing that meets the standards; but because enforcement is weak, simply avoid the regulations and build shelter illegally. Illegal dwellings, however, are not provided with water supply and other services and cannot serve as collateral for loans. Such unserviced settlements are among the most affected by urban environmental degradation in the region. In those few countries that have been able to prevent illegal construction, development is constrained and housing prices have soared (*see* the Bank's analysis for Malaysia, 1989).

These issues have obvious implications for capital budget decisions. Leaders in this forum might begin by assessing the enforcement capacity the regulatory agencies can realistically support, and then suggest more simple and clear standards that focus only on the most critical issues and areas so they can be enforced within that capacity. This might lead to a new type of zoning map perhaps specifying critical zones (for example, environmentally sensitive areas) where tight controls would be applied; zones with much simpler and more flexible standards; and zones where some classes of development might be legally exempt from control altogether.

Finally, it is important to note that the most critical barrier to achieving environmental objectives through capital planning may be financial: the lack of funds for effective sanitation systems is often a more important constraint than agency techniques or capacities. Considerable emphasis in broadened capital planning, therefore, should be given to techniques of financing programs (Devas 1991; Peterson, Kingsley and Telgarsky 1991a).

Institutional Options and Decentralization

A theme emphasized in the Policy Paper is again strongly supported: that is, urban environmental strategies must be city-specific. As already noted, uncoordinated infrastructure placement by independent sectoral agencies can be disastrous. Tradeoffs have to be assessed and priorities established across sectors, considering the needs and circumstances of each particular urban area.

While the type of enhanced capital budgeting process we have suggested must necessarily be city-specific, it does not have to be controlled and conducted by local government. Local political control of city capital planning and financing has many inherent advantages in the long run, and recognition of these advantages (as well as of the infrastructure difficulties of many central and provincial agencies) has prompted the decentralization programs now under way in several Asian countries. However, in these programs complete and immediate transfers of full authority to localities are both unlikely, and in some cases unadvisable.[4]

But there is no reason why city-specific capital budgeting and UEQM processes cannot be conducted, since they can be adapted and tailored to a country's circumstances, and if necessary its particular stage of decentralization. In some parts of India, popularly elected local governments already are dominant in local infrastructure programming, but in Karnataka the committee that develops city-specific investment programs is composed of a mix of state and local officials. In the Philippines, local leaders have most of the power but central officials are still involved to some extent. As noted earlier, Indonesia has initiated a nation-wide decentralization effort, but to date negotiations between local, provincial and central officials are still required (Peterson, Kingsley and Telgarsky 1990).

The point is whichever group is involved in planning should include the people having the authority and responsibility for financing and implementation; the actual composition can change over time as authority and responsibility change.

The Importance of Dialogue and Consensus Building

Establishing consensus in the planning process is fundamental to effective UEQM. If the key people do not leave the process feeling that the product is their plan, the process will have been useless. If implementing agencies leave the process with a set of politically and financially realistic guidelines for development that they themselves helped to create, a better result can be expected. They face serious political costs if later they propose priorities that are inconsistent with the consensus of the group. If, on the other hand, they are allowed to develop their priorities without participating in such consensus building beforehand, they will naturally be resistant to imposed coordination after the fact.

Recommendation 3. For individual urban areas, establish strategic planning processes that balance and prioritize environmental management activities across sectors, build them in directly as part of ongoing multisector capital planning and budgeting, and involve NGOs and other private sector leaders.

Single-sector programs (particularly those planned by central governments) are prone to major errors in applying uniform strategies to localities with very different needs, opportunities and resources. One of the key contributions of the Beijing environmental project is that it begins with analyses of a single city to determine UEQM priorities across sectors, and then examines the cost-effectiveness tradeoffs of alternative strategies based on those priorities.

A major contribution of the East Java–Bali project is the recognition that planning exercises, no matter how well conceived, can easily be ignored if the plans are not built directly into action programs. Local capital budgeting processes are the only current processes that meet this requirement. They force the consideration of a city's development and the prioritization of alternatives according to budget constraints. The East Java–Bali project further requires environmental analysis as part of all local capital plans that are to receive Bank support.

Infrastructure programming has traditionally been considered a function of government solely, but as broader planning is attached to it, it will gain importance for the private sector and will need private participation and support. There should be many benefits from involving NGOs and representatives of the private business community directly in this process.

Simplify the Monitoring and Computational Basis for Planning

Within the context of an expanded capital budgeting process for an urban area (or any other public policy process), documentation will be necessary for UEQM to gain the priority and resources it deserves. Policymakers will be unlikely to take forceful actions unless they have a sense of past, current and future environmental quality levels for their city, the meaning of alternative levels in relation to effects on human health and other basic societal goals, and the comparative costs and benefits of different environmental outcomes.

Monitoring

A program of regular monitoring of environmental quality is essential. And as argued above, measures are needed for individual urban areas; data at the national or regional level are of little use for urban strategic planning where the use of environmental monitoring can have the highest potential to motivate action.

Attempts are often made to define ideal monitoring systems and databases, but few such ambitious projects are actually implemented. It may make more sense to begin with a limited set of indicators for a few cities and then ensure that they are updated on a regular basis. Additional and more refined indicators can be added later, and the program can be expanded to additional cities as capacity permits.

Operational programs can provide a basis for monitoring to expand quite rapidly. For example, much has been written inside and outside the Bank about the effectiveness of effluent charges. But, how would a manager of an urban sewerage agency go about setting up and implementing an effluent (sewer) charges system? What does the manager need to know about monitoring and analyzing discharges? Where does the manager begin?

An example is found in the experience of the French with setting up their effluent charges system from operations. They had no data on actual discharges from individual plants. However, they had technical data from the French Classified Establishment Service about the technological characteristics and hence waste generating characteristics of French industry. (Such information is also available form various tabulations, such as those of the World Health Organization.) The procedure then was to apply these known emission coefficients to the various industrial plants. The regulations provided that if the plant did not agree with the emission coefficient, it could ask for a measurement, which was then jointly done. If the coefficient turned out to be less than that assigned, the charge was decreased appropriately; if it turned out to be larger, the plant paid for all sampling and analysis plus an increased charge. Over time, the French agencies compiled more and more data on measured discharges, and required self-monitoring and reporting, thus providing actual data rather than estimated data as a basis for assessing the effluent charges.

The manager must also understand the normal variation in discharges from all types of activities, including industrial and institutional activities that operate all day every day (except for down time for maintenance and breakdowns). To obtain an accurate estimate of what such an activity discharges in a year, the sampling must cover the range of discharge conditions, not a simple task. Sampling procedures must be specified, equipment must be calibrated and quality control of laboratory analyses must be maintained. Unannounced inspections must be made at any time of day (and night), on any day of the week, including holidays. This level of detail will ultimately be required for program operations.

Setting UEQM Priorities

Because resources are always limited and have multiple demands made on them, establishing priorities is a major problem. A study of environmental quality in a city overall prior to the beginning of capital budget and strategic planning could be extremely helpful in this regard. It could well be surprising which aspects of UEQM warrant the most attention in that particular city and which indicators are most critical to track in the future. (*See*, for example, the USAID-sponsored study to rate the comparative seriousness of different environmental problems in Bangkok (Abt Associates and Sobotka and Co. 1990).)

Then priorities must be set, and this of course is difficult. If it were possible to translate all environmental quality changes (plus or minus) into monetary terms, the net benefits per unit of capital invested or per unit of present value of net benefits, could be used. At present, this is not possible, although much progress has been made in the last decade in developing analytical techniques for making such translations.

However, what can be done now is to combine cost-effectiveness analysis with exposure analysis. The sequence of analysis is: compute the reduction in discharge per million dollars; then, compute the change in environmental quality as a result of the reduction in discharge. Therefore, the reduction in, for example, SO_2 concentration per million dollars, plus the reduction in number of people exposed to the change in SO_2 concentration, yields the reduction in number of people exposed per million dollars.

Computational Framework for Assessing Alternative Strategies

The Bank is paying increasing attention to the environmental implications of its lending program, as shown in Chapter 2. This is true for all individual sectors, for example, agriculture, energy, forestry, urbanization and transport. However, more integration of analyses across sectors is needed in order to establish, for example, priorities for improving environmental quality within regions of a country and within individual cities, that is, what investments will yield the largest benefits in terms of improved environmental quality for receptors.

Development of a computational framework for analyzing the environmental effects of alternative development plans for urban areas is needed to be used in the capital planning process (as discussed in the previous section). It would be even more beneficial if the same type of framework could be applied at the state or provincial level (for example, for a natural region such as a river basin) to provide a context for local planning. Such a framework would document conditions in a base year, describing spatial pattern of activities, estimated discharges and estimated environmental quality. Proposed projects and projected population and economic growth (by sector) would be imposed on that base, for whatever target years were under consideration, and environmental (as well as cost and spatial pattern) effects estimated. Excellent models for such approaches have been developed and successfully applied in the past (*see* more complete discussion in the Appendix).

A particularly important output of this type of analysis is the relative importance of different types of sources of discharges: for example, point vs. nonpoint, local vs. long-distance. Experience shows that in some areas, agricultural discharges for many pollutants outnumber industrial and municipal discharges. In other areas discharges via urban storm run-off are more important than industrial and domestic discharges. In comparing point and nonpoint sources, Baker and Horton (1990) state, "In sum, the Chesapeake Bay's restoration depends fully as much on controlling pollution running off the lands of its vast watershed as it does on controlling the more traditional sources, such as discharges from sewage and industrial pipes." In an investigation of alternatives for improving water quality in Dillon Reservoir in Colorado, it was found that controlling nonpoint sources were 1 to 10 percent of the costs of reducing phosphorus inputs form point sources in the region (Jaksch and Niedzialkowski 1985).

This analysis could be made for a given region, as is being done in effect in the Beijing environmental project and in the India Industrial Pollution Control Project. Then, the framework could be expanded over time to include additional regions. The procedure would be approximately as follows:

- Divide the country into interior sub-basins, coastal sub-basins, and airsheds.

- Compile distributions of flows and meteorological conditions for each sub-basin and airshed.

- Compile locations, levels, and technologies of existing activities in each area (for example, municipalities and industrial, agricultural and forestry operations).

- Develop gaseous, liquid, and solid emission coefficients for each of the major activities and class of activities for the base year.

- For analysis of projects or future economic development proposals, changes in the levels and nature of activities and in emission coefficients can be estimated, providing a basis for projecting waste loads to the environment and impacts on ambient environmental quality.

Development of such a computational framework has been recommended for the Danube Basin for improving water quality (Bower, Day and Rijsberman 1991). The National Residuals Discharge Inventory (Luken and others 1976) represents a computational framework at the national level.

Resource Use Intensity and Service Level Indicators

Two types of measures could be of greater benefit in strategic analyses for UEQM, but are often undeveloped or ignored. The first is estimates of the intensity of resource use in individual urban areas and the associated factors that result in the given intensity of use. As noted earlier, UEQM cannot be successful in Asia if it focuses only on end-of-pipe programs. Reduced resource use should be feasible with least-cost operations for many urban enterprises, public and private. Intensity of resource use could be one of the criteria used in developing "an environmental typology of cities" (Urban Environment Team 1991).

Improving environmental quality in urban areas often is related also to the provision of services—water supply, for instance. An analogous question is, what would it cost to provide different levels of service? How much is society willing to invest to improve the level of service? Developing and regularly updating a set of service level indicators (SLIs) for a city would provide a means of relating output to investment, analogous to the relationship between environmental quality and cost (Stevens and Cook 1991a and 1991b).

Simplifying and Shortening the Process

The type of rational analysis of environmental problems linked to policy formulation has often been proposed and actually implemented in some locations (*see* references). There is a tendency, however, to make research and analysis like this much too complex and time consuming. If it moves too slowly there is the danger that, at best, it will be regarded only as an academic exercise; at worst, that it will never be completed. In part, it was this sort of elaboration and complexity that made the urban master plan harder to link to action and thus pushed it toward irrelevance.

It is extremely important that these tendencies for over-elaboration be avoided in the computational frameworks for UEQM. The basic data collection and strategic planning required for UEQM can be done in a short period of time if a simple and understandable framework is established. It will not be perfect the first time—many data and perhaps conceptual gaps will remain—but the process can be improved incrementally as it is repeated in the future. Perhaps the best way to stop it from becoming too elaborate would be to set a definite time limit for UEQM strategic analysis and planning (say, three to six months from start to completion).

Building Technical Capacity for UEQM Analysis

Positive returns from investment in urban environmental projects will be achieved only if institutional capacity in UEQM is developed in the host countries. Since UEQM is done primarily at the local and regional levels, and since the effects of economic development activities and population growth in a country occur primarily at local and regional levels, this should be a, or maybe the, major focus of the Bank's efforts. The national governments can provide some assistance such as establishing some financial boundaries, assisting in research, devising some discharge standards, establishing import restrictions, and intervening in inter-regional problems.

Capacity building may well be more important, and it is certainly more difficult, than lending money for capital projects. The Asia Region has well understood this fact, as is reflected in such projects as the MEIP, East Java-Bali, India Industrial Pollution Control Project, and Beijing Urban. As Okun and Lauria (1991) point out, "Other problems with implementing capacity building projects are that investments in processing a loan or grant for capacity building are not so rewarding as investments in capital projects which move larger blocks of money. Also, capacity building efforts are not so visible as capital projects. They are not amenable to dedication ceremonies and plaques, nor can they memorialize national leaders.

To begin to address this issue for a reasonable cost, it might be possible to develop "flying squads" of UEQM technical assistance teams, at least one per country or group of countries. Each team would have the necessary technologic, economic, ecologic and institutional expertise; and would go from urban area to urban area, assisting in the development of the analytic capability and the installation of monitoring and analytic software, returning periodically for review of results and provision of further advice. The team might begin with a composition of international and local expertise, with the plan to shift over time to more and more locals and fewer internationals, except for special problems. Such projects as the India Industrial Pollution Control Project and the East Java-Bali Project might be candidates for locations in which to begin this type of effort. This approach is similar to the approach for providing technical assistance to local officials in capital project preparation and budgeting already in use in Indonesia's IUIDP program, around which the East Java-Bali project has been developed.

After having started in this way and built experience and credibility, it might make sense to turn this activity into a permanent UEQM "extension service." The services would be staffed by local experts trained, in part, by the initial flying squads. Over the longer term the services might provide training for new local staff, keep up with new developments in the field and communicate them to local leaders, and provide special consulting assistance on an as-needed basis.

Recommendation 4. Provide support for building local capacity to monitor environmental trends and for developing and using an appropriate computational framework for strategic UEQM planning.

In tough-minded debates (in capital budgeting and other local policy formulation), environmental issues will not get the attention they deserve unless their impacts are quantified. Cities need to begin monitoring indicators of environmental quality over time, and this is most likely to succeed through using limited numbers of straightforward measures at the start and then expanding the system later as capacity permits.

When some measurements are in hand, the next step should be an overall study of environmental quality to permit the establishment of relevant priorities among environmental goals. This can be accomplished through a meshing of exposure analysis and cost-effectiveness analysis. The computational framework then is built on conditions in a base year—the spatial pattern of activities, estimated discharges, estimated environmental quality and other factors. Proposed projects and projected population and economic growth (by sector) would be imposed on that base, for whatever target years were under consideration, and environmental (as well as cost and spatial pattern) effects would then be estimated and evaluated. Developing measures of local resource use intensity and SLIs could be extremely valuable for this analysis.

One way to develop such capacity would be to set up a number of "flying squads" of UEQM technical assistance experts who would go from urban area to urban area, assisting in the development of the institutional framework around local capital budgeting processes, building analytic capability, and installing monitoring and analytic software—then returning periodically to review results and provide further advice. Over time this idea could develop into a permanent indigenous UEQM "extension service," which could train new staff and offer other assistance to local leaders on a regular basis.

Notes

1. More complete discussions of these problems are found in Dunkerly 1978; Taylor and Williams 1982; McNeill 1983; and Peterson, Kingsley and Telgarsky 1990. Goh Ban Lee (1988) discusses how many of the problems of master plans have carried over into urban planning in Malaysia.

2. Surveys by the Urban Institute have shown that even in the United States comparatively few local jurisdictions systematically employ cost-benefit analysis in evaluating candidate projects for their capital budgets (Hatry and others 1984).

3. See, for example, discussions in Tjahjati (1990), World Bank (1991), and Kingsley (1991a) for Indonesia; Kingsley and Mikelsons (1991) for the Philippines; Peterson, Kingsley, and Telgarsky (1990) for India. Wegelin (1990) discusses recent trends in urban service delivery, including capital budgeting aspects, for several Asian countries.

4. Bahl (1990) indicates that while decentralization objectives are laudable, decentralization may need to be staged over a considerable period of time in many developing countries for a number of reasons, including insufficient local capacity and national fiscal policy.

Chapter 4

Best Practice in the Key Elements of UEQM

The preceding chapter described a multisectoral institutional mechanism that is essential for efficient UEQM strategies, ensuring coordination in their implementation, and building adequate public understanding and support for them. But what are the substantive programs that should operate under this process and how should they be structured?

While there are other related activities of interest, there are five major elements needing attention in any UEQM strategy. With effective performance in each of these five areas, there would be few environmental problems in Asian cities left to worry about.

- Water supply
- Household waste
- Industrial waste
- Transportation
- Land management

Bank operations in most of these areas are well-advanced and have been addressing environmental concerns squarely since at least the mid-1980s.

Water Supply

Ensuring the provision of clean water to the growing populations of Asia's cities has been an urban sector goal for decades, and the Bank's emphasis on the environment should help enhance public understanding of its importance. As noted in Chapter 1, water pollution is the leading urban environmental problem: 3 million children die and approximately 900 million people worldwide become ill each year because of diarrheal diseases that result directly from contaminated water.

Less immediately severe but nonetheless serious are other physical and economic problems that arise from inadequate urban water supply systems: subsidence or saline intrusion into aquifers that occurs when urban populations are forced to overuse groundwater because of the lack of a piped supply (as has occurred in Bangkok and Jakarta); an enormous energy cost when people have to boil their drinking water to avoid disease (excess fuelwood that must be used and the associated air pollution created);[1] the economic loss from illness in the workforce and discouragement of tourism because of water-borne disease or from time wasted in procuring safe water.

The World Health Organization estimates that the world population served with safe water supply increased from 77 percent to 82 percent during the 1980s, but that the total number without such access increased by 30 million. And even where there are piped systems, water from the tap often is contaminated because of inadequate maintenance and repair. Clearly, the problem of providing adequate water in cities is far from being resolved.

The basic technologies of water supply systems—pumping and other facilities at the source, treatment plants and piped distribution networks—are well-known and reasonably efficient in the Asia region. While they do not need to be markedly altered in order to provide safe water supplies in urban areas, what is needed instead are reforms in service mix and cost recovery, water conservation, demand management, and regulatory and delivery institutions.

Service People Are Willing and Able to Pay For

In industrial countries, consumers usually pay for all of the recurring costs and much of the capital costs incurred in urban water supply. In most of the developing world (including Asia), consumers still pay directly for only a fraction of those costs. In World Bank-financed projects, for example, the charge for water has been only about 35 percent of the average cost of supplying it. If these circumstances continue, there will be a deterioration of existing service levels rather than growth of new urban capacity. The primary need in water supply, then, is to find a way to make the service financially self-sustaining.

Affordability studies indicate that in most countries the majority of urban populations (including many officially classed as poor) are able to pay much more, and would be willing to do so if the service provided met their needs. One of the great mistakes of the past few decades was the assumption that, since most of the urban population was poor, only the lowest common denominator in water supply, public standpipes, should be provided. Research and demonstrations since have shown that many who were unwilling to pay even a small charge for water from standpipes would pay a significant part of their income for water delivered to their own home, or at least to their own yard. If almost all consumers receive the service they want and pay for it, it is possible to recover costs even from the poorest of the poor through cross-subsidies.

Water tariffs should be raised sufficiently to recover the full resource costs of a customer's use. This should be possible economically, but it will be a non-trivial political problem in Asian cities where water has always been heavily subsidized. Building consensus among a city's public and private leadership that such increases are both essential and feasible is therefore crucial. They then can play a strong role in educating the public. This is another example of the benefits of consensus building planning, such as that describe in Chapter 3, where leaders look at the costs and benefits of alternative courses of action.

Water Conservation and Demand Management

CONSERVATION. A second vital point is that conservation is often a much less expensive way to augment delivered water supply than new investment that draws larger volumes of water from ground or surface sources. As discussed previously, a large percentage of the water produced in urban systems in developing countries never reaches customers because of leaks, pilferage and other problems. Kalberton and Middleton (1992) note that in a study of 134 Bank-financed water projects, for example, unaccounted-for water amounted to 35 percent of production on average. More efficient and timely maintenance can substantially reduce such loss rates, however. For example, a program in Quito, Ecuador, supported the installation of 72,000 new meters and a much more rigorous inspection and repair policy—results are expected to save 27 percent of current consumption.

Recycling is another important tool in conservation. An internal World Bank study noted that private companies in the Vallejo area of Mexico developed a plant to provide secondary treatment and recirculate sewage water. The plants provide water for their own needs (cooling and some processing) and for government uses (irrigations and washing cars) as payment for the concession to use the sewage flows. The cost of this program is a fraction of that for generating new water for these purposes.

DEMAND MANAGEMENT. The elements of demand management are: first, technological improvements (for instance, new showerheads and toilet fixtures that markedly reduce water use; and second, financial incentives (fees for disposing of industrial wastewater, for example). The discounted costs for various ways of increasing delivered water by 15 percent of current domestic consumption has been calculated for Beijing (Hulfschmidt and others 1987). With the costs of water from a new source set at 100, the costs of the alternatives were 14 for improved water conservation in public facilities, 22 for leakage reduction, 34 for recycling air conditioning water, and 81 for installing water-efficient flush toilets.

A further option, often overlooked, is for users to pay full costs across sectors. An internal World Bank study notes that in most countries irrigated agriculture is the dominant high-volume, low-value water user, with payments seldom covering more than 10 percent of operating costs. In developing countries, 85 percent of all water withdrawn goes to irrigation, 10 percent to industry, and only 5 percent to domestic use. It has been estimated that raising the efficiency of irrigation by only 10 percent would save enough water to ensure adequate supply for all residential use worldwide (Postel 1984).

Institutional Reform and Private Sector Involvement

Because water supply generally is a public service, the public sector must continue to regulate it. Problems normally arise, however, when the same government agency attempts to be the producer and distributer as well as the regulator. An important guideline here then is to specify separate institutions for (a) establishing policy, setting water tariffs, setting and enforcing standards, and regulating overall performance, and (b) producing water. Both need to be established so that they are protected from undue political influence.

A second guideline is that there is much more room for competition and private and community involvement in water production and distribution than has typically been recognized in much of urban Asia. While it is not likely to be feasible to have more than one set of production and distribution facilities in a community, there can be competition at periodic intervals to determine who next will operate that set. In some countries, for example, Côte d'Ivoire, private companies operate the city-wide system (Roth 1987). Another option is for a private firms (or NGOs or community groups) to develop or operate the distribution network in individual communities within the city, with treated water being supplied in bulk by a city-wide agency or utility. There is also the possibility of private entities competing to perform component services (for instance, billing and tariff collection) for a public water supply entity.

Household Waste

All people assign a high priority to safe water, and less urgency normally is attached to the urban problem of treatment and disposal of liquid and solid household waste. These wastes, however, are the major contributors to illness and death-causing contaminants in water. The percentage of the world's urban population being provided basic sanitation is lower than that provided safe water (72 percent vs. 82 percent in 1990). The share with sanitary facilities had increased marginally since 1980 (up from 69 percent), but the absolute number without sanitation increased by 85 million over the decade. In developing countries, furthermore, even where sewage is collected, generally less no more than 5 percent is treated before disposal (Bartone 1991). Few cities have treatment plants, and many of the plants that do exist are not functioning because of inadequate maintenance and repair. It is also estimated that in many large cities in developing countries, only about 70 percent of municipal solid wastes are collected (with only about one-half of all households being served). Dumping solid wastes into storm drainage canals, causing stoppage and flooding, also is common occurrence in Asian cities.

Many of the principles noted in relation to water supply above, also apply to UEQM activities in this area, but there are variations.

Broadening the Base of Technical Options

Unlike providing a safe water supply, disposing of household waste can be significantly improved by alternative technologies. In the past, only two options have existed: full piped sewer systems or nothing. Cost analyses furthermore suggest that basic water supply should be affordable to a majority of urban dwellers in Asia, while only a small percent could afford to cover the costs of full sewerage service (which ranges from $300 to $1,000 per household). Collection by conventional piped sewers is the only realistic option for high-density cores of most Asian cities (and it should be feasible to require developers to provide them and occupants to pay the required cost), but there is an urgent need for alternative sanitation options for the remaining (and larger) parts of the urban populations.

Since the late 1970s, the Bank has played a leading role in researching and promoting alternatives. Analysis has shown that low-cost on-site options (ventilated improved pit [VIP] latrines and pour flush latrines) can substantially reduce negative health and aesthetic effects (Kalbermatten and others 1982a and 1982b). Still, these options are not satisfactory in many conditions (particularly, low-lying areas and higher densities). Probably the most promising alternative is the small-bore sewer: solids are collected in an on-site tank before they reach the sewer connection. Since the sewer only has to handle the liquid effluent, it is possible to use smaller pipes, lay them at flatter gradients, and use fewer manholes—all of which can substantially reduce cost. Further savings are possible where the households in a block develop a joint system in which pipes are run from yard to yard before reaching the street sewer (rather than the conventional approach of having each house independently connected to the street sewer), and where they assume joint responsibility for maintenance inside-the block. This approach is called the "condominial" system in Brazil, where it has been a success. Vacuum cartage systems offer another intermediate cost option that has been successfully applied in some cities.

User Charges for Cost Recovery

Just as they do in water supply, user charges in household waste disposal not only collect needed revenue but also create positive incentives. Here, user charges are in keeping with the polluter pays principle (PPP), sending a clear message that those who generate more waste will have to pay more. In most of Asia, at present, sewage rates are either not charged at all or set at levels that are far too low to influence behavior, let alone recover a significant share of operating costs. It is common for solid waste collection and disposal to come from local general revenues; for example, from property taxes, which are now far from adequate to meet municipal needs (Bartone 1991). However, while most of the cost of sanitation improvements should be financed by user charges, there is justification for general subsidies for sewage treatment and disposal since it is so important to environmental quality.

Recycling

Steps to encourage greater recycling of household wastes also offer great promise in slowing the rate of environmental degradation in Asia's cities. Reusing treated sewerage flows was cited in the section above as an example of conserving water supplies. Liquid wastes can also be recycled (after appropriate treatment) for toilet flushing, irrigation, and recharging underground aquifers where groundwater resources have been depleted.

The possibilities are also substantial for recycling solid wastes. Informal scavengers already operate profitable recycling operations in many Asian cities. In Jakarta, efforts have been made to help some of these operations become more efficient, established businesses. Other new opportunities for recycling are also being considered there and in other Asian countries. These range from the co-composting of solid waste and sewage sludge (to produce a soil conditioner for reclaiming degraded land as well as re-establishing vegetation) to the shredding of used automobile tires (which also can be added to soil as a conditioner to increase drought resistance).

Institutional Alternatives

At the community level, the case for shifting responsibility from public bureaucracies to competitive private firms and community groups is even stronger for disposing of household wastes than it was for providing water supply. The most familiar method is the use of competitive contracts for intracommunity solid waste collection. Bartone (1991) notes that there are "few economies of scale and large economies of contiguity" in this service, so dividing a large city into many service districts is natural. Barriers to entry in this work should be minimal, so small informal firms from the communities themselves can often be quite competitive at this task.

Opportunities for community management of household wastewater also exist in most communities, although not to the same extent. Kalbermatten and Middleton (1992) cite the case of a SIRDO project that operates in the Il Molino squatter settlement in Mexico. In this system, the "grey water" from sinks, laundry and bath is filtered, and then 80 percent of it is channeled for use in irrigation. The "black water" (sewage from toilets) first goes to a sedimentation tank. Under the management of the local Cooperative, the resulting sludge is later removed and placed in an anaerobic decomposition chamber with household garbage (after recyclables have been removed). Some of the fertilizer that is produced after drying is used in gardens within the community, but some also is marketed commercially.

Even at the city-wide level, broader private involvement is achievable. Contracting out the management of transfer stations, treatment plants, landfills and special industrial waste facilities (under competitive procurement) is a feasible and growing practice. Another means of mobilizing resources is a build-operate-transfer (BOT) arrangement, in which a private firm (under a prior contract with government) builds a treatment or disposal facility and then operates it until a satisfactory return on investment is made, and then finally transfers the facility back to the public sector.

Industrial Waste

Many Asian countries have made little progress in controlling toxic and hazardous waste generated by industry. The reasons include lack of reliable field surveys on generation and disposal, the complex nature of these residues and the high cost of cleanup. These wastes are increasing at an ominous rate. By one estimate, manufacturing plants generate 100 tons of hazardous water for every $1 billion increase in GDP. In addition, the rate at which industries discharge toxic wastes appears to be rising in many Asian countries. Only Japan has successfully decreased this rate to modest levels.

The greatest barrier to solutions is political will. Many Asian countries stimulate industrialization at all costs to achieve economic growth. Charging industry for industrial wastes would seem to defeat the purpose. And controlling industrial waste is costly. (The U.S. EPA estimates that industries must spend an average of 5 percent of capital costs on environmental measures.) Governments then often do not take action until very serious conditions, or a catastrophe, occur. The severe pollution of the river in Surabaya—which is too polluted for even industry to use, the exponential growth of toxic waste in Bangkok,[2] and the accident at Bhopal (India) where methyl isocyanate gas killed over 2,500 people, have prompted action.

Cleaning up industrial waste is very expensive. The cost would quickly exhaust the resources of most industrializing Asian countries and donors. Even if they could be raised, such huge sums might well result in politicking and inefficiency.[3] Treatment is a more permanent solution, but also expensive. Large and medium-sized industries, particularly where subsidized inputs or protected outputs increase profit margins, may be able to afford these costs. Small industries however have neither the resources nor the interest (given lax enforcement) to adopt such measures. Even for large industries, low-cost or no-cost assistance may be necessary to entice them to install facilities. If programs enforce blanket standards, the required sums become unmanageable. In this context, five measures hold promise:

- Waste reduction through recycling, process modification and other means for existing industries, and through adoption of clean technologies for new industries.
- Use of incentives rather than tight standards.
- Collective treatment and a range of indirect instruments such as taxation of inputs for small industries.
- Demonstration projects.
- A program of monitoring and testing, environmental education and incentives for identifying environmental problems.

Waste Reduction

Waste reduction is the least expensive alternative for solving the industrial waste problems of many existing industries. Using the by-products of industries, particularly water, as the inputs to others offers economic opportunities and cuts discharges. Modification of industrial processes can help eliminate high levels of pollution and the sub-optimal scale that helps makes industries less profitable and less able to afford pollution control. New industries should be required to use clean technologies or pollution control equipment. Building new industries is more effective for waste reduction than upgrading old ones, and existing industries are often major sources of pollutants.

Studies should determine the best mix. If a new type of industry will produce large amounts of toxic waste, efforts should target preventing this problem. Publicly owned companies should be targeted as well as private ones. The public sector often accounts for a substantial share of industrial pollution in developing countries. Similarly, municipal sewer companies—which receive the bulk of industrial as well as household wastes—must be included in program designs.

As economies develop, industries tend to adopt modern technologies and move away from the heavy manufacturing that pollutes most. This industrial restructuring promises to improve the environment more than environmental controls. Therefore, environmental measures should facilitate the evolution to more sophisticated, less polluting technologies.

Incentives

Joining rewards with punishments provides the most effective inducement to reduce wastes. Punishments include fines, user charges and intervention. Fines are most effectively set at a level comparable to the cost of treatment. User charges are levied on industrial effluent discharged into municipal sewerage systems or for solid wastes generated at a plant, and cover the cost of the treatment and disposal systems in many developed countries. The charge can be based on the amount of different pollutants, such as organic or oxidizing substances or heavy metals. A period of declining subsidies could ease adjustment to these charges. An industry's economic contribution may justify user charges at levels below environmental costs, however, strictly enforced rules should govern making such exceptions. As pollutants decrease, user charges should decline.

User charges and fines can help supply an environmental fund for pollution control. If industries persistently fail to comply, governments must occasionally intervene. One plant closure is worth many reams of regulations.

For many industries in developing countries, however, rewards are also necessary because of the low financial returns from pollution control equipment relative to their environmental benefits. Options include low-interest loans, tax rebates, accelerated depreciation, reduced excise taxes, lower customs duties and capital grants. Up-front capital grants show the subsidy amount most clearly.

Collective Treatment and Indirect Instruments

Collective waste facilities at industrial estates can make recycling and treatment economically feasible, but planning such a facility is not simple and should be done systematically. The following steps should be taken: (1) survey the effluent situation at the site; (2) study the economic and financial feasibility of the plan; (3) enlist a sponsor with adequate institutional and technical capacity to operate the joint facility; (4) define the legal and financial responsibilities of participants; and (5) adopt cost recovery formulas.

These measures can substantially reduce industrial pollution from medium and large-scale industries—often the biggest and worse polluters. However, smaller plants pose a much more elusive problem. Indirect instruments, such as taxation of inputs—energy, chemicals and technologies—as well as bond and deposit-refund schemes, offer potential solutions.

Governments could, for example, support the development of industrial parks for groups of highly-polluting, small industries, such as small metal-plating plants. These industrial parks should include the equipment and infrastructure necessary for collective treatment, recycling and reduction of discharges. Such incentives can influence industries to locate away from population centers. They should be designed and located so as not to interfere with the agglomeration economies of location that brought industries to cities in the first place—notably, the forward and backward links with other industries and access to the services of large urban areas. The environmental and economic returns from such investments far exceed their cost.

Demonstration Projects

Demonstration projects can play a key role in showing small- and medium-scale industries how to control pollution. These projects should pioneer the use of new technologies in the country and procedures. They should focus on industries that have achieved economic viability but need comparatively large sums to reduce their discharges.

Monitoring and Testing

These measures require better monitoring and analysis of industrial discharges and their effect on the environment. The physical plant necessary for monitoring and analysis includes laboratory facilities, specialized testing and analysis rooms (such as fuming chambers, dust free rooms for trace level sample preparation and glove boxes for handling waste samples), office space, computers, and backup power facilities and voltage regulators. Effective industrial pollution control programs must also invest in training and building a career ladder for environmental technicians and managers.

Monitoring, analysis and enforcement should focus on the most damaging wastes and industries, to prevent being overwhelmed by the scope of problem. In any case, enforcement alone promises limited, although important, returns. To achieve greater scope, education of the public should play a central role, including presentations at schools and in the media and working with environmental NGOs.

Industrial Location

Finally, the locational pattern of industry is important—the industrial clustering and locations of different industrial types in relation to residences, the transportation network, prevailing wind patterns and natural watercourses. In the past, rigid zoning and ill-conceived industrial estate plans have often failed because they have not taken market realities into account (Peterson, Kingsley and Telgarsky 1991a). Zoning of industry is most effectively accomplished as part of strategic spatial planning (linked to UEQM) that was discussed in Chapter 3. (See also the discussion of urban land management below.)

Transportation

Although Asia generates a small portion of world vehicular emissions, they damage Asian urban environments far more than this modest share suggests for many reasons, including the concentration of 2-stroke vehicles and other "smoke belchers," and the long commutes that expose many people to high roadside levels of pollution. Adding to these problems are the growth of many mega-cities and the extremely fast rise in vehicle ownership resulting from economic growth and domestic car industries. The growth in the sheer number of vehicles—at about 10 percent per year in the region—represents a great challenge to air pollution control. Vehicle emissions contribute 75 to 95 percent of carbon dioxide emissions, 55 to 90 percent of carbon monoxide emissions, 30 to 70 percent of nitrogen oxide emissions, 90 percent of lead in urban air, up to 60 percent of particulate matter, and considerable ozone.

Basic Strategies

Two technical strategies for reducing vehicle pollution are (1) to reduce emissions per vehicle mile travelled (VMT) and (2) to reduce the total number of vehicle miles travelled (Midgley 1991). A number of means exist to achieve the first goal. Government can set emission standards for new car designs and can enforce a minimum level of maintenance during use. Cutting the lead and sulfur content of fuels is fundamental to reducing emissions per VMT.

The means to control total miles travelled include public transport, land-use planning, traffic management, carpooling and parking restrictions. Although less politically acceptable, these approaches promote fuel conservation, aid in efficient urban development, and represent the only options once technology has been pushed to its limits. Furthermore, experience has shown that technological solutions are offset by growth in the vehicle population, and that ultimately, reducing total miles travelled is the only way to manage growth.

Hence, the following four strategies should guide vehicle pollution reduction programs:

- Reduction of emissions per VMT through inspection and maintenance, cleaner fuels and better technologies.

- Institutional coordination of agencies and centralization of authority in fewer agencies.

- Improvement of air pollution monitoring and agency staffing and management capacity.

- Decrease in VMT through land-use planning, traffic management, car pools, public transport and parking restrictions.

Cleaner Fuels and Better Technologies

Introducing unleaded fuels and catalytic converters offers, perhaps, the greatest promise for short-term reduction of the most dangerous discharge—lead. Many Asian countries have made slow or no progress.[4] Hence, much room for improvement exists. Pricing unleaded fuels below leaded fuels provides a key incentive for adoption of this cleaner technology, but taxing leaded fuels probably is more effective.

Similarly, cutting sulfur content in diesel to reduce particulates and shifting to alternate fuels—such as LPG and ethanol—reduces other discharges. Thailand shifted from a mixture of gas and fuel oil to cleaner burning LPG in 3-wheel taxis through enforcing a new law.

Assembly line testing provides a relatively easy means to apply standards to vehicle manufacturers. Maintenance represents more of a problem, although periodic inspection can be effective if applied seriously. During 1983--1987, Metro Manila succeeded in citing only 12,000 vehicles, about 5 percent of the "smoke belcher" problem. With increased effort at public education, redeployment of inspectors along key routes, and seizure of registration on the spot, the rate increased to 5,000 per month in 1990.

Vehicle inspection programs can be organized in two general ways: in many privately-operated garages or in a smaller number of dedicated government facilities or government-authorized concessions. The second option can achieve lower-cost inspections, higher consistency and better record-keeping.

Reducing Total Miles Traveled

Governments have neglected measures to reduce total miles travelled. However, they offer the greatest possibility for real solutions. In Asia, people have only recently begun using motorized vehicles in large numbers. Much of the population continues to travel by bicycles, bicycle-taxis and on foot. Rather than identify development and economic growth with greater private automobile use, governments could seriously examine the potential of adapting non-motorized transport and public transport. The potential of alternative modes of transport and the intense traffic congestion resulting from geometric auto growth underscore the importance of effective land-use planning (as discussed below and in Chapter 3). Road paving programs are also important since road dust is itself a major pollutant.

Land Management

The environmental problems associated with inadequate urban land management were cited in Chapter 3: for example, the high cost of water, sanitation and other infrastructure systems caused by low-density urban sprawl; and the loss of ecosystems when urban development spreads into wetlands, watersheds and other environmentally sensitive areas.

Land management is the one element of UEQM in which Bank activity in Asia is not well advanced. The Bank has clearly endorsed effectively functioning private land markets in Asian cities and offered some support for institutional changes. These, however, have been frustratingly slow to bear fruit in some countries, and in and of themselves do not ensure spatial patterns that avoid the degradation of environmentally sensitive lands.

The Shift to a Private Market Orientation

Progress has been made, however, as Asian countries have begun to recognize the failure of public-sector dominated urban land development in the past. From the 1950s through the 1970s, public agencies were the primary actors in urban land development in many Asian countries. The record of such agencies has generally been disastrous: high-cost, high-subsidy and tortuously cumbersome development processes with very little output compared to the need.[5] In response to these failures, governments now increasingly recognize that private markets must play the leading role in urban land development. Accordingly, policy recommendations (by the Bank and others) have increasingly concentrated on two types of reforms to facilitate (remove government barriers to) private land development, reforming land development regulations and reforming land titling (*see* for example, the Bank Policy Paper on urban development).

REFORMING REGULATIONS. Reforming regulations such as subdivision and zoning ordinances and building codes entails revising (or eliminating) standards requiring high-cost materials and processes, simplifying other regulations and streamlining review processes.

REFORMING LAND TITLING. This involves revising laws to permit unambiguous transfers of ownership, improving (and automating) land ownership records and streamlining (reducing both the duration and cost of) the processing of title transfers.

There are important differences in Asian traditions in this regard. Thailand, for example, has a well-ordered system for processing changes in land ownership; a tradition of moderate controls on development; and accordingly, thriving private urban land markets. Traditions in India and Malaysia, in contrast, rely on more rigid controls that have frustrated private initiative. Systems in Indonesia fall somewhere in between—a fairly rigid formal system, but official tolerance of quasi-legal processes that permit active informal development.[6]

Where the old systems are more rigid, traditions apparently die hard. Efforts (supported by the Bank and others) to reform regulations and build improved land registration systems have not made much headway to date, and continued emphasis on these activities will be essential. (Improvements in low cost computer technology make the processing aspects of these changes more feasible.)

Tools for More Effective Environmental Protection

Even if land titling and the regulatory environment were made efficient, however, this would not ensure that sufficient land would be developed to keep up with burgeoning urban population growth or that it will be developed at appropriate densities and in an appropriate spatial pattern so as to promote resource conservation and avoid the degradation of environments will probably have to play a more proactive role—not in returning to the direct provision of land but rather in taking more effectively guiding the private land development process toward key environmental objectives. There are four major tools for these efforts.

PROVIDING TRUNK INFRASTRUCTURE. In many Asian cities, the provision of major roads, water mains and other trunk infrastructure to open up new land for development has lagged behind urban population growth to a considerable degree. As noted in Chapter 3, the placement of such infrastructure is key to shaping urban land use and avoiding environmental degradation, and the urban capital budgeting process is the primary tool for this.

DISPOSING OF GOVERNMENT-OWNED LAND. A substantial amount of land in many Asian cities is government-owned and substantially under-utilized. Bringing this land into private use can be an important part of a local economic development strategy. A program along these lines is in the early stages of development in the Philippines (Kingsley and Mikelsons 1991). Guidelines could be built into the divestment plan that would control private reuse in an environmentally sensitive manner, controls likely to be much more effective than those contained in standard development regulations.

BUILDING PRIVATE-PUBLIC PARTNERSHIPS. Over the past decade in particular, U.S. municipalities have joined forces with private firms to develop key parcels of land in order to spur local economic development. In these arrangements, the private partners do most of the work while the public partners participate in planning, provide incentives in return for design features regarded as in the local public interest, and otherwise facilitate the development process. Sometimes, Chambers of Commerce and other private NGOs also are involved. Some of these projects have been extremely successful and there is interest in this approach in Asia (Kingsley and others 1989). There are risks but the dialogue between partners should provide an excellent opportunity for the public sector to influence location and design choices.

INFLUENCING ENVIRONMENTAL REGULATIONS. The argument was made in Chapter 3 that land regulations have not been a very effective means to achieving environmental objectives in Asian urban development to date. Future strategies may include more flexibility in some areas to permit stronger control in others, for example, as in the type of zoning map noted (in Chapter 3) where there were (a) critical zones (environmentally sensitive areas) where tight controls would be applied; (b) zones with much simpler and more flexible standards; and (c) zones where some classes of development might be exempt from control altogether.

For any of these tools to be workable, they would probably have to be applied as an outgrowth of the type of capital-budget related structure planning process discussed in Chapter 3; that is, they would need the political force and legitimacy that such a consensus-based process could give to them. The mandate would be particularly strong if private sector leaders and NGOs, as well as infrastructure agency directors and other public officials, participated in forming the consensus.

Notes

1. It is estimated that households in Jakarta alone spend $20 million-$30 million annually to boil water—a very large amount in comparison with the cost of providing an adequate and safe piped water supply system (Davis 1988).

2. In response to the Thai government's policy to increase manufactured exports, the number of chemical plants doubled from 300 to 600 between 1972 and 1982. A 1984 study of metropolitan Bangkok identified 862 factories as potential generators of inorganic hazardous wastes with a yearly output of an estimated 29,000 tons—predicted at almost two million tons yearly by the mid-1990s.

3. The U.S. Superfund for cleanup of toxic wastes is an example. Each of the fifty states chooses its quota of sites and standards—rather than least-cost strategies—govern the cleanup. In the absence of enforcement, the same problem could re-emerge.

4. Unleaded fuels are unavailable in many countries, including Bhutan, Cambodia, India, Myanmar, Nepal, Pakistan, the Philippines and Viet Nam. Malaysia and Thailand are introducing unleaded fuels and requiring catalytic converters. Hong Kong, Japan, Taiwan (China) and Singapore are the most advanced.

5. One of the primary examples of such failures is one of the most ambitious, the Delhi Development Authority (World Bank 1986; Kingsley and others 1989). For a broader discussion of the problems of public land development, see Van Meurs (1986).

6. These contrasts are discussed further in Kingsley (1991b); Hoffman (1990); Tanphiphat and Simapichaicheth (1990).

Appendix

Context and Computational Framework

by
Blair T. Bower

This Annex provides basic concepts and approaches that have guided the thinking in the main body of this report on Urban Environmental Quality Management (UEQM). It opens by reviewing elements of the context that provide guidelines for improving UEQM in Asia. It then offers several definitions to clarify concepts that are used and notes several "facts of life" that both guide and constrain UEQM opportunities. Finally, it outlines a computational framework for use in strategic planning for UEQM in individual regions and urban areas.

Context

Objectives

Major objectives stated in the Bank's Policy Paper on urban development (1991c) are: aiding economic growth; alleviating poverty; and protecting the environment. With respect to environment, operational objectives should be: (1) to improve indoor (both residential and work place) and ambient environmental quality, thereby reducing adverse effects on humans, other living species, and materials; and (2) to sustain the economic functions of terrestrial and aquatic ecosystems, and prevent irreversibilities and loss of ecosystems, to the extent possible. (Obviously the evolution of a village into a city is impossible without the elimination of some, or parts of some, ecosystems.)

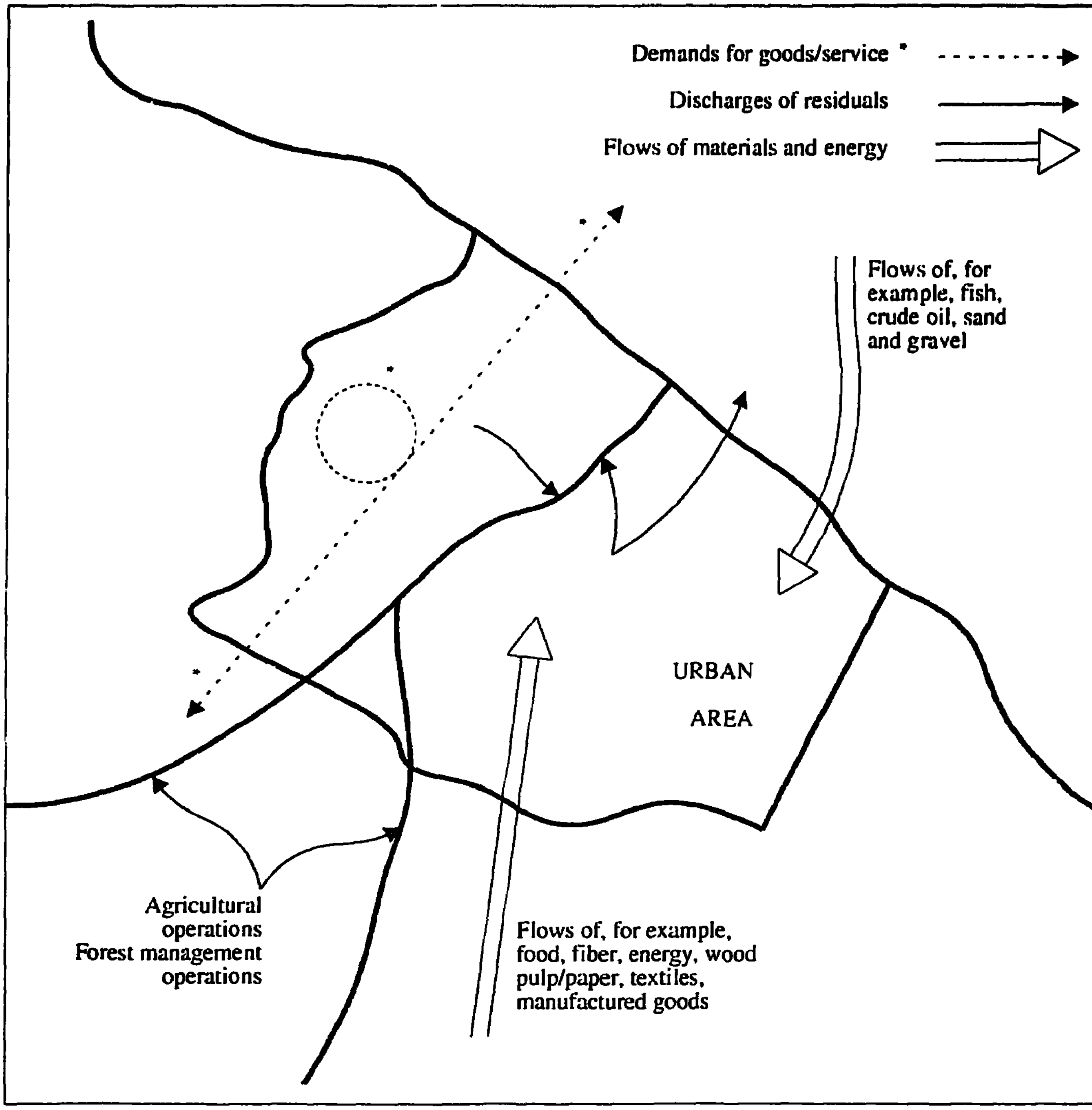
Addressing these objectives in a realistic way requires the establishment of priorities that, in turn, require information and analysis, with particular attention to defining who is affected and how they are impacted by each alternative course (who gains? who pays? how much?). Definition of a realistic set of priorities to address both operational objectives noted above must be regarded as a prerequisite for sustained economic growth of every urban area in the Asia Region.

Setting

It is important to emphasize that urban environmental quality management (UEQM) is *part* of urban management, which in turn is part of regional economic development. There must be consistency between UEQM and urban management, between urban management and regional economic development, and between regional economic development and macro economic development and policy.

The focus of this report is on urban/metropolitan areas, which typically are defined in terms of management jurisdiction/authority by boundaries of governments of general jurisdiction. These boundaries rarely coincide with the boundaries of resource management areas, such as watersheds and airsheds. Nor do they coincide with either demand areas or effects areas. Demands in relation to an urban area, with which UEQM must deal, stem from areas peripheral to the defined urban area, and from areas far beyond in terms of products and services produced by the urban area but demanded by "outsiders" (tourists). Similarly, areas affected by activities in the urban area extend far beyond its boundaries,

Figure A.1 Simplified representation of interelationships between an urban area and upstream and downstream area



* Includes demands for disposal of residuals, e.g., liquid to streams, coastal waters; solid to land; gaseous to atmosphere, some of which move inland via on-shore winds for deposition on land.

Source: White and Burton 1983.

both downstream/downwind, and upstream. Long-range transport in the atmosphere carries residuals hundreds and thousands of miles away from an urban area. Demands of the urban area for fuelwood can have substantial effects on forest lands upstream, and in other river basins outside of the one in which the urban area is situated. These relationships are depicted simply in Figure A.1, and in a more detailed fashion in Figure A.2.

The orientation of this report is on the problem of generating information for resource allocation decisions with respect to environmental quality management in urban areas: how well has the Asia region of the Bank incorporated EQM considerations in its activities relating to urban areas; how might the Asia region do this task better. However, the Bank's role is limited; actual UEQM is done by individuals and entities in the various countries. Thus, a critical issue is how to improve UEQM in urban areas in Asia, which is a fundamental problem in developing institutional capability.

The nature, extent, and severity of EQ problems in urban areas are a function of: spatial pattern of activities, SP; mix and levels of activities, LA; geomorphological setting (coastal, valley, plain, upland), G; meteorological conditions, M; hydrologic conditions, H; demands for goods and services, i.e., "life style" as embodied in product specifications and hence in find demand, FD; technologies, T, and raw materials, R, for producing the goods and services; factor prices, P; and UEQM strategies, UEQMSt. Thus, for an urban area/region:

$$AEQ = f(SP, LA, G, M, H, FD, T, R, P, UEQMSt).$$

Substantive Focus of UEQM

Various views exist with respect to what substantive phenomena are included in UEQM. Herein the term is limited to the management of the "leftovers" (residuals) from society's activities, th^ nonproduct outputs of materials and energy which no longer have utility, at least at a given point in time. UEQM then is the task of managing the various types and forms of material and energy residuals in relation to their expected or potential short-run and long-run effects of their discharge into the three environmental media: air, water bodies; land.

Figure A.3 is a conceptual schema of an UEQM system. It should be emphasized that an UEQM strategy selected to improve EQ can include measures and associated incentives related to one or more of the elements of the UEQM system: final demand; spatial pattern of activities; level of activities; timing of activities; raw materials used in and technologies of production; product mix and specifications for products in the mix; extent of residuals modification before discharge; modification of assimilative capacity; installation of protective measures between AEQ and receptors, such as intake water treatment; changing perceptions of the attitudes toward EQ; and modification of the institutional arrangement for UEQM.

Not included in UEQM in this context are: the preservation of historic/scenic resources; the effects of natural hazards; and the effects of climatic change, such as rise in sea level and changes in frequency and intensity of hydrological events. All three have implications for developing UEQM strategies.

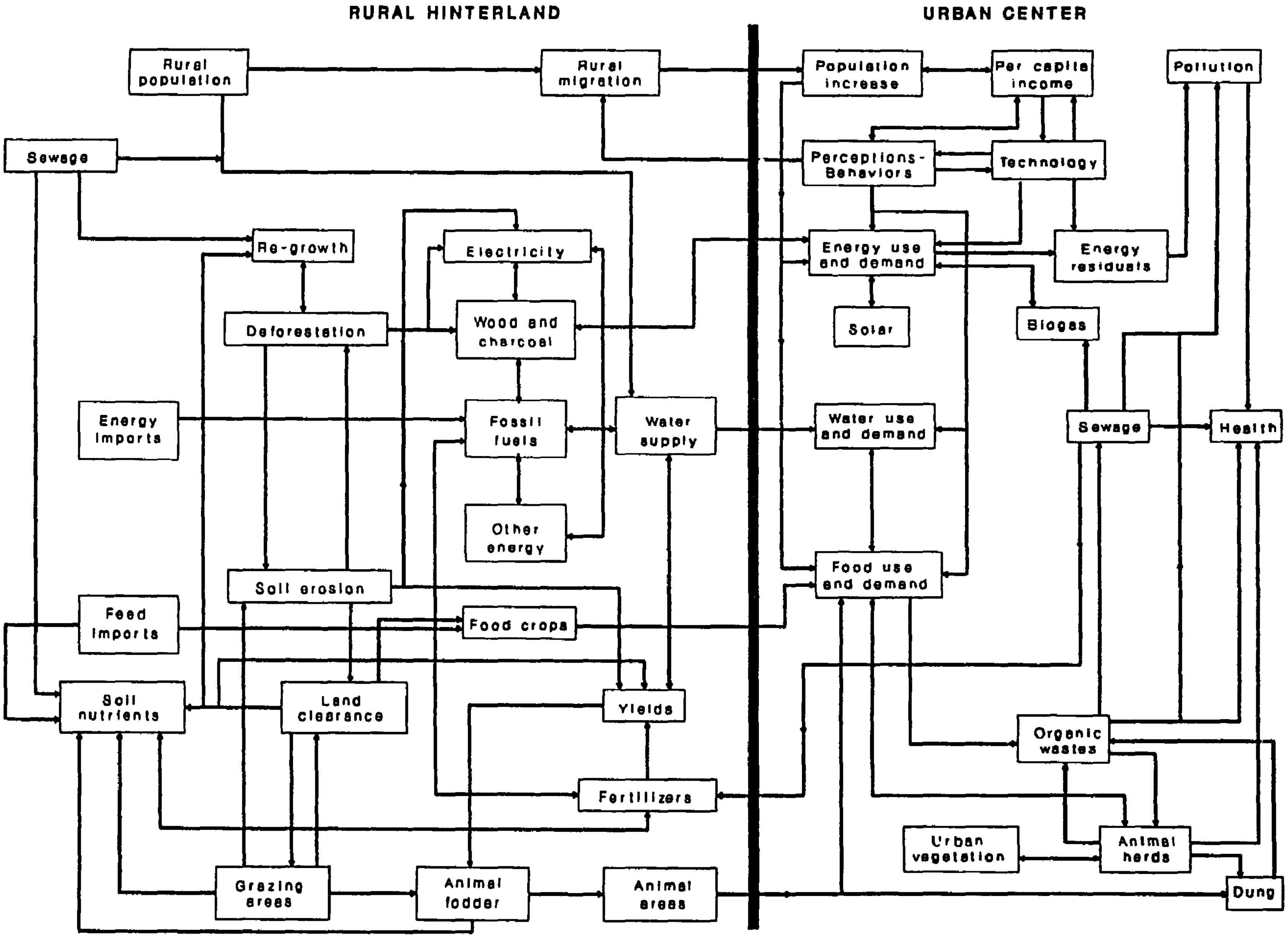
Spatial Foci of UEQM

UEQM includes within its purview the following four spatial foci.

(1) Indoor environments, both residential and work place—These environments are affected by residuals generated *within* and *external* to these environments.

(2) AEQ *within* the urban or metropolitan area, however that area is defined—AEQ within the area is affected both by residuals generated and discharged within the urban area and residuals which flow into

Figure A.2 Illustration of Some of the Demands Urban Centers Make on their Rural Hinterlands



Source: White and Burton 1983.

the urban area, via water bodies and the atmosphere, from areas outside the designated urban area. These *cross-boundary flows* are *imports* into the urban area, just as the discharge of residuals across the boundaries of the urban area represent *exports* from the urban area. Some of the imports result from activities which provide inputs to the urban area. For example, storm runoff from agricultural lands providing food for the urban area will usually contain suspended sediment, nitrogen, perhaps pesticides, which often are transported via river systems to the urban area in the same river basin. Some of the imports will be derived, primarily by transport in the atmosphere, from areas outside the river basin in which the urban area is located, from activities which do *not* provide inputs to the urban area.

(3) AEQ *outside* the urban area as a result of discharges of residuals generated within the urban area and exported downstream (in surface and ground water bodies) and downwind—these cross-boundary flows are *exports* from the urban area, resulting in the "externalities" of the economics literature.

(4) AEQ effects (and social effects) upstream and downstream from the urban area as a consequence of activities to produce resource inputs for the urban area (for example, deforestation to provide fuelwood for the urban area or elimination of mangrove ecosystems to enable mariculture to produce fish for the urban area)—the focus here is on the environmental effects in areas *external* to the urban area, effects which stem from demands for resource inputs by the urban area. In (2), the focus is on AEQ *in* the urban area. The AEQ effects in (2) and (4) are produced by the same phenomena—agricultural or silvicultural operations; it is the spatial focus for analyzing effects which differs. The AEQ effects considered herein may, often do, occur hundreds of kilometers away from the urban area.

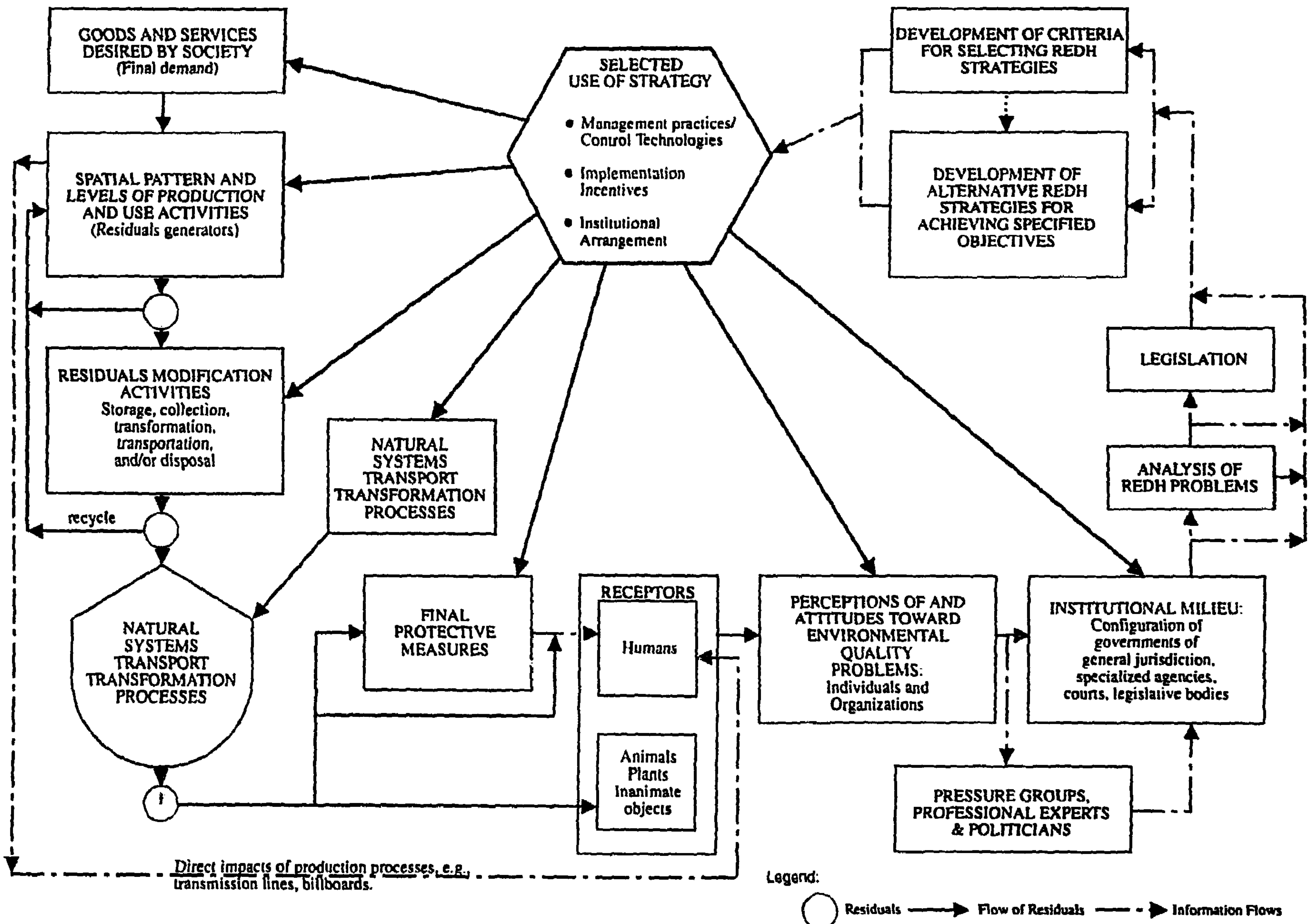
Definitions

Semantics can be, and often is, a block to communication. In order to try to preclude argument concerning meanings of words, rather than focussing on substantive ideas, some operational definitions are presented. The point is not whether or not these are the "correct" definitions, or whether or not they are institutionally "acceptable." They are set down here as a basis for making the subsequent discussion more understandable.

Management is the set of activities required to produce the desired outputs, in this case, AEQ in an urban area. Included are: research; data collection; analysis; planning; design and construction of facilities; operation of facilities; education of individuals, groups, firms, institutions; providing technical assistance; establishing input charges; reviewing requests for intake licenses and withdrawal permits, and issuing permits; establishing emission charges; establishing product specifications and process technology; inspecting operations; monitoring AEQ and monitoring discharges of activities at all times; cleaning up spills; imposing incentives on activities, including sanctions for failure to perform; feedback of information from monitoring and operations into analysis and planning; design, construction, operations. All of these tasks must be performed, day after day, in order to produce the desired outputs relating to EQ.

Urban environmental quality management refers to managing the various types and forms of material and energy residuals, generated internally and externally, which affect an urban area, and which affect areas outside the urban area as a result of discharges from the urban area. However, UEQ managers in a particular

Figure A.3 Conceptual Schema of an Urban Environmental Quality Management System



Source: Modified from Bower and Sewell 1971.

urban area normally will have no jurisdiction over activities in other areas which *export* residuals to the given urban area.

Planning is the process of deciding what resources are to be allocated when to produce what products and services for whom, where. Planning is one of the tasks of UEQM. Given that conditions in urban areas in Asia are changing with great rapidity, analysis and planning—the latter being the decisions resulting from the analysis—should be carried out continuously. Thus, the focus is on *planning not on a plan*. What is required is to provide information for the next actions to be taken, the next investments to be made (capital and Operations and Maintenance [O&M]). The connotation of "plan" tends to be static, whether or not that is the implication the Bank wants to convey. A relevant analogy is to the planning procedures of typical western electric and water supply utilities, public and private. These procedures involve continual reassessment of: demands, supply possibilities and prices; system operation procedures; demand management options; technological trends in both supply and demand; demographic forecasts; and feedback from design/construction/operations to the analysis/planning activity. The thrust herein is simply to broaden that approach at the sectoral level to the multisectoral, UEQM level.

A *computational framework* for analysis for UEQM is a system which systematically links the analyses of the different elements of an urban (or regional) system—human activities, natural systems, effects of changes in AEQ on receptors—in order to generate quantitative information for resource allocation decisions. Various *analytical tools* can be, and are, applied to the different elements, such as an engineering-economic model of a steel mill, an ecosystem model of an estuary. [Terminology is virtually always somewhat arbitrary. Herein, the term "analytical" has been reserved for application to analytical "tools" applied to individual elements of the system, such as various forms of mathematical programming, various types of statistical analyses, various approaches to modeling natural systems. "Computational" is then reserved for the broader context.]

Strategy for UEQM in a given urban area is operationally defined as consisting of:

- a set of outputs, in terms of the time pattern of desired indicators of EQ over space;

- a set of physical measures/facilities needed to produce outputs, and the related personnel for operation and maintenance;

- a set of operating procedures, specifying which measures and facilities are to be operated when and how;

- a set of implementation incentives to induce actions by public and private entities/ activities to reduce discharges or otherwise make changes to improve AEQ;

- an institutional arrangement which allocates the various tasks of UEQM among relevant public agencies and private entities, including the authority to impose implementation incentives on activities; and

- a financial program for supporting all of the management costs over time.

Residuals (nonproduct outputs). Because no production or use activity transforms 100 percent of the material and energy inputs to an activity into products/services/utilities, there are always remaining streams of materials and energy, termed *nonproduct outputs* (NPOs). No matter how efficient a society becomes, there will always be gaseous, liquid, solid, and energy nonproduct streams form various activities, which streams require management.

Traditionally these NPOs have been termed "wastes." However, many of the NPO streams contain materials and/or energy of value. Therefore, an NPO is termed a *residual* only when the *cost* of collecting, transporting, and processing the NPO to obtain desired material(s) or energy is *greater than* the value of the recovered material(s) and/or energy. The value of an NPO depends on the relative costs of other materials and energy which can be used instead of the NPO, as inputs into other production activities, at the same site or at other sites. These costs in turn depend on the level of technology at the point in time, and on various governmental policies which affect the prices of raw materials. Technology and policies typically change over time. Hence what is a residual at one point in time may become a valuable raw material at another time; and the reverse.

The *discharge* of a residual *from an activity* does not occur until the residual crosses the boundary of the site of the activity—an industrial plant, an hot .. apartment house—in or from a pipe or st: via overland runoff to surface water bodies, via seepage to ground water aquifers, via vaporization or entrainment into the atmosphere, by truck or rail car. The residual may or may not be modified before discharge into the environment or transport from the site of the activity.

Figure A.4 shows the definition of residuals generation and discharge. It also shows definitions of materials and energy recovery and of byproduct production. The notes indicate what the economically efficient position for the activity would be, with no external constraints.

There are two basic types of residuals, material and energy. There are three forms of material residuals, namely, liquid, gaseous, and solid. Energy residuals are exemplified by heat and noise.

An *activity* is operationally defined as consisting of a set of unit processes and operations, including the transport mechanisms between the processes and operations. Examples include a restaurant, an apartment house, a shopping mall, an industrial operation, a sewage treatment plant, a materials recovery facility (MRF). Depending on the nature of the urban area, on the relative importance of different sources of discharges, and of the available analytical resources, different disaggregations of activities will be necessary, and logical. Each activity generates nd discharges residuals into the various environmental media. In addition, an urban area as a whole is considered a generator and discharger of residuals, via urban storm runoff and via entrainment of particu'ıtes by wind. As pointed out by the World .'ank (1991b, p. 154), "urban runoff is a major source of nonpoint pollution."

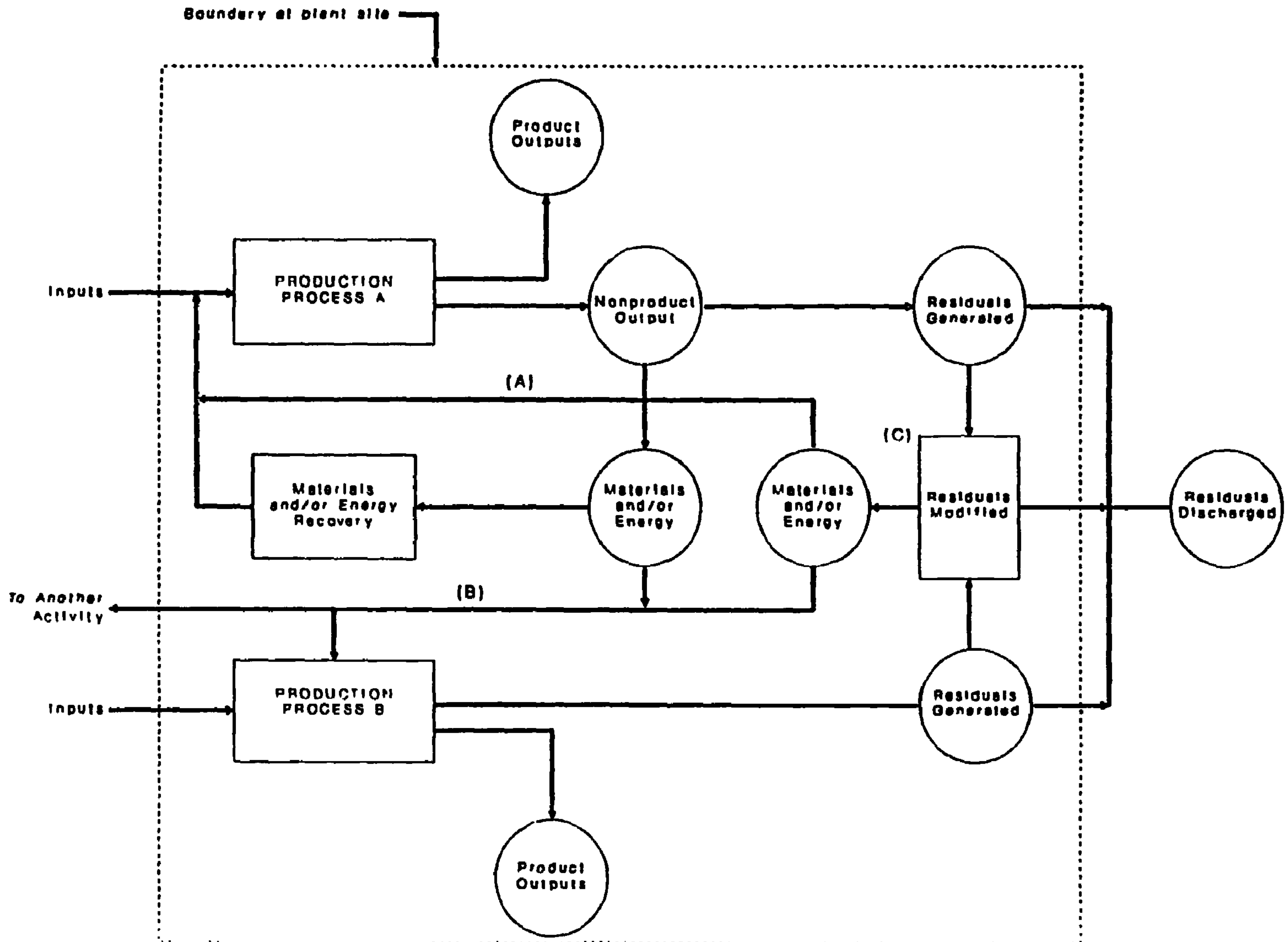
Waste minimization is a term which can be very misleading, unless the context or boundary of analysis is explicitly provided. For example, if the purview is for a particular industrial operation on a given site, and with no regard for the environmental effects at other sites where inputs for the given activity may be produced, "minimizing wastes" at the site may result in significant increases in the generation and discharge of wastes at sites providing inputs. In addition, does "minimizing wastes" mean reducing the discharge of all wastes, or only some wastes? Does one minimize wastes when discharges of certain particularly noxious wastes, small in amounts, are reduced, but increased energy use is required to achieve that reduction? Generating energy results in the discharge of many wastes.

Consumer is a term which *should* include many more actors than the "individuals" implied in the discussion of demand and supply curves in the classical and neoclassical economics textbooks. Many buyers and purchasers of goods and services are "institutions"—governmental agencies, universities, school system food services divisions, industrial firms, office building management firms, hospitals. In the context of UEQM, it is important to recognize this wide array of decision makers whose activities have to be influenced by the set of implementation incentives of the UEQM strategy, if the desired levels of AEQ are to be achieved. Some, perhaps many, of these institutions are publicly owned, and do not respond to market incentives.

Some Facts of Life

In developing the capacity to do analysis for UEQM and to perform other UEQM tasks, it is important to recognize some "facts of life."

Figure A.4 **Definition of Residuals Generation and Discharge**



Note: (A) Materials and energy recovery will take place up to the level where marginal cost of recovery equals the value of the recovered material or energy, within the context of whatever external constraints exist.
(B) By-product production path, either in on-site or off-site facilities.
(C) Residuals modification for materials or energy recovery will take place only to the extent that overall costs of meeting discharge constraints are decreased by such recovery.

The following are relevant to urban areas in developed and developing countries alike.

Institutional Facts of Life

- In virtually all contexts of UEQM, there will be a multiplicity of agencies with a splintering of responsibilities for the tasks of UEQM. Some, or many, of the governmental agencies involved will be producing entities, actually providing products and services, rather than having only administrative or regulatory responsibility for them. Some agencies will have responsibilities without authorities. In addition, a myriad of private entities, including NGOs, will be involved in the institutional milieu.

- The boundaries of the political jurisdictions in an urban area will rarely, if ever, coincide with river basin boundaries, airshed boundaries, ecosystem boundaries, economically efficient solid wastes management areas, as suggested by Figure A.5. Nor will they coincide with areas of demands on the urban area for products and services.

As recognition has occurred of, and knowledge has increased about, long-range transport of residuals, the upstream-downstream-coastal-marine physical, economic, and ecologic interrelationships have increased the difficulty of establishing viable linkages among institutions in order to carry out UEQM. An anadromous fish species, providing important protein for individuals in a coastal city, spawns in an upstream area, subject to stresses from activities in the spawning area, then must run the gamut of water uses and storage reservoirs and releases through turbines, on the journey downstream. In the ocean the fish faces fishermen from several nations. On the return journey to spawn, the fish finds the recreational fishers and commercial fishers waiting, and the uphill battle over the man-made obstacles now in his path to the spawning area. The fish, in this round trip, will come under the jurisdiction of dozens of different agencies. An independent urban area UEQM agency would have little influence over most of them.

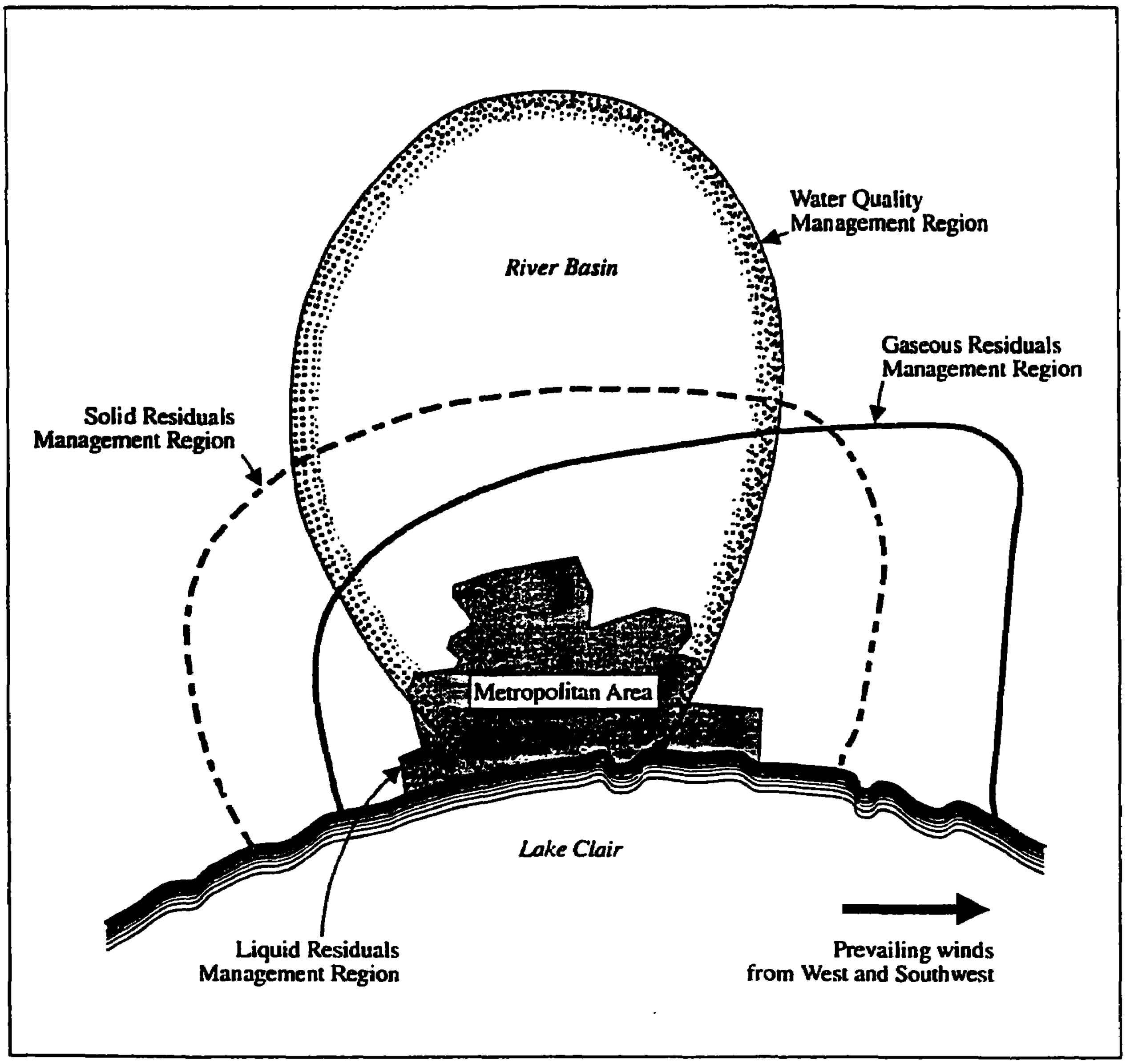
- The spatial pattern of activities in an urban area/urban region has major effects on AEQ, energy use, residuals generation, and EQM costs, as indicated in, for example, Regional Plan association (1974), Bower, Larson, Michaels and Phillips, 1968, and Real Estate Research Corporation 1974.

- Computational frameworks exist for analyzing EQM in urban areas, and in regions with several urban centers. Development began at least two decades ago; application has occurred in various contexts, as indicated in the box.

That computational frameworks have existed and have been used, does not mean that they cannot be improved. In addition, applications are needed in various contexts to demonstrate how a framework can be adapted to different situations, including: (1) mix of activities; (2) number of competent analysts available; (3) existing data; (4) time available in which to generate the first outputs; (5) physical settings (geomorphologic, hydrologic, meteorologic); and (6) institutional and cultural milieu. The same level of sophistication of analysis is not suitable everywhere. In many cases, *simple* analytical tools are sufficient, especially for "first round" analyses. Such analyses should identify some major problems and hence the first actions to be taken, leaving the next actions to be taken to be determined by probably more detailed analysis.

It should be emphasized that, even if more time and analytical resources are available, it may well not be justified to use more sophisticated analytical methods. If the estimates of discharges are no more accurate than by a factor of two or three, which is not unlikely, there is no justification for developing a sophisticated aquatic ecosystem model.

Figure A.5 Non-Contiguous Boundaries of Metropolitan Area and Management Areas



Source: Bower and Sewell 1971.

Physical Facts of Life

- *Interrelationships exist among forms of material residuals*, i.e., one form can be transformed into another during production and modification on the site of the activity. Interrelationships also exist between material residuals and energy residuals. Once discharged to the environment, residuals are not stationary. They are transported and transformed by natural processes in the three environmental media, and often move from one medium to another.

A critical implication of the foregoing is that different residuals modification methods and systems may pose significantly different hazards to humans and other species, because of the different pathways of exposure. A small amount of a substance, such as lead or cadmium, discharged to the atmosphere may have greater or lesser adverse effects than, or the same adverse effects as, the same amountdischarged to surface water—where it may be taken up by various species—or onto the land, from where plant uptake may occur. In both cases the material gets into the food chain. Simply separating the undesirable material from a residuals stream does not solve the problem; the separated material still requires disposal. Heavy metals in residuals streams are not destroyed in any processing, recycling, reclamation activity. Depending on the characteristics of the modified residual (sludge, ash, compost) and the environmental medium (soil, water), the heavy metals may become more or less available to various species.

- *Removal of undesired materials or energy from a residuals stream* requires inputs of materials and energy, which in turn become residuals discharged to the environmental media. Thus, "waste treatment" (end-of-pipe) actually *increases* the total quantity of residuals discharged to the environment. Only reduction in *generation* can reduce the total quantity of residuals discharged. Waste treatment is adopted under the assumption that the mix of residuals discharged *after* treatment will have fewer adverse effects on the environment that the mix of residuals discharged *without* treatment.

- *Costs of removing materials or energy* from a discharge stream increase approximately exponentially as the degree of removal increases, assuming that the activitiy is at its least cost point of its production function.

- *Accumulation* of conservative (nondegradable) materials, such as heavy metals, in the environment is common, if not universal. Accumulation of slowly degrading materials,

EXAMPLES

Urban Areas/Urban Regions

Ljubljana, Yugoslavia: Basta, Kounsbury and Bower (1978)
Lower Delaware Valley, Pennsylvania/New Jersey/Delaware: Spofford, Russell and Kelly (1976)
New England coastal area: Isard and others (1968)
Hunter Valley, New South Wales: James, Chambers, Gilbert and Wright (1983)
Tokyo Bay region: Bower and Takao (1993)
Addis-Abbaba: Whitney and Dufournaud (1982)

U.S. Environmental Protection Agency Integrated Environmental Program: Philadelphia; Kanawha Valley, West Virginia;
Santa Clara Valley, California.

Larger Regions

Arizona: Kelso, Martin and Mack (1975)
Susquehanna River Basin: Hamilton, Goldstone, Milliman, Pugh, Roberts and Zellner (1969)
Upper Colorado River Basin: Howe (1975)
West Virginia: Miernyk and Sears (1974)

such as DDT, PCBs, also occurs. Accumulation occurs in sediments, birds, animals, and vegetation.

- *Long-range transport* of materials, especially via the atmosphere (such as acid precipitation) results in deposition of chemicals hundreds and thousands of miles from discharge locations. This phenomenon has major implications for UEQM. In some cases it may be that reducing discharges *within* a particular urban area or region would not enable meeting desired levels of AEQ because of "imports."

- *The capacity* of the environment to assimilate residuals *varies substantially*, daily, weekly, seasonally, year-to-year, as a result of variations in hydrologic and meteorologic conditions. The same physical measures to reduce discharges will not produce desired AEQ levels under "adverse" environmental conditions, if those measures were designed in relation to mean conditions.

- *Substantial, often large, variations occur in residuals generation and discharge* in most activities, even activities which operate 24-hours every day, except for downtime for maintenance and lack of demand.

Computational Framework

The focus in this section is on a computational framework for the generation of information for decisions with respect to UEQM. The focus is *not* on a framework for management per se, which involves the totality of tasks of management. Development of a framework for management involves the analysis of the institutional milieu in a given culture/country/region, in order to develop a feasible specification of the *linkages* among, and *allocation of responsibilities to*, the multiple entities involved in carrying out the various tasks of management. The most appropriate institutional arrangement will vary among countries, and even among regions within countries. Thus, the analysis of possible institutional arrangements for UEQ *Management* must be done by each Bank SOD or COD. However, the computational framework explicitly includes a part of the institutional analysis, as indicated below, because the institutional arrangement will affect the implementation of some segments of the computational framework. The computational framework explicated herein assumes:

- an institutional context exists in which analysis and decision-making comprise a continuous process;

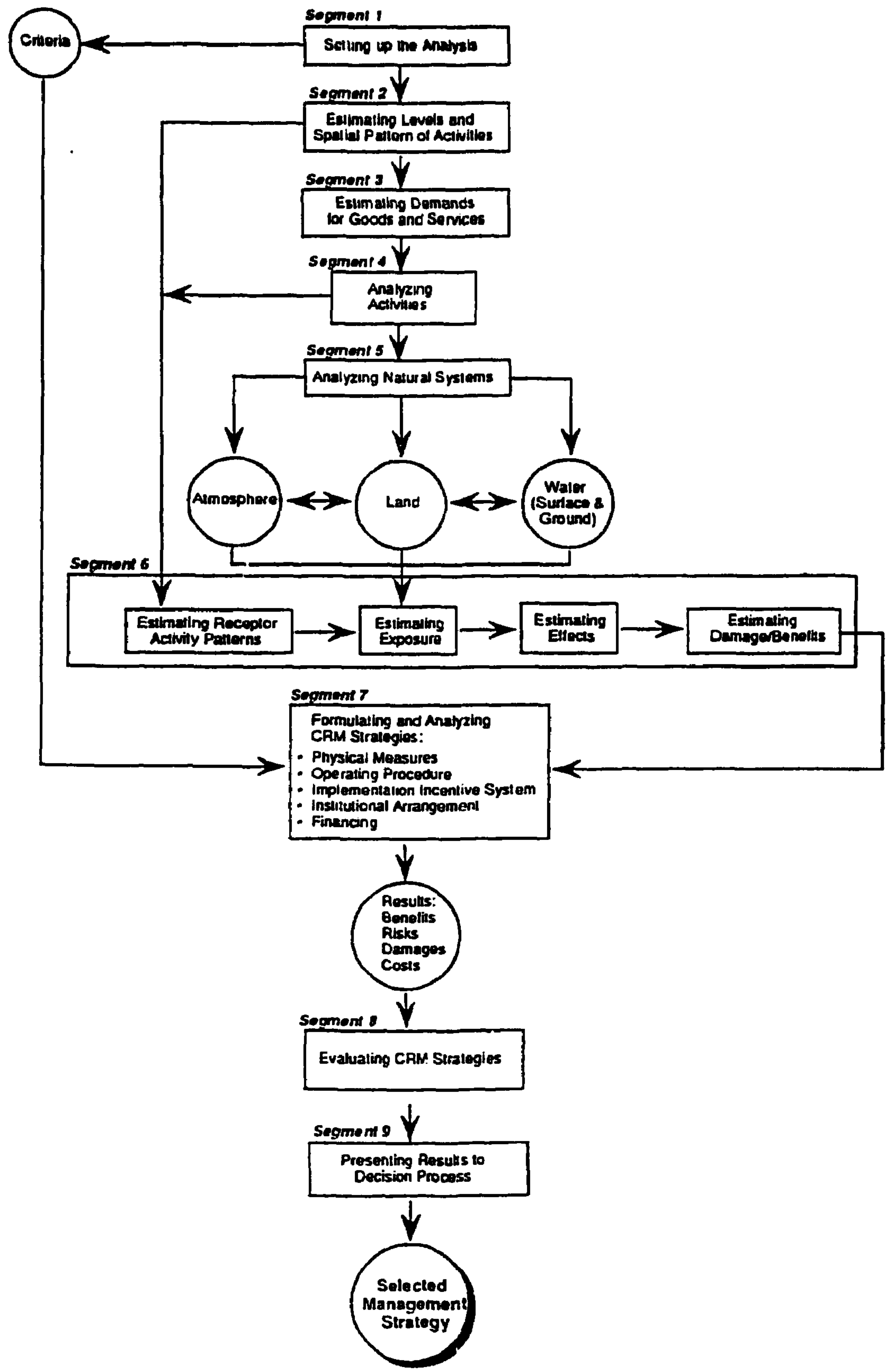
- that information on specific next steps to take must be generated at various points in time, as inputs to decisions;

- that using 20-year time horizons and several scenarios in the analysis comprise an operational procedure for determining the *next steps* to take but within a longer-run context.

The development of a *computational framework* begins with a conception of the system—the interacting elements thereof—which is to be analyzed, whether that system is an urban area or an aquatic ecosystem. A simplified conceptual framework of an UEQM system was presented earlier in this appendix. The system is driven by the final demands of society—the goods and services desired. This in turn drives the spatial pattern and levels of production and use activities, an example of the latter being households. These activities (manufacturing, retail operations, universities, hospitals, residences of various types) are the residuals generators and hence "demanders" for the use of the environmental media for direct or indirect disposal of their residuals. These activities are also major demanders of improved AEQ, given the often adverse effects on these activities of degraded AEQ. They are both "polluters" and the "polluted".

The activities may discharge their residuals unmodified into the environment. Or they may undertake, individually or collectively, various types of modification measures, before dis-

Figure A.6 Conceptual Framework for Analysis for Urban Environmental Quality Management



charging—materials/energy recovery, byproduct production, reclamation, or "waste treatment." The time and spatial patterns of discharges enter the environmental media, in which they are transported, often transformed, deposited, reentrained. The result is change in the time and spatial patten of EQ, as measured by various EQ indicators—chemical, physical, biological—applied to both indoor and ambient environments. The short-run and long-run changes in EQ affect various receptors, including humans, plants, animals, materials. The effects on receptors are a function of exposure, which in turn is a function of mobility, and of any protective measures imposed between the environment and the receptors (for example, intake water treatment).

The other elements of the system represent the institutional response mechanism of a society, at urban, regional, national levels. If the EQ problems are considered to be sufficiently adverse, in relation to other problems, various parties at interest are likely to try to stimulate action to improve EQ. Through the interaction of formal and informal power structures of a society, decisions will be made and an urban EQM strategy will be selected, and—hopefully—implemented. This assumes that the net impact of the strategy is more positive than a strategy of doing nothing.

In order to generate information for decisions, a conceptual framework must be translated into a *computational framework*, one which will enable analyzing the elements of the system for different values of the relevant parameters and of the decision variables. *A computational framework is a set of linked analyses, either formally linked by an algorithm, or linked in the sense that the output of one analysis or the outputs of several analyses become the input or inputs into another analysis.* Thus, a computational framework can be thought of as being analogous to a CPM or PERT diagram, either one representing a set of connected analyses or activities to produce an output in some specified time.

Figure A.6 shows a computational framework for analysis for UEQM, in terms of a set of segments of analysis. Carrying out the analyses for the various segments requires analytical tools or techniques from economics, engineering (civil, chemical, industrial), ecology, and institutions (including public administration, sociology/anthropology, political science). The major problem in analysis for UEQM is finding staff capable of *integrating* the various disciplines and the analyses of the segments.

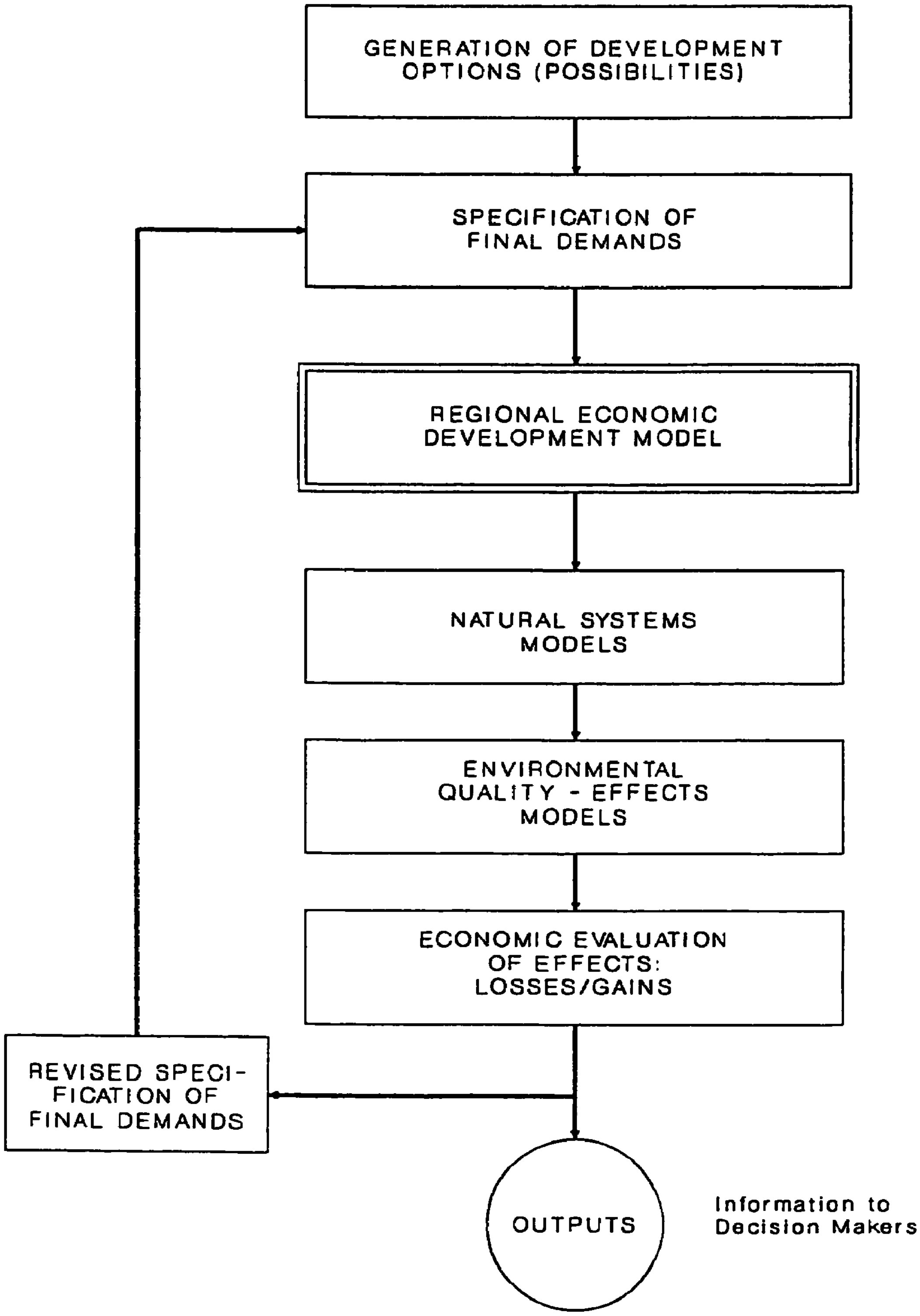
Uses of a Computational Framework

A computational framework has at least two critical uses in terms of the urban and industrial activities of the Asia Region. One is to provide a framework for linking analyses (and implementation) of various projects (for example, industrial, water supply, transportation) in terms of their joint and separable environmental (and economic) effects. The converse is that the individual industrial, sewerage, transportation projects will provide inputs into the urban area analysis, thereby aiding in determining which problems are more important than other problems, thus helping to set priorities.

The second use is to provide a means for estimating the effects of various proposed activities on indicators of EQ (for example, what is likely to be the change in SO_2 concentration at street level as a result of a coal-fired power plant, or the change in CO concentrations at street level of a specified transportation alternative). Given the costs of the alternatives to achieve improvement in relation to a given indicator, cost-effectiveness can be determined, for example, whether a power plant project or a transportation project is more cost-effective in reducing particulate concentrations at street level. Combining the cost-effective analysis with estimates of exposure of different segments of the population yields information on who gains, or who is continuing to be adversely affected, by UEQM strategies.

This second use appears to go beyond most of the project analyses currently undertaken by the Bank, or under the auspices of the Bank. For example, industrial projects have indicated

Figure A.7
Computational Framework for Analysis for Regional Economic Development



how different measures would reduce discharges of particulates or SO_2. Such analyses in themselves can not indicate what the estimated reductions would mean in terms of the spatial distribution of mean annual SO_2 concentration, or SO_2 concentration during inversion periods. The effect on AEQ can only be estimated in relation to all other discharging activities which contribute to AEQ in the area, by using one or more natural systems models.

This second use is analogous to, and should be considered a corollary part to, the proposed development of service level indicators (SLIs). If a project were to bring piped water supply 24 hours a day, 7 days a week, 52 weeks of the year, to a particular segment of the population of an urban area, in contrast to the former complete lack of piped water, the service to the population would be very much improved. Analogously, if a transportation project were to decrease concentrations of CO, HC, and NO_X to which some segment of the population is exposed by approximately 50 percent, this would be a significant improvement in the "service" provided by the ambient air environment.

To make such estimates involves: Segment 3, Analyzing Activities; Segment 4, Analyzing Natural Systems; and Segment 5, Analyzing Effects (Figure A.6). The first involves identifying and then modeling the factors that determine the inputs to, and the residuals discharged by, various point, nonpoint, line, and mobile sources. Thus:

INPUTS[1] REQUIRED FOR AN ACTIVITY, and

RESIDUALS[2] DISCHARGED FROM AN ACTIVITY

= f (RM, PP, Product mix, Product specifications, C_W,

C_E, C_{MR}, C_{SWD}, E*, meteorological/hydrologic conditions, factor prices,....)

where,

RM = raw materials;
PP = production technology (processes and operations);
C_W = costs of water;
C_E = costs of energy;
C_{MR} = costs of materials recovery;
C_{SWD} = costs of solid wastes disposal; and
E* = effluent (discharge) charges/constraints.

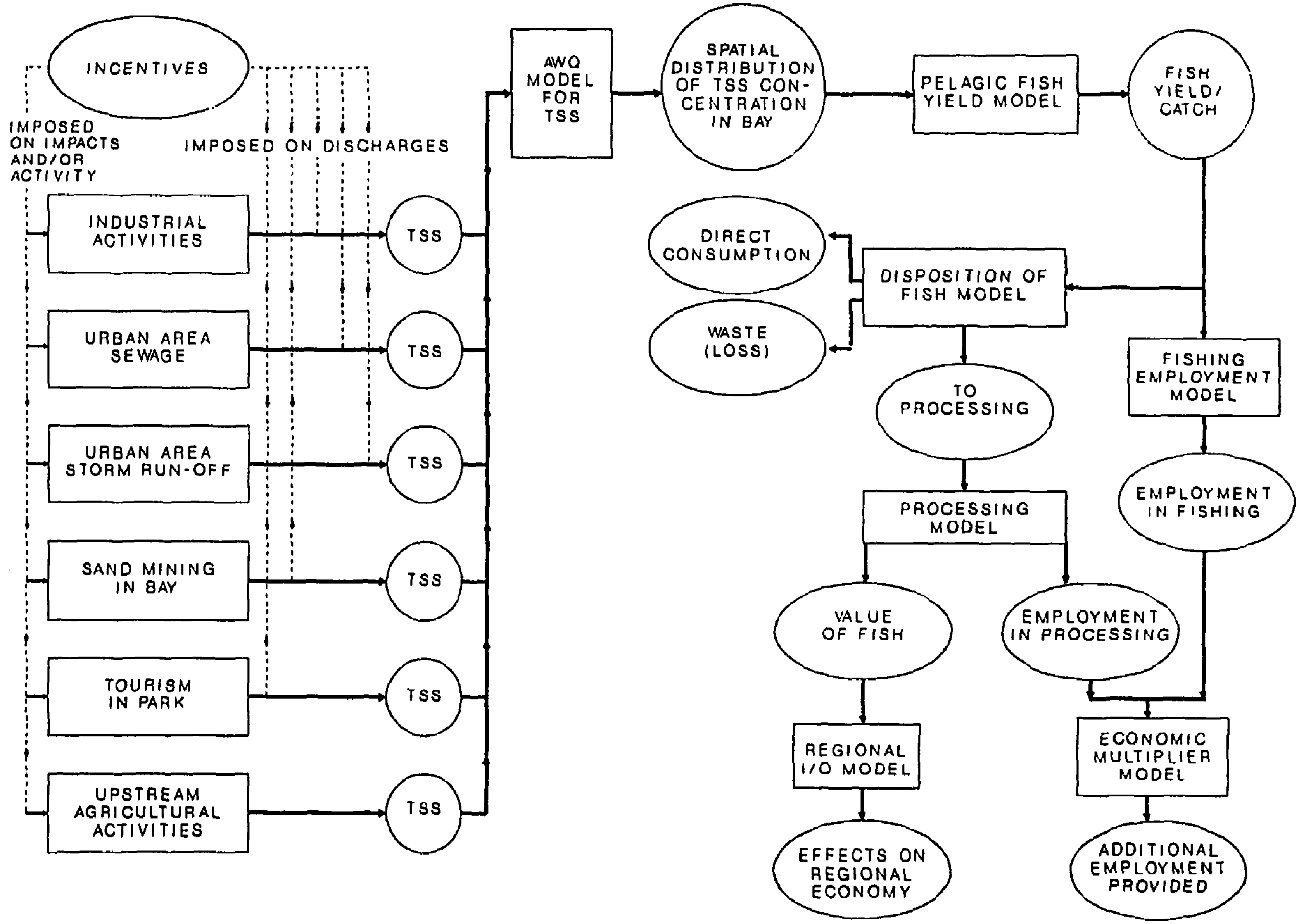
[1]E.g., chemicals, steel, labor, capital, land.
[2]E.g., TSS, SO_2, HC, CO, Cd, Hg, BOD_5, NH_4, waste heat

Segment 4 requires the capability of analyzing what are termed "natural systems," although essentially all ecosystems have been modified to some degree by anthropogenic inputs. Types of natural systems models include those for: surface waters (streams, rivers, lakes, estuaries, coastal waters); ground water aquifers of various types; sediment transport and deposition; atmospheric transport, at local, regional, continental scales; geomorphological changes; terrestrial and aquatic ecosystems; and food chains. In many cases relatively simple models are sufficient to obtain the desired answers with sufficient accuracy; in other cases quite sophisticated models are necessary.

The outputs of Segment 4 become the inputs into Segment 5, which involves analyzing the effects on receptors, and translating those effects into monetary terms to the extent possible. Effects are a function of exposure, and exposure in a function of the patterns of movement of the receptors. Various methods are available for estimating monetary damages or benefits to receptors, as a function of effects. These are discussed in Hufschmidt, James, Meister, Bower and Dixon (1983).

The fundamental premises herein with respect to the analysis are: (1) that the analysis will be quantitative, and thus provide a basis for Bank investment decisions; and (2) that the analysis will result in the costs and consequences of alternative UEQM strategies, and the distributions of these costs and consequences.

Figure A.8 **Sequence of Analysis for Bay of Dreams: Steady State Impacts of TSS on Fisheries**



Note that Segment 6 includes the analysis of implementation. That is, as stated earlier, a strategy for UEQM includes the implementation incentives necessary to induce actions by activities, the institutional arrangement for imposing the incentives and for carrying out the tasks of UEQM, and a program for financing the tasks. Although the analysis of these aspects cannot be as quantitative as those for the previous segments: (1) it can and should be rigorous; and (2) it must be tied to the previous segments of analysis.[1]

UEQM and Regional Economic Development

Originally, the computational framework for analysis for UEQM was applied to a current or near future set of conditions—spatial pattern and levels of activities in an area, assuming the levels to be fixed (Ljubljana), or to the spatial pattern and levels of activities at several points in time (New York Region, Tokyo Bay region). The purpose of the analysis was to determine the least cost set of measures to achieve various specified levels of AEQ, under various sets of conditions including governmental policies, where AEQ was measured in terms of various indicators of ambient air quality, ambient water quality, concentrations in sediment, and sophistication of landfill operations for solid residuals. The distribution of costs and the distribution of improved AEQ were among the outputs of the analysis relevant to selecting an UEQM strategy.

Subsequently, the computational framework was expanded to combine analysis for UEQM with analysis for regional economic development. In this context, alternative regional economic development programs were posited and evaluated with respect to net regional product, i.e., gross regional product minus costs, where costs include various environmental costs and benefits. The objective function used was:

$$\text{MAX } [GRP - C_p - C_{dr} - D + B - C_a],$$

where,

GRP= gross regional product;
C_p= normal production costs;
C_{dr}= discharge reduction costs;
D= remaining environmental damages;
B= environmental benefits not incorporated in GRP; and
C_a= UEQM (or regional EQM) administrative costs.

This approach and this objective function are consistent with the objective in the Singrauli project (India: Proposed Singrauli Development and Environmental Strategy Study, Draft TOR, The World Bank, 26 October 1990). The first output of the project is to be "a regional development and environmental strategy which places the economic development of the region in the context of environmental sustainability and appropriate environmental standards" (ibid, p.12). Operationally, a computational framework for producing this integration is shown in Figure A.7. In practice, the "regional economic development model" has been an input-output model of the regional economy. Driven by the estimated final demands reflecting alternative development programs, the regional economic model computes the required inter-industry transactions necessary to achieve the specified development program, and the resulting discharges into the environmental media. The changes in AEQ affect various receptors, such as fish. These effects, translated into monetary terms, affect the regional economy, negatively or positively. Various economic development programs and UEQM (or REQM) strategies for *each* proposed development alternative can be tested. The search is continued until that combination of development program and UEQM strategy is found which yields the largest value of the objective function.

Figure A.8 shows an example of the sequence of analyses used to obtain quantitative estimates of the effects, in a regional economic development context. A given development program combined with an UEQM strategy, which includes various incentives imposed on the different activities, is estimated to result in various magnitudes of discharges of total suspended solids (TSS) into a given body of water. The natural system model translates these discharges into the resulting effects on AWQ. The changes in AWQ affect fish yield, and hence fish catch, for some level of fishing effort associated with the regional economy. The sequence of analysis is followed until the effects on the regional economy are derived in monetary terms, in employment terms, and in terms of household income.

Notes

1. Detailed discussions of the segments of analysis are in Bower, Ehler and Basta (1982) and Bower, Spofford and Waddell (1987). The computational framework presented cursorily here is consistent with, but somewhat more extensive than, the approach described in Annex 6 of Environment, Human Resources and Urban Development Operations Division (1991b).

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