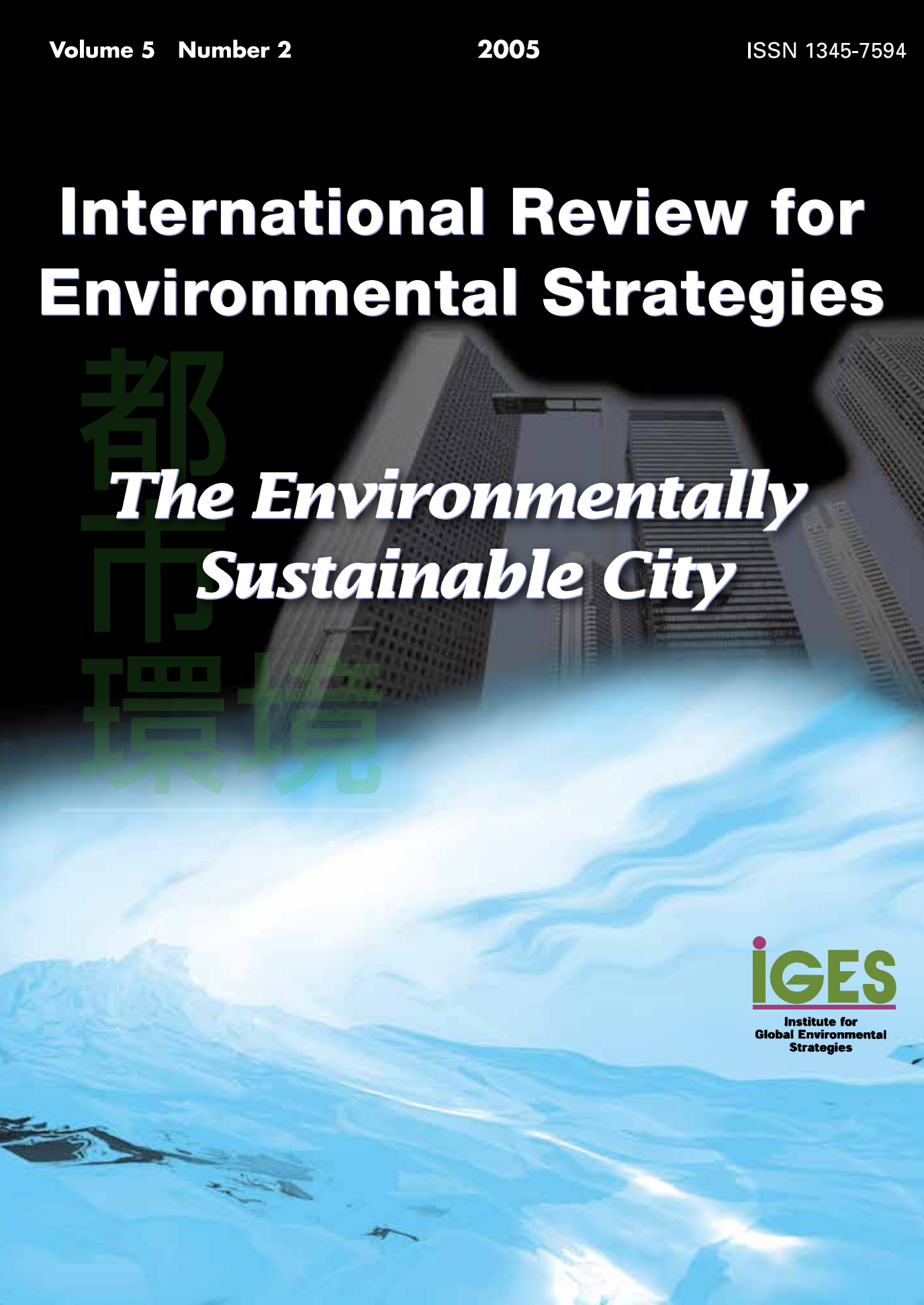
Volume 5 Number 2 2005 ISSN 1345-7594

International Review for Environmental Strategies



The Environmentally Sustainable City

IGES
Institute for Global Environmental Strategies

International Review for Environmental Strategies

Volume 5 Number 2 2005

Institute for Global Environmental Strategies
Japan

Orders and product inquires:
Please contact the IGES Secretariat, Institute for Global Environmental Strategies, 2108-11 Kamiyamaguchi, Hayama, Kanagawa, 240-0115 Japan; Tel: +81-46-855-3730; Fax: +81-46-855-3739; E-mail: IRESinquiry@iges.or.jp.

Submissions:
For queries relating to the general submission of manuscripts including electronic text, and the status of accepted manuscripts, please contact the IGES Secretariat, Institute for Global Environmental Strategies; Tel: +81-46-855-3730;
Fax: +81-46-855-3739; E-mail: IRESsubmission@iges.or.jp.

© 2005 Institute for Global Environmental Strategies. All rights reserved.

Exclusive copyrights of papers in IRES belong to IGES. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from IGES.

Although every effort is made to ensure objectivity and balance, the printing of a book or translation does not imply IGES endorsement or acquiescence with its conclusions or the endorsement of IGES financers.

IGES maintains a position of neutrality at all times on issues concerning public policy. Hence conclusions that are reached in IGES publications should be understood to be those of the authors and not attributed to staff-members, officers, directors, trustees, funders, or to IGES itself.

Copy-Edit: Caspar Trimmer
Print: Sato Printing Co. Ltd.

IGES has entered into a licensing partnership with EBSCO Publishing, a leading database provider to the library marketplace. The text of IRES can be found in these databases, marketed worldwide to libraries.

Editor's Note

According to an estimation by the United Nations, 15 cities in the Asia Pacific region will become megacities with a total population exceeding 10 million by 2015, and 60 percent of the total population in the region will live in urban areas by 2030 (APFED 2005). Urban environment management in Asia is now one of the most critical subjects. Being focused on the Asia Pacific region, the topic of the urban environment is something that *IRES, International Review for Environmental Strategies*, cannot ignore.

In this special *IRES* issue on the 'Environmentally Sustainable City', we have acquired a number of article contributions from distinguished scholars. The articles give broad perspectives of the urban issues, including air, solid waste, water, and ways to manage and foster cooperation among different stakeholders. It is our hope that this information will suggest ways to tackle the problems surrounding the urban environment.

IGES is also vigorously working on the issue of urban environmental management. Two activities among others are worth noting on this occasion of the publication of an *IRES* special issue; the Kitakyushu Initiative and Asia-Pacific Forum for Environment and Development (APFED).

The Kitakyushu Initiative was adopted by the Ministeral Conference on Environment and Development in Asia and the Pacific (MCED) in 2000, to assist in the priority implementation of the Regional Action Programme for environmentally sound and sustainable development in the Asia Pacific region. It mandates the achievement of measurable progress in the improvement of the urban environment in cities, mainly through local initiatives aiming to control air and water pollution and to minimize all kinds of waste. IGES assists it as its secretariat to gather and record successful cases of urban environmental management. Some of its progress and results are reported in this issue of *IRES*.

APFED was established by the Environment Congress for Asia and the Pacific in 2001 as a forum to address critical issues facing the Asia-Pacific region and to propose a model of equitable and sustainable development for the region. IGES contributes to the APFED deliberation process by providing relevant background information, drafting necessary documents for the Forum and its associated meetings, and proposing options for policy recommendations. A report from APFED, giving an overview of the Asia-Pacific region, its future vision and recommendations, and an action platform is included in this issue of *IRES*.

We look forward to contributions from readers of *IRES*, to keep its future issues useful, and to tackle the environmental problems we face in the Asia Pacific region.

Akio Morishima
Chair of Editorial Board
International Review for Environmental Strategies
Chair of the Board of Directors, President
Institute for Global Environmental Strategies

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 331 – 334, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Editor's Note

Since the 1970s, Asia has been engaged in a process of rapid economic growth through industrialization, with urban populations growing rapidly. This is causing a variety of environmental problems in the region: air pollution due to increasing vehicle traffic, shortage of clean water supply, pollution of urban rivers, and an increasing volume of municipal solid waste associated with higher levels of material consumption.

In 1800, London was the only city in the world with a population of over one million, and the total population of the world's top 100 cities was less than 20 million. By 2000, the world's top 100 cities were home to 540 million people, of whom 220 million lived in "megacities" with populations of over 10 million. Moreover, 35 cities exceeded five million in population, and several hundred cities were home to over one million people. The degree of urbanization, however, varies by country, as seen in terms of the urbanization ratio—the percentage of urban dwellers compared to the national total population. In Europe and North America, the shift from rural to urban populations was completed between the nineteenth and the mid-twentieth century, when urbanization rates stabilized at 70 to 80 percent, while urbanization after the Meiji Restoration[1] in Japan was slightly behind Europe and North America. In contrast, developing countries in Asia and Latin America were the main global players in population growth and urbanization in the latter half of the twentieth century.

It must be noted that the impact or "footprint" of urban activities does not stop at the city limits. Cities not only affect their local environments but also have large impacts at the global level through the consumption of food, energy, and other resources. As urbanization will continue globally in the coming years, it would be no exaggeration to state that the fate of cities is the fate of the world and that urban sustainability actually means global sustainability. Following the UN Conference on Environment and Development in 1992, the idea of sustainability started to attract serious attention in governmental policies and corporate management, as well as in personal lifestyle decisions. Related to this, the term *sustainable cities* began to enter the vernacular when discussing cities.

What we must keep in mind in discussing how to build "sustainable cities" is that not all cities are alike—there is a huge difference between mature cities in developed countries and "young" cities in developing countries. In mature cities in Europe and North America, the basic infrastructure has already been built, and the challenge is now to make qualitative rather than quantitative improvements. In contrast, young cities in developing cities can not keep up with the construction of the large amount of infrastructure needed to support their enormous populations and production and consumption activities. This situation stifles economic growth and results in a variety of urban environmental problems. The phrase *young cities* does not literally mean that they are young, but it means they have only relatively recently started developing into modern cities with good public services and basic environmental infrastructure such as urban sewerage systems, solid waste collection and disposal systems, parks and green space, and so forth. Even in developed countries, not all cities are necessarily mature; many could

1. In 1900's.

still be considered young in terms of social infrastructure. For example, many of Japan's small and medium-sized cities could still be considered young, as they still have inadequate infrastructure for sewage treatment compared to cities in Europe and North America.

Urban environmental management is one challenge facing young cities in Asia. At the same time, they face a number of other issues. While on the one hand some cities—a number of coastal cities in China, for example—are enjoying the benefits of rapid economic growth, many of these cities are also experiencing huge inflows of poorer people from the surrounding areas, and some cities are unable to control urban sprawl. While it could be said that environmental problems are one result of economic development, it is also true that without economic development, there is no effective way to solve environmental problems.

If one is to attempt a discussion on the concept of sustainable cities, it is impossible to avoid one basic question: exactly what is sustainable development and sustainability? There has already been much debate about the meaning of these terms, but it is not easy to offer a simple answer. First of all, there is a difference of opinion between developed and developing countries in terms of priority—should the emphasis be on improving human standards of living or on protecting the environment? In short, there is a diversity of opinion when it comes to the question of how humans should actually be managing the earth's ecosystems. Besides this, there are socio-political challenges like eliminating urban poverty, protecting the vulnerable people in society, ensuring equity, and securing public participation in political decision-making processes. The ways chosen to address these challenges are also important topics for sustainable cities.

In this context, when we consider the environmental impacts of urban activities and the sustainability of cities, we encounter the question of balance with the "environmental space" or "eco-space" of cities. We must consider both the *absolute measures* of urban activity (for example, urban population, area, or resource consumption of the city), and the *intensity* of each item per unit of area. For example, because rivers have a self-purifying function, if the concentration of pollutants discharged from urban activities is low, the river will clean itself up at the local scale. However, if the urban area is large, even if the environmental load is small at the local scale, the total load will be large and may exceed the environmental space of the region. Above all, the most important thing needed to control the environmental burden is growth management, which means the exertion of control on the expansion of urban populations and economic activity. Many difficulties arise, however, when attempting to control and coordinate all of these measures.

The above is the thinking that underlies this issue of *IRES* on the Environmentally Sustainable City. We invited renowned authors who have been working on various topics related to urban environmental management to write papers that could inspire discussion on the issues involved in developing sustainable cities in Asia. We also sought contributions from other authors on several topics that were not covered by the invited papers. This volume starts with three overview papers on basic questions in urban environmental management and the state of urban environments in Asia. The later papers cover specific topics in air, water, and solid waste, and the issue concludes with two papers discussing the role of civil society and international cooperation among cities for achieving sustainable urban development.

Gordon McGranahan focuses on the importance of scale to understanding urban environmental burdens and sustainability. He discusses the environmental burdens within urban areas in contrast to environmental burdens within larger urban regions and those on the global scale. He discusses the role of indicators such as ecological footprints in understanding the impacts of cities upon the global eco-system, and discusses the policy agenda to resolve the question of burden sharing between high-income and low-income settlings. Hidefumi Imura, Sudhakar Yedla, Hiroaki Shirakawa, and Mushtaq Memon contribute a review of the state of urban environments in Asia. Their paper presents basic trend data on urbanization and environmental quality and discusses transport management strategies for air quality, financing for water supply and sanitation, and improving efficiency in material cycles. Peter Newman discusses sustainability assessment and cities. Referring to recent attempts in Australia, he discusses how to integrate environmental matters with economic and social considerations, taking up three types of systems: complex and strategic projects; policies, programs, and plans; and buildings and developments.

Shobhakar Dhakal and Lee Schipper focus on urban transport in Asia. Many Asian cities lack appropriate public transport services, and rely heavily upon vehicular traffic to respond to increasing demands for mobility. A number of past studies show that health risks from air pollutants emitted from mobile sources are high, and air pollution control is one of the big challenges for Asian cities. In this context, their paper analyzes the development of urban transport and the factors behind it, and discusses emerging policy issues. Absar Kazmi and Hiroaki Furumai present a paper on urban wastewater treatment in Asia. Many Asian cities do not enjoy sewerage services because very rapid increase in urban population and financial shortages make it difficult for them to make the large investments necessary for the construction and maintenance of urban sewerage systems. This paper discusses the factors behind the low coverage of sewage services, assessing conditions in different countries. Atsushi Terazono, Yuichi Moriguchi, Yuko Sato Yamamoto and others take up relatively new issues related to material cycles. Building a sound material-cycle society has taken its place on the policy agenda in developed countries such as Japan, and many Asian countries are showing growing interest in the topic. Thus there have been emerging initiatives among Asian countries, and the authors discuss solid waste management in Asian cities from this perspective.

The last two papers discuss the roles of civil society and international cooperation. Nurul Amin sheds light on the role of the informal sector in urban environmental management. His paper traces the origins of the informal sector and urban environmental paradigms, and examines their points of intersection in solid waste management and water supply and sanitation. The paper then proposes strategies to strengthen the market-force-propelled beneficial role of the informal sector in urban environmental management. The last paper, by Mushtaq Memon, Christine Pearson, and Hidefumi Imura, discusses opportunities and challenges to local governments in international cooperation. The writers take up the experiences with the Kitakyushu Initiative, and discuss the major concepts that form the basis for inter-city cooperation to facilitate local capacity building.

This entire issues, with the papers I have briefly introduced, identifies major issues on the policy agenda for urban environmental management, particularly for rapidly growing Asian cities. Yet there are many important issues that it does not cover, such as urban sprawl, slums, and squatting, which have

their roots in poverty. In the trend of globalization and industrialization, Asian cities may be split into two groups: cities that are enjoying economic growth, and those that are marginalized from it. How to build sustainable cities based on global partnership is a big challenge for both mature and young cities in Asia.

Hidefumi Imura
Professor
Nagoya University
Director
IGES Kitakyushu Office

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 335 – 356, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

An Overview of Urban Environmental Burdens at Three Scales: Intra-urban, Urban-Regional, and Global

Gordon McGranahan[a]

This article focuses on the importance of scale to understanding urban environmental burdens and sustainability. It examines urban environmental burdens at three different scales: (1) within urban areas, where the central concern is how the quality of urban environments affects the lives of the people who live in them; (2) within urban regions, where relations between urban development and the state of adjoining ecosystems, resources , and waste sinks comes into focus; and (3) globally, where the emphasis is on the impact of urban production and consumption on global processes and distant resources. The spatial dimensions to urban environmental burdens are shown to be important ecologically, economically, and even politically. By focusing on a particular scale, it is easy to construct misleading accounts of the qualities of urban settlements that generate the environmental burdens. It is easy, for example, to present either urban poverty or affluence as the most serious threat to the environment, depending on whether the focus is on local or global environmental burdens. The article concludes with a comment on the implications for urban environmental agendas.

Keywords: Urban, Environment, Sustainable, Cities, Ecological footprint.

There is a long history of environmentalists presenting urban settlements in purely negative terms. This article follows a more recent tradition that recognizes that urban settlements are unsustainable in and of themselves, but also that they may provide the key to moving towards a more environmentally sustainable world (Rees and Wackernagel 1996; Satterthwaite 1997). Urban residents and their activities undoubtedly create environmental burdens, but even from an ecocentric perspective there should be no presumption that these burdens would be less if the same people and their activities were dispersed across the rural landscape. Urban settlements concentrate environmentally harmful people and activities, but they also concentrate the people who must change their ways if environmental burdens are to be reduced, and they can be made to provide opportunities and incentives for them to do so.

1. Environmental burdens in an urbanizing and economically growing world

People are growing in number, producing and consuming more, increasingly likely to live in urban areas, and placing growing pressure on the global environment. Behind these widely accepted trends lie complex and uneven processes that are difficult to define and disentangle. There is not even agreement on the meaning and measurement of urbanization, or on the relationship between economic

a. Director, Human Settlements Programme, International Institute for Environment and Development (IIED), London, UK.

production and human well-being, let alone on the consequences of urbanization and economic growth for the environment or the well-being of future generations.

It is widely agreed that, compared to rural settlement, urban settlement is associated with higher population density, larger settlement size, more centralized administrative functions, and a less agricultural occupational profile. But different countries, and in some cases even different agencies within countries, apply different definitions of urban, in terms of both the criteria applied and the cut-off points used (United Nations 2002b; Cohen 2004). In effect, international statistics are forced to rely on country-specific definitions that display numerous arbitrary differences (Montgomery et al. 2003).

The complex of demographic, social, and economic characteristics that once maintained a multidimensional urban/rural distinction has been unraveling for some time (Pahl 1965). Especially in affluent countries, agriculture has been becoming more industrial, and a great many rural dwellers have what would once have been considered urban occupations and lifestyles (Friedmann 2002). Urban settlements, on the other hand, have become less industrial. Moreover, better transportation and communications have blurred the distinction between urban and rural living.

Urban regions and extended metropolises have grown in importance (McGee and Robinson 1995), and in Asia the term *desakota*, combining the Indonesian words for village (*desa*) and city (*kota*), was coined to capture the emergence of new forms of economic interaction characterized by a concentrated mix of agricultural and non-agricultural activities that often stretches along corridors between large city cores (McGee 1987, 1991; Sui and Zeng 2001). Alternatively, the importance and special character of smaller urban centers is often neglected. Even in demographic terms the distinction between urban and rural fails to capture the changing densities and patterning of human settlements (Hugo, Champion, and Lattes 2003).

The concept of economic growth is also contended, particularly when taken as a goal that governments should aspire to (Lawn 2003). Few economists would claim that per capita gross national product is a good measure of human well-being, let alone "sustainable" well-being (Asheim and Buchholz 2004; Hamilton and Dixon 2003). Indeed it was not designed to measure well-being (Beckerman 1988). Among other things, the importance of inequality has long been recognized, and recent decades have brought increasing attention on the importance of maintaining social and environmental capital. Even for identifying households and individuals living in poverty, income levels can be very misleading (Satterthwaite 2004), and other dimensions of poverty such as social exclusion and environmental deprivation are receiving greater recognition (Rakodi 1995; Wratten 1995).

Yet even if concepts like urbanization and economic growth do not do justice to the complex shifts in human patterns of movement, settlement, and well-being, by virtually any measure urbanization and economic growth have been two of the most striking trends of the past century. They have occurred very unevenly, but usually in tandem. Over the course of the twentieth century, it is estimated that the world's urban population increased almost fifteenfold, rising from less than 15 percent to close to half of the total population. Over the same period, gross domestic product (GDP) at constant prices increased about 19-fold, or an almost five-fold increase in GDP per capita—with, on average, faster growth in rich than in poor countries (International Monetary Fund 2000). To a significant degree, rapid urbanization

has taken place in the locations where there has been rapid economic growth (Satterthwaite 2002). The relatively close relationship is hardly surprising: for much of the twentieth century, modern economic growth was predicated on industrialization, commercialization, trade, and the use of fossil fuels, all of which have helped to drive urbanization.

The expansion of urban land area is often presented as an environmental impact of urbanization, though urban settlements still cover less than 3 percent of the earth's total land area (McGranahan et al. forthcoming). Urban land area is a very poor indicator of the environmental burdens imposed by an urban settlement, however. On the one hand, many of the burdens of urban activities fall well outside urban boundaries, and depend upon the character and intensity of the activities. On the other hand, urban environmental burdens include hazards in the living and working environments in urban areas, which vary within and between urban areas.[1]

William Rees has compared urban settlements to anthills or cattle feedlots, characterized by extraordinarily high densities of their keystone species, and sustained primarily by biophysical processes that take place outside the high density areas themselves (Rees 2003). A city's urban land area only represents a small share of the land whose services are required to sustain the city; what has come to be termed its "ecological footprint" (Rees 1992). Moreover, as an urban area develops it leaves it imprint on the surrounding countryside in numerous ways, only some of which are directly related to the demands of the urban residents themselves (Cronon 1992).

Just as it is important to look to the extra-urban, it is also important to look at intra-urban scales, and in particular at urban environmental health profiles and how they vary within and between urban areas. Just as two cities of the same area can have very differently sized ecological footprints, so they can have very different environmental health profiles. Moreover, while more environmentally minded urban policies can reduce both environmental health risks and ecological footprints, they do not necessarily move together. Indeed, historically urban environmental burdens at different scales have often tended to move in opposite directions, as will be described in the following section.

2. The importance of scale

Urban environmental burdens vary enormously in scale. If fecal material from a latrine contaminates the water in a neighbor's well, the burden is, at least in the first instance, very localized. If, on the other hand, urban greenhouse gas emissions contribute to climate change, the burden is globalized. And to complicate matters, if an urban enterprise contaminates local wells and ships its products to distant cities, this is a local environmental burden from the perspective of urban production, but a global burden from the perspective of urban consumption.

There is also enormous variation in the severity of the environmental burdens cities impose, even among cities of similar populations and extents. Some urban and neighborhood environments are extremely unhealthy to live in, while others are not. Some urban centers release large quantities of waste

1. Urban environmental burdens can be defined as threats to present or future human well-being (or other things of value), arising from damage to the physical environment caused directly or indirectly by activities undertaken in urban areas (IIED 2001).

into the surrounding region, and deplete regional resources, while others of the same size are far less burdensome. And while the ecological footprint of virtually every urban settlement is larger than its urban area, ecological footprints also vary enormously.

The severity of urban environmental burdens at each scale depends upon the geographical setting; the social, economic, and technical characteristics of the urban settlement(s); and the measures taken to reduce the burdens. The severity of the burdens at different scales are interrelated, but are not always positively correlated. Reducing local environmental burdens, for example, can increase or reduce large-scale burdens, depending in part on the specific measures taken to relieve the local burden. Introducing a piped water and sewerage system is likely to decrease the environmental health burdens within the city, at the cost of increasing the resource and waste burdens the city imposes on the region. On the other hand, increasing fuel efficiency or switching to cleaner fuels is quite likely to improve air quality within the city, and also to reduce greenhouse gas emissions and their contribution to global burdens.

The relationship between per capita income and the overall per capita environmental burden of an urban settlement is ambiguous, but there is a tendency for the environmental burdens of more affluent urban settlements to be more dispersed and delayed (McGranahan et al. 2001). In cities where average incomes are very low, local environmental health burdens relating to poor sanitation and indoor air pollution tend to be severe, while the global pressures resulting from resource use and waste generation tend to be low. On the other hand, in cities where average incomes are very high, environmental health burdens tend to be low, while consumption tends to be high, leading both directly and indirectly to high levels of resources use and waste generation. A number of studies have found that some intermediate-scale burdens, indicated for example by urban air pollution concentrations, first rise and then decline with income (the environmental Kuznet's curve), although these findings have been challenged and the relation to scale has not been generally accepted (Stern 2004).

The relationship between income and the scale at which urban environmental burdens occur also involves the increasing separation of consumption from locally polluting production, with productive activities that cause pollution more likely to be displaced from affluent settlements. There are indications that "dirty" industries are moving from more affluent to lower income countries, although the evidence is not easy to interpret and other factors often seem to dominate (Cole 2004). More specifically, for air pollution there is evidence that income starts to be associated with environmental improvements earlier in the case of pollutants for which spatial separation is relatively easy (Khanna and Plassmann forthcoming).

The different scales at which urban environmental burdens occur are not only important because of the relation to economic growth. A recent book on assessing ecosystems and human well-being has a chapter outlining the importance of multi-scalar assessments (Millennium Ecosystem Assessment 2003, ch. 8, "Dealing with Scale"), which observes that:

- "Big" processes tend to be slower than "small" processes;
- By focusing on one scale, assessments are likely to neglect critical processes at other scales;
- Inter-scale effects are often critical;
- The choice of scale is not politically neutral;

- Many environmental problems arise from a mismatch between the scale of the burden and the scale at which the response is taken.

All of these observations apply to urban environmental burdens, and are examined in turn below.

"Big" processes tend to be slower than "small" processes

The burdens that urban consumption and pollution impose globally tend to be of longer term than the burdens that remain localized. Thus, global burdens, such as climate change and the global depletion of non-renewable resources, are long-term threats to future generations, while most of the local environmental health hazards in and around people's homes and workplaces affect the well-being of those exposed within a fairly short time.

By focusing on one scale, assessments are likely to neglect critical processes at other scales

Focusing on urban environmental burdens that are local in scale draws attention to intra-urban environmental health hazards, but can lead to the neglect of the larger-scale problems that result when, for example, local sanitation problems are resolved by conveying sewage to be carried away by rivers, or local air pollution problems are resolved by introducing taller stacks or forcing polluting industries to locate downwind of the town center. On the other hand, focusing on urban environmental burdens at the global scale draws attention to the consumption of internationally traded resources and global pollutants (for example, greenhouse gas emissions), but can lead to the neglect of local environmental health hazards, particularly when these vary by location.

Inter-scale effects are often critical

It can be misleading to identify burdens exclusively with one scale. In many ways global warming is an archetypal global burden, since the mechanism is so clearly global in scale. The risks, however, are likely to be very location specific. Bad sanitation, on the other hand, is an archetypal local burden, since it involves local conditions allowing diseases to spread among local residents via fecal-oral routes. Yet when unsanitary conditions extend over large areas, there is a risk of epidemics or even pandemics, potentially threatening people on the other side of the globe from where the outbreak originated (Haggett 2000). Furthermore, as noted above, international trade often links the local environmental burdens of production in one place to consumption in a different part of the globe, creating a global burden from a consumption perspective out of a local burden from a production perspective. For more on these contrasting perspectives, see section 5 below

The choice of scale is not politically neutral

Environmental burdens usually have a public aspect, but fall unequally, some more unequally than others. The scale at which environmental burdens are being assessed not only influences the scale at which public responses are likely to be conceived, but the types of inequalities that are likely to be observed. Thus, for example, measures to improve environmental conditions in low-income neighborhoods and cities are easier to justify when the focus is on localized environmental burdens, while measures to reduce burdens on future generations are better served by a global focus. Alternatively, a local focus is more favorable to the narrow pursuit of economic growth, while taking a global focus can support a stance more critical of high consumption patterns. It is no coincidence that

anti-growth environmentalists (for example, Daly 1996) are primarily concerned with global environmental burdens, while pro-growth environmentalists (for example, Lomborg 2001) are more concerned with local environmental burdens—though it is often difficult to tell which came first, the focus or the attitude to growth. Moreover, environmental politics often center on the shifting environmental burdens, which involves changing scales.

Despite all of the substantial differences between environmental burdens at different scales, there are also important similarities. On the one hand, there are structurally similar institutional obstacles to reducing urban environmental burdens at every scale. On the other hand, urban settlements provide opportunities for reducing environmental burdens at every scale, and it cannot be presumed that a more rural population distribution would create less severe burdens, locally, regionally, or globally.

At every scale, urban environmental burdens are difficult to address because they:

- Involve complex and poorly understood processes;
- Fail to conform to the boundaries of private property, circumventing market mechanisms and creating economic externalities (consequences of one party's action or decision on another party's well-being that occur without effective negotiation or agreement on compensation);
- Fail to conform to the boundaries of administrative responsibilities, circumventing effective public-sector management, and creating what could be termed political externalities (consequences of actions undertaken within one administrative unit on the ability of another administrative unit's ability to meet its goals);
- Fall most heavily on the politically or economically weak, although in the case of local burdens the most vulnerable are the urban and peri-urban poor, while in the case of global burdens, future generations are also extremely vulnerable.

While these obstacles are difficult to overcome, they are not specific to urban living. Indeed, while urban settlements can be very difficult to manage effectively and equitably, at every scale, they have a number of advantages over rural settlements when it comes to reducing environmental burdens. The following list has been adapted from McGranahan, Satterthwaite, and Tacoli 2004.

For *urban* and *peri-urban* environmental living conditions:

- Returns to scale and proximity yield lower costs per capita of providing piped treated water, sewerage systems, waste collection, clean fuels, and many other environmental services;
- There are more possibilities for local governments to fund or manage other forms of infrastructure and services that reduce environmental health risks (for example, enforce pollution control and occupational health and safety).

For *regional* environmental burdens:

- High urban population densities can reduce the per capita demand for occupied land;
- The concentration of major polluters facilitates pollution control.

For *global* environmental burdens:

- Compact urban settlement patterns reduce transport distances, increasing opportunities for more energy efficient public transport and thereby reducing carbon emissions;
- Economies of scale and agglomeration make electrical co-generation possible and facilitate the use of waste process-heat from industry or power plants for local (neighborhood) water and space heating, again reducing carbon emissions.

3. Urban areas as habitats for humans

In urban areas, humans are the defining species and built-over land is the defining land use. Yet most human evolution took place before sedentary living, let alone urban living, became the norm, and urban living has historically posed serious physical challenges for humans. Many non-human species, on the other hand, have adapted to urban living. Urban ecological landscapes are characterized by patchiness and variation (Collins et al. 2000) and by greater species richness than in the countryside (Rebele 1994). With a wide range of contrasting habitats, there is more scope for biodiversity in urban areas than in, for example, agricultural monocultures. Even urban core areas usually contain a mix of land uses, though it is in peri-urban areas that variability and land use change is likely to be at its height.

The relationship between humans and the other species in their settlements has always been critical to human well-being, even if people have not generally been aware of the connection, and not all of the relationships have been positive. It has been proposed, for example, that one of the reasons why New World inhabitants came to be decimated by Old World diseases when the two populations came into contact, was that only in the Old World had people shared their settlements with domesticated animals. This led to the emergence of diseases that eventually began to spread from person to person: measles and smallpox from cattle, influenza from pigs or chickens, the common cold from horses, and most respiratory infections from one domestic animal species or another (Watts 2003; Cohen 1989). In the New World people had not been exposed to these diseases, which made them vulnerable when the two populations met. The risk of avian flu, a very contemporary concern, also derives from close relations between humans and other species in human settlements. Even when human settlements have not been the source of the initial outbreak, they affect disease transmission, as in the case of HIV/AIDS.

Many of the more serious infectious diseases can only have emerged as a serious threat to health when people began to congregate in large enough settlements to allow the infection to be maintained (Cohen 1989; Mascie-Taylor 1993). Research on measles, well before vaccinations altered transmission patterns, found that the time between epidemics was inversely proportional to the town's population, and implied that above a population of about 250,000, a continuous chain of infection would be maintained. For a number of infectious diseases, large cities can act as reservoirs of disease, and then spark an epidemic when the susceptible population builds up above a critical level (Haggett 2000). Urban networks can then become conduits in the spread of infectious diseases regionally or even globally.

Disease transmission also depends on how urban environments are managed. Historically, the most serious urban environmental health hazards have involved unsanitary conditions, including inadequate access to clean water, which facilitate the spread of fecal-oral diseases (Cairncross and Feachem 1993). Unsanitary conditions are believed to be a major factor in the urban health penalty—that is, the higher

mortality and morbidity rates found in urban than in rural areas—that burdened so many urban areas well into the nineteenth century.

The sanitary revolution that began in some of the more affluent cities towards the end of the nineteenth century provides a revealing example of how better governance and urban environmental management can not only overcome but even reverse the disadvantages of urban living. In England, for example, there is evidence that despite their economic success urban areas were becoming increasingly unhealthy places to live for several decades of the nineteenth century (Szreter 1997). The reforms initiated in the second half of the century, which eventually brought urban health up and above that of rural areas, were closely linked to changing urban politics and governance (Szreter 2002).

From the perspective of environmental conditions in areas adjoining urban settlements, the reforms of the sanitary revolution added to the urban burden. Sewerage networks carried human waste out of the cities and released them untreated into nearby waterways. Piped water networks drove the search for more and more distant water sources. What we would now characterize as ecological concerns, such as over the disruption of natural cycles and the loss of soil nutrients, were voiced at the time. Edwin Chadwick, perhaps the most influential sanitary reformer, had hoped to recycle sewage onto the fields. As it transpired, however, sanitary reform led to major improvements in urban health, but at the cost of deteriorating environmental relations with the surrounding areas.

More important from the perspective of urban areas as habitats for humans, water and sanitation conditions remain extremely unhealthy in a great many low-income settlements in Africa, Asia, and Latin America (United Nations Human Settlements Programme 2003; Hardoy, Mitlin, and Satterthwaite 2001). Official figures put the number of urban dwellers without improved water supplies at 173 million (WHO and UNICEF 2000), though it has also been estimated that upward of 700 million are without adequate provision (United Nations Human Settlements Programme 2003). Despite widespread agreement that improvements are necessary, the urgency evident in the nineteenth and early twentieth centuries is missing, in both local and international policy arenas. True, one of the 18 international targets now associated with the Millennium Declaration adopted by the world's leaders at the Millennium Summit of the United Nations in 2000 was to "halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation".[2] But, most of the policy debate in the water sector still centers on issues of water resource management or private-ector participation, neither of which is critical to sanitary improvement in deprived areas (McGranahan and Satterthwaite 2003). Even within the water sector, it is widely recognized that sanitation receives insufficient attention.

At least part of the reason why the urgency of sanitary reform has declined, despite so many evident deficiencies, is that fecal-oral diseases less often give rise to epidemics that threaten those who do not live in deprived settlements (Cairncross and Feachem 1993). Endemic diseases that are rarely fatal except to infants and children in low-income neighborhoods do not motivate international agencies, national governments, or even local governments in the way that epidemics did historically, as they spread from city to city. In September 1848 the *Times* of London described cholera as "the best of all

2. The reference to sanitation was added after the World Summit for Sustainable Development in Johannesburg in 2002—see the Millennium Development Goals, described at http://www.developmentgoals.org (accessed 24 November 2004).

sanitary reformers" (Wohl 1983), and to this day most governments can find extra resources for improving sanitation when a cholera epidemic threatens.

The crisis-driven sanitary reforms of the nineteenth century had their problems too. The epidemics helped to reinforce elite stereotyping of slum residents as dirty, morally suspect, and dangerous to deal with, just as contemporary epidemics reinforce prejudice and discrimination against deprived groups (Briggs and Mantini-Briggs 2003). Equally important, fears of epidemics helped to justify a top-down approach still evident in most water and sanitation utilities. Even the technologies employed, such as piped water and sewerage networks, were attractive in part because they allowed the technical and managerial responsibilities for urban water and waste flows to be shifted from the residents to engineers.

Recent decades have seen considerable debate over the institutional forms appropriate for managing urban water and sanitation systems. Private-sector participation has been vigorously promoted from some quarters, especially in the World Bank (Finger and Allouche 2002). However, while the choice between public and private utility operators is clearly of great importance to vested interests within the water sector, it not of obvious significance to those deprived of water and sanitation, who generally remain unserved whether the water and sanitation utilities are public or private (Budds and McGranahan 2003). Moreover, while private-sector participation has generated the most heated debates, some of the most notable successes have come from initiatives directly supportive of community organization and action (Mitlin and Satterthwaite 2004). Even the World Bank, in its recent World Development Report on *Making Services Work for Poor People*, argues that better services to low-income groups can only be achieved by "by putting poor people at the center of service provision: by enabling them to monitor and discipline service providers, by amplifying their voice in policymaking, and by strengthening the incentives for providers to serve the poor" (World Bank 2003).

While the history of infectious diseases has been closely bound up with the history of human settlements, for most people urbanization is more closely associated with the chemical pollution of air and water. Ever since people began to cook food and warm themselves around fires, rural dwellers have been exposed to health-threatening air pollution. Even today, rural exposure to indoor air pollution is probably more of a health burden than urban ambient air pollution (Ezzati et al. 2002). But industrialization and motorization brought new, more visible, and more public forms of pollution. While sanitary reformers of the nineteenth century did often try to introduce pollution controls, the politics were not favorable (Mosley 2001). Even more than in industrializing and motorizing cities today, smoke and chemicals were associated in many people's minds with economic success. There was no equivalent to water pipes and sewers promising to address air pollution problems and to shift the intellectual and practical burdens of environmental management from individuals and enterprises to experts in a government agency or utility. It was not until the middle of the twentieth century that a number of governments, spurred on by the evidence of high mortality rates resulting from severe air pollution episodes in a few major cities, were put under pressure to enact laws and introduce regulations capable of reducing the concentrations of the best-known pollutants (McGranahan and Murray 2003). While exposure to chemical pollution remains a significant urban health issue, in countries that have taken strong measures to reduce emissions, reductions in concentrations of the targeted pollutants have been appreciable.

Even in affluent countries where ambient air and water pollution are increasingly regulated, chemical waste disposal can lead to serious and often inequitable urban environmental health burdens, and the urban developments can undermine public health. In the United States, for example, the "environmental justice" movement emerged in response to inequalities in exposure to environmental health hazards (Shrader-Frechette 2002), and serious questions have been raised about the implications of urban sprawl for human health (Frumkin, Frank, and Jackson 2004). Indeed, while local environmental health hazards may be far more severe in the urban settlements of low-income countries—and particularly their more deprived neighborhoods—they remain an issue in virtually all urban areas.

4. Urban environmental relations with their adjoining regions

Urban settlements have always been dependent on their hinterlands, as a source of natural resources and rural products, as a sink for wastes, and as sites for expansion. While the distances involved have grown in recent centuries, and an increasing number of products and resources can be sourced globally, urban regions remain critical loci of urban–rural flows and environmental impacts.

The metabolism of an urban area, described by the flows of energy and materials in and out of a settlement, is revealing of the environmental burdens it is likely to impose on ecosystems beyond the urban boundaries (Douglas 1981; White 1994; Decker et al. 2000; Newman 1999). The linear flows characteristic of urban external relations, as opposed to the circular flows characteristic of stable ecosystems, reflect the nature of the regional environmental challenges urban development poses: resources are susceptible to depletion and waste sinks to continued accumulation. The multifold increase in throughput per capita observed over the last few centuries is indicative of the size of the challenge.

A recent review examined the energy and material flows in and out of the world's 25 largest cities. Water was estimated to account for about 90 percent of all material entering megacities, and it was found that these cities were usually more dependent on their proximate environments for water and waste processing than as a source of fuel, food, or aggregates (Decker et al. 2000). Except for biofuels, fuels are now only rarely sourced locally, but urban air pollution from fuel combustion can contribute to direct exposure in the adjoining region, and to acid rain, often at a considerable distance from the polluting location. Food and other agricultural products are often imported from distant locations, but urban development does often lead to radical transformations in land-use patterns in the surrounding region. The following sub-sections focus on water, fuel, and land use in turn.

4.1. Water

Although urban water consumption is usually several times smaller than the amount of water consumed in irrigated agriculture (Gleick 2003), getting sufficient water of adequate quality to meet growing demand has long been a challenge for urban settlements. The utilities that operate urban piped water networks have traditionally tried to meet this challenge by investing in water infrastructure so as to bring greater quantities of water from further away. Where water infrastructure is highly developed and urban centers are networked together, local variation in supply/demand balances are merged, and water shortage becomes a regional phenomenon. The tendency for urban settlements to tap more-distant

sources for their water supplies is not confined to affluent countries. Research on the changing urban water systems in Africa, where insufficient infrastructure is often cited as a major problem, indicates that while in the early 1970s many major cities still used groundwater supplies as their primary water sources, by the 1990s the primary water sources were more likely to be rivers, and increasingly these river sources were more than 25 kilometers away (Showers 2002).

Although regional water scarcity is a very serious problem in many parts of the world, it does not explain the fact that so many urban residents do not have adequate water supplies. Indeed, for urban dwellers in countries subject to water stress—defined as less than 1,700 cubic meters per capita per annum of renewable fresh water resources—the official figures indicate slightly higher coverage rates (McGranahan 2002). For those without improved water supplies, water resource problems can be particularly severe. The amount of clean water households need to stay healthy is very small compared even to urban water demands, however, and the challenge for deprived households is to get access to the potable water supplies that do exist.

In any case, getting sufficient water to urban settlements is only one of the urban water challenges. Water enters and leaves urban areas in almost equal quantities, but while it is flowing through urban areas it is likely to be used, polluted, and otherwise transformed. Urban areas usually have a high percentage of paved areas; they concentrate rainwater rather than dissipate it. This can intensify flooding and cause flash floods. Changes in the water flows can also affect downstream fish stocks, recreational opportunities, and biodiversity. Sewers convey human waste out of urban locations, often releasing it untreated into local waterways or coastal waters. Human waste not only poses a health risk for people who might come to ingest the contaminated water, but can also cause eutrophication and damage to aquatic ecosystems downstream. Chemical water pollution is also a major problem, particularly around large industrial centers. When cities and surrounding rural areas are competing for water resources, ecological water requirements (the water needed to maintain ecosystem function and local hydrological cycles) are often neglected.

Integrated water resource management has been advocated as a means of addressing these regional water issues. By getting different water stakeholders to negotiate acceptable solutions, and imposing regulations when necessary, basin-level authorities are in a good position to address urban-region water issues. In the Plan of Implementation of the World Summit for Sustainable Development (United Nations 2002a), countries are exhorted to develop integrated water resource management plans by 2005. The natural scales for water resource management are river basins and catchment areas, and the Plan of Implementation explicitly indicates that countries should “adopt an integrated water basin approach” (ibid., 21). However, river basin and catchment management organizations are unlikely to have the political power to address issues of equitable access to urban water networks. In effect, while equity is often emphasized as a goal of integrated water resource management, organizations adapted to the scale most suitable to urban-region issues are unlikely to be able to address the most critical intra-urban issues.

4.2. Fuel consumption and air pollution

Fossil fuels have not only enabled radical changes to urban form, but have also broken urban dependence on local energy sources. The urban settlements where resource links remain strong are in

those low-income countries where charcoal is an important fuel for urban households. Charcoal is sometimes blamed for "rings" of deforestation around some African cities, although charcoal producers are often not as destructive as they are portrayed to be (Hosier 1993). Electricity produced from hydropower also draws on regional resources, and dams can have major environmental consequences. Otherwise the strongest environmental links between urban energy use and environmental conditions in the surrounding region derives from air pollution, which results primarily from fuel combustion.

Certain types of air pollution involve transformations in the environment that take place away from the site of emission (Smith and Akbar 2003). For example, it can take several hours for ozone to form, creating concentrations quite far from the site where the precursors were originally emitted. Some particulates are also formed through chemical reactions in the atmosphere. These particulates and ozone may be created outside of the urban centers where the emissions originated, imposing health risks in areas downwind, as well as damage to crops. Acid depositions (for example, acid rain) are the result of emissions of oxides of sulfur and nitrogen, which can be carried hundreds of kilometers by the air. In addition to harming crops, acid depositions can disrupt natural ecosystems.

There is the potential to use cross-scale effects to exploit synergies and find the best means of reducing air pollution problems at all scales. Unfortunately, there is still a tendency to treat these air pollution issues separately, or to assume that reducing air pollution at one scale also reduces it at others. Historically this has not always been the case. Higher stacks, for example, were used for many years to reduce local concentrations, at the cost of allowing the pollution to disperse over longer distances. Even greater energy efficiency does not always reduce air pollution at every scale—a wood stove that transfers a greater share of the fuel energy to heating a pan, for example, may achieve this at the cost of greater emissions of the products of incomplete combustion because the combustion site is more confined.

Unlike watersheds, airsheds are not easy to identify, and they do not provide the spatial basis for air pollution management organizations. National governments have been more important, as sources of both local air pollution regulation and of global air pollution governance. On the other hand, global air pollution governance (including negotiation over greenhouse gas emissions) remains rudimentary, local air pollution regulation is still a challenge, and efforts to coordinate measures targeting different scales have barely begun. And as with water, there is little evidence that the higher-level institutions responsible for air pollution management will be in a position to address the indoor air pollution burdens that tend to be more severe in low-income settlements—and especially rural settlements.

4.3. Urban development and changing regional land use

Urban land areas have been expanding, historically because of population growth (which is still the main driver of urban expansion in many lower-income countries), and more recently as the result of increasing numbers of smaller households and urban sprawl (especially in some higher-income countries). A disproportionate share of urban area is located in coastal zones, and the loss of wetlands to

urban expansion is of special concern.[3] In North America, where compared to other continents a large share of the urban population is located in agricultural zones, and urban sprawl is leading to the expansion of what are already some of the world's least densely settled urban areas, the loss of agricultural land to urban expansion is also of particular concern.

While urban land area is undoubtedly increasing, it is misleading to draw a sharp distinction between environmental impacts that involve rural land being converted to urban land, and those that involve rural (or for that matter urban) land whose usage is being influenced by urban development. First, urban boundaries are arbitrary. There is not even agreement on the criteria by which urban areas should be identified—whether, for example, boundaries should be based on population densities, land cover, the occupational profile of residents, administrative limits, or some combination. Official urban boundaries rarely match the extent of contiguous built-up area; they may be smaller (as urban development has spilled over boundaries set many years ago) or larger (as urban boundaries have been defined that encompass large areas of agriculture, forest, and water). In addition, an aerial view of a major urban regions is unlikely to display a concentrated urban center surrounded by countryside; more likely there will be a complex spatial pattern of urbanized and non-urbanized areas, with built-up areas stretching along major transport corridors for long distances, and green areas reflecting planning decisions as much as distance from an urban center. In addition, it is common for residential communities and industrial and commercial concentrations to develop close to major cities, but separated from the main built-up area.

In any case, urban expansion transforms not only the land that becomes urbanized (however defined) but also the land whose use is determined by demand both for land-based products and for resources (such as water) whose appropriation changes land-use patterns. Large demands are made on the regions around cities for building materials and landfill as a result of the construction of buildings, roads, industries, and other components of the urban fabric. Many of the urban-generated solid wastes impact the surrounding region—for instance, urban solid wastes are often transported to parts of the surrounding region and disposed of at open-air sites with little or no provision for protecting nearby soil and water from contamination. Moreover, urban development changes agricultural land-use patterns. As Cronon has illustrated for the case of Chicago, rural environments and ecologies reflect demands and innovations that occur in nearby urban centers (Cronon 1992).

5. Urban consumption and global ecological footprints

Contemporary urbanization is based upon that quintessentially global resource, petroleum. Petroleum products have not only fueled the transportation systems that enable modern urban systems to function, and are a dominant influence on urban form, but they fuel many of the productive activities undertaken to meet urban demands. However, petroleum consumption itself only accounts for a small share of the burden urban consumption is placing on the world's resources and waste sinks.

3. The boundary limits used for mapping coastal zones in the Millennium Ecosystems Assessment were area between 50 meters below mean sea level and 50 meters above the high tide level or extending landwards to a distance of 100 kilometers from the shore (Millennium Ecosystem Assessment 2003). Globally, an estimated 10 percent of land in the coastal zone is urban, as compared to less than 3 percent overall (McGranahan et al. 2005 forthcoming).

In principle, it is possible to assign environmental burdens to an urban settlement either by considering the impact of the transformations that take place within the urban settlement's boundaries or by considering all of the transformations undertaken globally in supplying the goods and services consumed by the settlement's residents. The former provides a more suitable basis for examining urban technologies and production patterns, and the environmental pressures exerted on the surrounding region. The latter provides a more suitable basis for examining lifestyles and consumption patterns, and the environmental pressures exerted globally to sustain the settlement's residents. Perhaps equally important, the former will tend to assign higher burdens to settlements where resource- or waste-intensive industries are concentrated, while the latter will tend to assign higher burdens to more affluent urban settlements. For the cities that industrialized early, there was a significant overlap between the two, but affluent cities are now unlikely to be centers of heavy industry.

Some of the differences between taking either a consumption or a production perspective on global urban environmental burdens can be illustrated with CO_2 emissions. A recent study of urban energy use and greenhouse gas emissions in Asian megacities has estimated the CO_2 emissions of Beijing, Shanghai, and Tokyo, distinguishing between the CO_2 emitted within the urban areas and the CO_2 emitted in supplying the demands of the people who live in these cities (Dhakal forthcoming). Table 1 is based on estimates calculated for this study.

Table 1. Carbon dioxide emissions per capita for Beijing, Shanghai, and Tokyo

	Beijing (1997)	Shanghai (1997)	Tokyo (1995)
CO_2 emitted in city (tons per capita)	6.4	7.8	4.9
CO_2 emitted in providing goods and services consumed in city (tons per capita)	8.3	11.6	12.1

Source: Data provided in Dhakal forthcoming.

Tokyo does comparatively well in terms of CO_2 emissions per capita, and as the wealthiest city it fares even better in terms of CO_2 emissions per unit of economic output. A detailed analysis of the changing sources of emissions over time indicates that emissions per unit of economic output have been declining in Beijing and Shanghai, but still remain far higher than in the major Japanese cities (Dhakal forthcoming).

On the other hand, as indicated in the second row of table 1, things look very different from a consumption perspective, with the highest emissions per capita associated with the far higher consumption levels of Tokyo. Indeed, while for Beijing the emissions associated with consumption are only 30 percent above the direct emissions per capita, in Tokyo this figure rises by almost 150 percent.

Measuring the burden of the CO_2 emissions brought about by an urban settlement's consumption is complicated by data problems, issues of imputation (that is, whether it is misleading to assign the CO_2 emitted in producing a good to the end consumer), and uncertainty about the effects (that is, climate change and its consequences). On the other hand, the impacts of CO_2 emissions are clearly externalities, since CO_2 is emitted without any negotiation or consent on the part of those who will be affected by

climate change. This is not true for all consumption-driven environmental pressures, however, and in many contexts it is important to consider the economic institutions through which the pressures of consumption have their environmental consequences, even if these institutions are located elsewhere.

When demand increases, private property and markets can yield higher prices rather than higher consumption, and higher prices can stimulate the development and use of substitutes or alternatives. Similarly, governmental and common property arrangements can operate to prevent resource degradation and waste generation. There are limits to substitutability, especially at the global scale. Markets do not just stimulate resource-conserving innovation, they encourage competitive enterprises to reduce costs, even when this means seeking out poorly managed resources and locating waste-generating processes where wastes are poorly controlled. However, while resource use and waste production have physical consequences whatever the institutional form, it is important to recognize that the link between consumption and resource use is not as straightforward as physical accounting systems might seem to suggest. For example, physical accounting relates consumption in the present with resource use in the past, while an economic analysis of the consequences of the same consumption will link it to resource use in the future, and these two resource uses need not be the same. Nevertheless, physical accounting can provide very useful indicators of environmental burdens.

Various indicators have been developed in order to estimate the aggregate environmental burdens of urban settlement, often applying a variant of the Commoner-Ehrlich equation: $I = PAT$, where I is the environmental impact, P is population, A is affluence measured as consumption or production per capita, and T an environmental impact coefficient.

The best-known indicator developed specifically with urban settlements in mind is the ecological footprint, although several other indicators have been adapted to urban applications (Nijkamp, Rossi, and Vindigni 2004). The ecological footprint has been defined as: the area of land "required, on a continuous basis, to produce the resources that the population consumes, and to assimilate the wastes that the population produces, wherever on Earth the relevant land/water is located".[4]

Current accounting procedures for ecological footprints include built-up area and area under crops, under pasture, under forest, and under fisheries, as well as estimates of the forest land that would be required to provide for energy consumption and sequester sufficient carbon to compensate for carbon emissions. The common unit into which other land areas are converted is a "global hectare" with a productivity equal to the average productivity of the roughly 11.4 billion bioproductive hectares in the world (Monfreda,Wackernagel, and Deumling 2004).

One of the heuristic benefits of presenting the global burden of urban areas in terms of ecological footprints is that it serves to emphasize the fact that urban settlements are heavily dependent on biophysical processes taking place elsewhere, and provides a common "currency" rooted in biophysical rather than economic productivity. They also help to illustrate how misleading it can be to view different urban settlements (or countries) as occupying different positions on a common development trajectory,

4. *Encyclopedia of Biodiversity*, ed. S. A. Levin (San Diego: Academic Press, 2001), s.v. "ecological footprint, concept of" (by W. E. Rees).

given the limited ecological "space" available. In short, imperfect though they may be, ecological footprints provide a useful counterpoint to conventional economic accounts.

Ecological footprints are meant to measure outcomes, in the sense that they provide an accounting of services appropriated. From the perspective of spatial externalities, they are better interpreted as pressure or stress indicators. Environmental and ecological externalities are extremely difficult to measure, but one would expect them to be more closely associated with ecological appropriation, as measured by the ecological footprint, than with the economic value of consumption/production as measured in national income accounts. To some degree, global markets also globalize the side effects of economic activity (Mol 2001). Some researchers have even interpreted the ecological footprint as an attempt to measure these environmental externalities (Nijkamp, Rossi, and Vindigni 2004). An ecological footprint does not, however, even attempt to measure the extent to which environmental burdens remain external to market transactions and are incurred without any private negotiation or public regulation. Thus, while a larger ecological footprint is likely to be associated with greater environmental externalities, the two are both empirically and conceptually distinct.

Ecological footprints are increasingly being calculated for nations rather than urban settlements. The availability of national data allows for more extensive statistical analysis. Ecological footprint estimates have, for example, been used as a measure of environmental impact in a framework that treats the IPAT equation (above) as the basis for examining statistical relationships rather than as an accounting identity (York, Rosa, and Dietz 2003). Not surprisingly, population and GDP were found to be highly significant in all of the models tested. Latitude was also found to be significant, a result interpreted as reflecting the important role climate can play in influencing consumption patterns and environmental impacts. Somewhat more surprising, the percentage of population that is urban was also found to be highly significant in models where it was included, suggesting that urbanization either directly (for example, through impacts associated with the physical features of urban settlements) or indirectly (for example, through impacts associated with lifestyles that urban residents are more inclined to adopt) increases the size of a country's ecological footprint.

Ecological footprint analysis is sometimes presented as a more comprehensive measure of environmental impact than local or regional measures because global impacts are included. This can be taken to imply that environmental impacts increase monotonically with economic growth, and that the different relationships associated with local environmental health hazards (which tend to be at their worst in low-income settings) or city-regional impacts (which tend to be at their worst in large, industrialized, and often middle-income cities) reflect the partial nature of their indicators. Thus, for example, it has been argued that the rise and fall of the environmental Kuznet's curve reflects the omission of global impacts, whose inclusion would transform the curve into something more S-shaped (see York, Rosa, and Dietz 2003, fig. 1). This is misleading, however, as the form of the relationship also depends on how environmental burdens are measured. It is perfectly conceivable that a measure based on human health impacts would still display the aggregate environmental burden declining with economic growth (see, for example, Holdren and Smith 2000, fig. 3.10), while a measure based on economic value might rise and then fall, and a measure based on appropriated bio-physical productivity might rise monotonically.

It should be possible to combine insights from different scales, but this requires more than simply extending analysis from one scale to the others. Ecological footprint analysis is not a useful tool for examining local environmental burdens, just as burden-of-disease analysis is not a useful tool for examining global environmental burdens; yet both provide information relevant to any multi-scaled assessment of urban environmental burdens.

6. Scaling urban environmental policy agendas

An optimist looking at the environmental history of most affluent cities sees: a centuries-old and highly successful sanitary revolution (addressing environmental health burdens in and around people's homes); a more recent and partially successful pollution revolution (addressing pollution, waste, and resource burdens in the urban-region sphere); and perhaps the beginnings of a sustainability revolution (addressing the global environmental burdens of urban consumption patterns). A pessimist, looking at the same history, sees the progressive displacement of environmental burdens from local to regional to global scales.

There is some truth to both of these views. On the one hand, past urban sanitary reforms, pollution management, and efficiency improvements do illustrate the potential for quite radical and effective responses to severe environmental burdens. On the other hand, the tendency to shift towards larger-scale and more-delayed burdens is a real concern, particularly if it going to require a global crisis to invoke a meaningful response.

Looking across the wide range of urban settlements around the world, there are also other concerns. Economic success is very unequally distributed, and environmental burdens tend to accentuate these inequalities. The environmental burdens of poverty tend to be localized, while the environmental burdens of affluence affect a larger public. Some of the most deprived groups are also the most likely to face multiple burdens: they are more vulnerable to the global threats driven by affluence such as climate change, are more exposed to problems of regional pollution and resource abuse associated with urban industrialization, and live in neighborhoods where sanitation is poor, water is difficult to access, and smoky fuels are used.

Also, while a great deal of attention is paid to the globalization of environmental burdens, for low-income groups the localization of environmental burdens is also a concern. Water and sanitation problems, for example, were once associated with epidemics that threatened all urban residents, and even the inhabitants of other cities and towns. This helped to inspire a social movement, and motivated municipalities and national governments to drive sanitary reform. Endemic diseases, largely restricted to low-income neighborhoods, do not provide the same public motivation. This may help to explain why the conventional top-down approaches to water and sanitation improvement no longer inspire, and why even relatively successful locally driven initiatives rarely receive much attention internationally.

More generally, the multi-scalar character of urban environmental burdens is itself a challenge for developing effective urban environmental agendas. International and inter-urban variation suggests that in different locations environmental burdens at different scales need to be prioritized. Ideally, priorities should be adapted to reflect the state of local environmental health conditions, the quality of

environmental relations with the surrounding region, and the size of a settlement's ecological footprint. Generally, this would justify a greater focus on environmental health issues in low-income settlements, and a greater focus on ecological footprints in high-income settlements.

There is also a relationship between the scale of the environmental burdens and the appropriate roles of different levels of government. Some governance failures can be traced to a mismatch between the scale of the problem and the scale at which the response has been articulated. Local governance should not be expected to reduce carbon emissions voluntarily, although it can be a very appropriate level for driving local water and sanitation improvements. Global governance, on the other hand, is clearly needed to help develop institutional mechanisms to reduce contributions to global climate change, but is inappropriate to developing institutional mechanisms for managing local water and sanitation systems. On the other hand, reducing local environmental burdens often requires support (or at least the absence of opposition) from global processes and institutions, while responses to global burdens often need to be rooted in local agency (Wilbanks and Kates 1999).

Acknowledgements

This article benefited from work funded by the Danish Ministry of Foreign Affairs (Danida) and the Swedish Agency for Development and Cooperation (Sida), and draws on a draft chapter on urban systems prepared as part of the contribution of the Condition and Trends Working Group to the Millennium Ecosystem Assessment (to be published by the Island Press in 2005).

References

Asheim, G. B., and W. Buchholz. 2004. A general approach to welfare measurement through national income accounting. *Scandinavian Journal of Economics* 106 (2):361–384.

Beckerman, W. 1988. National income. In *The new Palgrave: A dictionary of economics*, ed. J. Eatwell, M. Milgate, and P. Newman. London: Macmillan.

Briggs, C. L., and C. Mantini-Briggs. 2003. *Stories in the time of cholera: racial profiling during a medical nightmare*. Berkeley, CA: University of California Press.

Budds, J., and G. McGranahan. 2003. Are the debates on water privatization missing the point? Experiences from Africa, Asia and Latin America. *Environment and Urbanization* 15 (2):87–113.

Cairncross, S., and R. G. Feachem. 1993. *Environmental Health Engineering in the Tropics: An Introductory Text*. 2nd ed. Chichester: John Wiley & Sons.

Cohen, B. 2004. Urban growth in developing countries: A review of current trends and a caution regarding existing forecasts. *World Development* 32 (1):23–51.

Cohen, M. N. 1989. *Health and the rise of civilization*. New Haven, Conn.: Yale University Press.

Cole, M. A. 2004. Trade, the pollution haven hypothesis and the environmental kuznets curve: examining the linkages. *Ecological Economics* 48 (1):71–81.

Collins, J. P., A. Kinzig, N. B. Grimm, W. F. Fagan, D. Hope, J. G. Wu, and E. T. Borer. 2000. A new urban ecology. *American Scientist* 88 (5):416–425.

Cronon, W. 1992. *Nature's metropolis: Chicago and the Great West*. New York: W.W. Norton.

Daly, H. E. 1996. *Beyond growth: The economics of sustainable development*. Boston: Beacon Press.

Decker, E. H., S. Elliott, F. A. Smith, D. R. Blake, and F. S. Rowland. 2000. Energy and material flow through the urban ecosystem. *Annual Review of Energy and the Environment* 25:685–740.

Dhakal, S. Forthcoming. Urban energy use and greenhouse gas emissions in Asian mega-cities. Kitakyushu: Institute for Global Environmental Strategies.

Douglas, I. 1981. The city as ecosystem. *Progress in Physical Geography* 5 (3):315–367.

Ezzati, M., A. D. Lopez, A. Rodgers, S. V. Hoorn, and C. J. L. Murray. 2002. Selected major risk factors and global and regional burden of disease. *Lancet* 360 (9343):1,347–1,360.

Finger, M., and J. Allouche. 2002. *Water privatisation: Trans-national corporations and the re-regulation of the water industry*. London: Spon Press.

Friedmann, J. 2002. *The prospect of cities*. Minneapolis: University of Minnesota Press.

Frumkin, H., L. Frank, and R. Jackson. 2004. *Urban sprawl and public health: Designing, planning and building for healthy communities*. Washington D.C.: Island Press.

Gleick, P. H. 2003. Water use. *Annual Review of Environment and Resources* 28:275–314.

Haggett, P. 2000. *The geographical structure of epidemics*, *Clarendon lectures in geography and environmental studies*. Oxford: Oxford University Press.

Hamilton, K., and J. A. Dixon. 2003. Measuring the wealth of nations. *Environmental Monitoring and Assessment* 86 (1–2):75–89.

Hardoy, J. E., D. Mitlin, and D. Satterthwaite. 2001. *Environmental problems in an urbanizing world*. London: Earthscan.

Holdren, J. P., and K. R. Smith. 2000. Energy, the environment and health. In *World energy assessment: Energy and the challenge of sustainability*, ed. J. Goldemberg, 62–110. New York: UNDP.

Hosier, R. H. 1993. Charcoal production and environmental degradation: Environmental history, selective harvesting, and post-harvest management. *Energy Policy* 21 (5):491–509.

Hugo, G., A. Champion, and A. Lattes. 2003. Toward a new conceptualization of settlements for demography. *Population & Development Review* 29 (2):277–297.

IIED. 2001. *Urban environmental improvement and poverty reduction*. London: IIED for Danida.

International Monetary Fund (IMF). 2000. The world economy in the twentieth century: Striking developments and policy lessons. In *World economic outlook, May 2000*,. Washington, DC: IMF.

Khanna, N., and F. Plassmann. Forthcoming. The demand for environmental quality and the environmental Kuznets Curve hypothesis. *Ecological Economics*.

Lawn, P. A. 2003. A theoretical foundation to support the Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), and other related indexes. *Ecological Economics* 44 (1):105–118.

Lomborg, B. 2001. *The sceptical environmentalist: measuring the state of the world*. Cambridge: Cambridge University Press.

Mascie-Taylor, C. G. N., ed. 1993. *The anthropology of disease* (Biosocial Society Series 5). New York: Oxford University Press.

McGee, T. G. 1987. Urbanisasi or Kotadesasi? The emergence of new regions of economic interaction in Asia. Working paper. Honolulu, Hawaii: Environment and Policy Institute, East-West Center.

———. 1991. The emergence of Desakota regions in Asia: Expanding a hypothesis. In *The extended metropolis: Settlement transition in Asia*, ed. S. Ginsburg Norton, T. G. McGee, and B. Koppel. Honolulu: University of Hawaii Press.

McGee, T. G., and I. M. Robinson, eds. 1995. *The mega-urban regions of southeast Asia*. Vancouver, BC: UBC Press.

McGranahan, G. 2002. *Demand-side water strategies and the urban poor*. London: IIED.

McGranahan, G., P. Jacobi, J. Songsore, C. Surjadi, and M. Kjellén. 2001. *The citizens at risk: From urban sanitation to sustainable cities*. London: Earthscan.

McGranahan, G., P. J. Marcotullio, X. Bai, D. Balk, T. Braga, I. Douglas, T. Elmqvist, W. Rees, D. Satterthwaite, J. Songsore, and H. Zlotnik. Forthcoming. Urban systems. In Millennium ecosystem assessment, current state and trends: Findings of the Condition and Trends Working Group. *Ecosystems and Human Well-being*, vol. 1. Washington, DC: Island Press.

McGranahan, G., and F. Murray, eds. 2003. *Air pollution and health in rapidly developing countries*. London: Earthscan.

McGranahan, G., and D. Satterthwaite. 2003. Improving access to water and sanitation: Rethinking the way forward in light of the Millennium Development Goals. In *Survival for a small planet—the sustainable development agenda*, ed. T. Bigg. London: Earthscan.

McGranahan, G., D. Satterthwaite, and C. Tacoli. 2004. Rural-urban change, boundary problems and environmental burdens. In *Rural-urban series*. London: IIED.

Millennium Ecosystem Assessment. 2003. *Ecosystems and human well-being: A framework for assessment*. Washington, DC: Island Press.

Mitlin, D., and D. Satterthwaite. 2004. *Empowering squatter citizen: Local government, civil society, and urban poverty reduction*. London: Earthscan.

Mol, A. P. J. 2001. *Globalization and environmental reform: The ecological modernization of the global economy*. Cambridge, Mass.: MIT Press.

Monfreda, C., M. Wackernagel, and D. Deumling. 2004. Establishing national natural capital accounts based on detailed ecological footprint and biological capacity accounts. *Land Use Policy* 21:231–236.

Montgomery, M. R., R. Stren, B. Cohen, and H. E. Reed, eds. 2003. *Cities transformed: Demographic change and its implication for the developing world*. Washington, DC: National Academy Press.

Mosley, S. 2001. *The chimney of the world: A history of smoke pollution in Victorian and Edwardian Manchester*. Cambridge: White Horse.

Newman, P. W. G. 1999. Sustainability and cities: Extending the metabolism model. *Landscape and Urban Planning* 44 (4):219–226.

Nijkamp, P., E. Rossi, and G. Vindigni. 2004. Ecological footprints in plural: A meta-analytic comparison of empirical results. *Regional Studies* 38 (7):747–765.

Pahl, R. 1965. *Urbs in Rure*. London: Weidenfeld and Nicolson.

Rakodi, C. 1995. Poverty lines or household strategies? A review of conceptual issues in the study of urban poverty. *Habitat International* 19 (4):407–426.

Rebele, F. 1994. Urban ecology and special features of urban ecosystems. *Global Ecology and Biogeography Letters* 4 (6):173–187.

Rees, W. E. 1992. Ecological footprints and appropriated carrying capacity: What urban economics leaves out. *Environment and Urbanization* 4 (2):121–130.

———. 2003. Understanding urban ecosystems: An ecological economics perspective. In *Understanding urban ecosystems: A new frontier for science and education*, ed. A. R. Berkowitz, C. H. Nilon, and K. S. Hollweg. New York: Springer-Verlag.

Rees, W., and M. Wackernagel. 1996. Urban ecological footprints: Why cities cannot be sustainable—and why they are a key to sustainability. *Environmental Impact Assessment Review* 16 (4–6):223–248.

Satterthwaite, D. 1997. Sustainable cities or cities that contribute to sustainable development? *Urban Studies* 34 (10):1667–1691.

———. 2002. *Coping with rapid urban growth*. London: Royal Institution of Chartered Surveyors (RICS).

———. 2004. The under-estimation of urban poverty in low and middle-income Nations. Working paper on poverty reduction in urban areas 14. London: IIED.

Showers, K. B. 2002. Water scarcity and urban Africa: An overview of urban-rural water linkages. *World Development* 30 (4):621–648.

Shrader-Frechette, K. 2002. *Environmental justice: Creating equality, reclaiming democracy*. Environmental ethics and science policy series. New York: Oxford University Press.

Smith, K. and S. Akbar. 2003. Health-damaging air pollution: A matter of scale. In *Health and Air Pollution in Rapidly Developing Countries*, ed by G. McGranahan and F. Murray. London: Earthscan.

Stern, D. I. 2004. The rise and fall of the environmental Kuznets curve. *World Development* 32 (8):1,419–1,439.

Sui, D. Z., and H. Zeng. 2001. Modeling the dynamics of landscape structure in Asia's emerging desakota regions: A case study in Shenzen. *Landscape and Urban Planning* 53:37–52.

Szreter, S. 1997. Economic growth, disruption, deprivation, disease, and death: On the importance of the politics of public health for development. *Population and Development Review* 23 (4):693–728.

———. 2002. The state of social capital: Bringing back in power, politics, and history. *Theory and Society* 31 (5):573–621.

United Nations Human Settlements Programme. 2003. *Water and sanitation in the world's cities: Local action for global goals*. London: Earthscan.

United Nations. 2002a. Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August–-4 September 2002. New York: United Nations.

———. 2002b. *World urbanization prospects: The 2001 revision*. New York: United Nations.

Watts, S. J. 2003. *Disease and medicine in world history*. New York; London: Routledge.

White, R. R. 1994. *Urban environmental management: Environmental change and urban design*. Chichester, UK: John Wiley & Sons.

WHO and UNICEF. 2000. *Global water supply and sanitation assessment 2000 report*. Geneva and New York: World Health Organization and United Nations Children's Fund.

Wilbanks, T. J., and R. W. Kates. 1999. Global change in local places: How scale matters. *Climatic Change* 43 (3):601–628.

Wohl, A. S. 1983. *Endangered lives: Public health in Victorian Britain*. London: Methuen.

World Bank. 2003. *World development report 2004: Making services work for poor people*. Washington, DC: The World Bank and Oxford University Press.

Wratten, E. 1995. Conceptualizing urban poverty. *Environment and Urbanization* 7 (1):11–36.

York, R., E. A. Rosa, and T. Dietz. 2003. Footprints on the earth: The environmental consequences of modernity. *American Sociological Review* 68 (2):279–300.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 357 – 382, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

Urban Environmental Issues and Trends in Asia—An Overview

Hidefumi Imura[a], Sudhakar Yedla[b], Hiroaki Shirakawa[c], and Mushtaq A. Memon[d*]

This paper presents an overview of the linkages between population growth, urbanization, economic development, and environmental issues in Asian cities. Focusing on the areas of transport planning and air pollution, solid waste management, and water supply and sanitation, it looks at the major environmental issues faced by cities in the region, at the challenges confronting city adminstrators, and at some of the ways that they are responding. From the perspective of the environmental Kuznet's curve hypothesis, the authors argue that with appropriate policies, it should be possible for governments to continue to pursue economic growth while reducing environmental impacts.

Keywords: Air pollution, Asia, Environmental Kuznet's curve, Solid waste, Water, Wastewater.

1. Urbanization in Asia

In the year 2000, about 30 percent of the population in the Asia region lived in cities (World Bank 2003). Asia now has more major cities than any other region in the world. Table 1 shows the distribution of larger cities in Asia compared with the world total. China and India, the most highly populated countries, have the largest number of major cities.

There are, however, major disparities in the pace of urbanization within the region. Figure 1 shows the growth of urbanization in Asia from 1960–1999. As can be seen, urbanization proceeded rapidly first in Japan followed by South Korea during the 1960s; over 79 percent of the populations of both countries now live in urban areas. In Southeast Asia, urbanization started at a slower rate but gained momentum during the 1970s and 1980s. In Indonesia, for example, urbanization rate increased by an average of only 2.5 percent per annum between 1960 and 1970, but by 5.1 percent from 1970 to 1980, 7.5 percent from 1980 to 1990, and 10.3 percent from 1990 to 2000. South Asian countries have been experiencing only a gradual rise in their urban populations, but growth has been intensive in several major cities.

The speed of Asia's urbanization is without historical precedent. The urbanization of Europe in the nineteenth and twentieth centuries occurred much more slowly. Rapid urbanization in Asia has been

a. Director, IGES Kitakyushu Office, Institute for Global Environmental Strategies (IGES), Japan.
b. Policy researcher, Urban Environmental Management Project, IGES, Japan.
c. Researcher, Urban Environmental Management Project, IGES, Japan.
d. Senior policy researcher, Urban Environmental Management Project, IGES, Japan.
* Paper prepared with additional contributions from Dr. Shobhakar Dhakal, Dr. Mara Mendes, and Ms. Noriko Kono.

synchronous with dramatic rates of economic growth as well as leading to severe environmental problems.

Urbanization has been closely linked with the growth of manufacturing industry. Japan's rapid industrialization started in the 1960s. Twenty years later, South Korea initiated a range of policies aimed at accelerating industrialization. China's Open Door policy was initiated in the late 1970s. It was followed by increasing economic openness and export-led growth models in Malaysia, the Philippines, Indonesia, India, and Thailand. Higher annual rates of economic growth were achieved and sustained by some of these countries.

Especially since the 1980s, the economic growth of Asian cities has been catalyzed by increases in foreign direct investment (FDI). This has been particularly pronounced in East and Southeast Asian countries (Singapore, Thailand, Indonesia, China, and Vietnam) but has also been evident in South Asia (India and Pakistan). The Asian currency crisis of 1997 produced only a short-term drop in FDI to most of these countries. Figure 2 shows the trends in FDI in the major Asian countries.

Table 1. Population in Asian urban agglomerations of over 3 and 5 million population, 1990

	More than 5 million		More than 3 million	
	Number of cities	Population (millions)	Number of cities	Population (millions)
China	4	36.11	8	50.91
India	4	37.27	7	49.17
Indonesia	1	9.42	2	12.42
Japan	2	31.01	2	31.01
Korea	1	11.33	2	16.08
Pakistan	1	7.67	2	11.75
Philippines	1	8.40	1	8.40
Thailand	1	7.16	1	7.16
Vietnam	–	–	1	3.17
Sub Total	15	148.37	27	190.08
Others	20	190.29	42	268.37
World Total	35	338.66	69	458.45

Source: World Bank 2003; UN-HABITAT 2001.

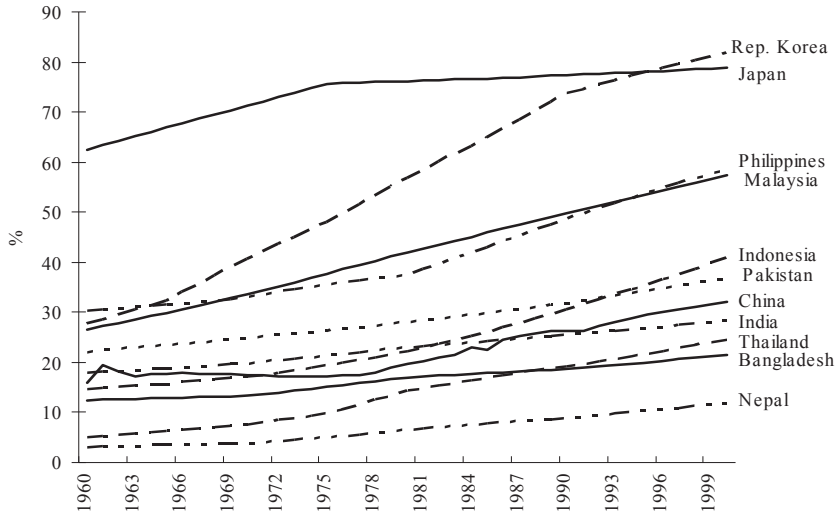


Figure 1. Urbanization trends in Asian countries (1960–2000)

Source: World Bank 2003b.

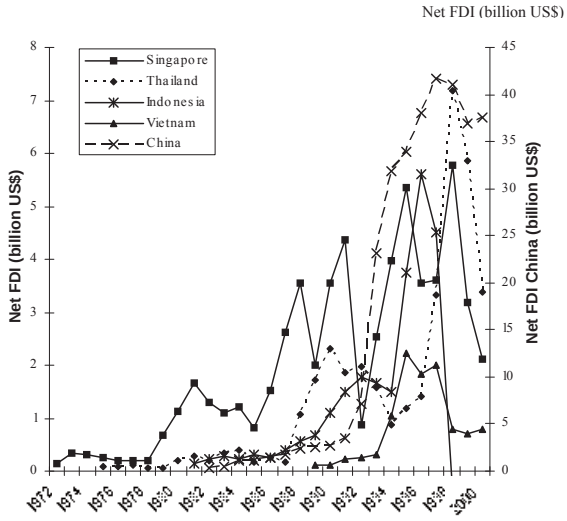


Figure 2a. Net Foreign direct investment in selected East and Southeast Asian Countries, 1970–2000

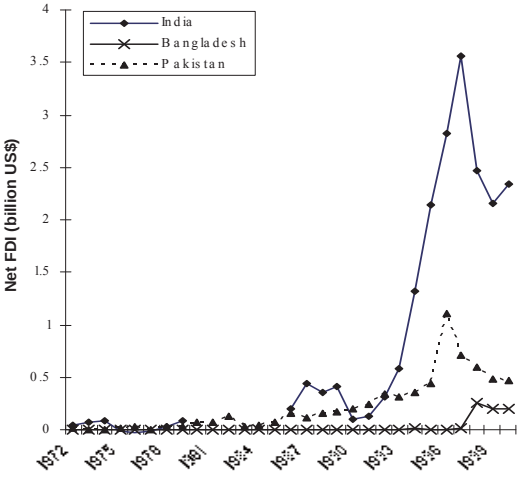


Figure 2b. Net Foreign direct investment in selected South Asian Countries, 1970–2000

Note: FDI = foreign direct investment
Source: Based on World Bank 2003.

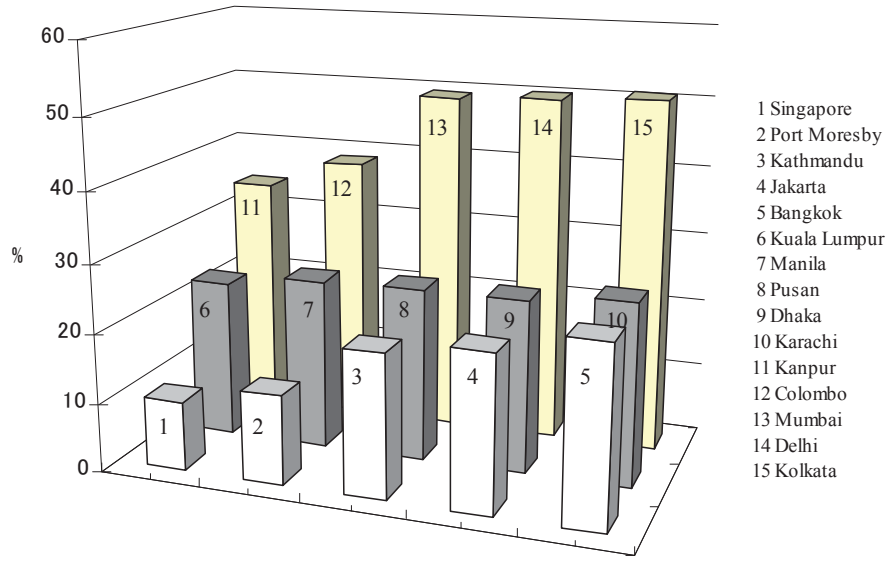


Figure 3. Share of slum population (illegal housing) in major Asian cities

Source: Ministry of the Environment, Japan, 1995.

According to Douglass (1995), Yeung and Lo (1996), and Tasaka (1998), these increases in FDI have created a new international division of labor in this region and are reconfiguring its cities with an entirely new structure that makes them functionally connected. These are described by Douglass as "Pacific-Asia urban corridors" and their interconnectedness is viewed as an additional driver of economic growth.

These rapid rates of urbanization and of economic growth have also led to pernicious levels of urban poverty in many Asian cities. Figure 3 presents the share of slum population in major Asian cities.

Yeung and Lo (1996) and Tasaka (1998) have shown hat the dynamics of urbanization in East Asia and Southeast Asia started to change rapidly in the 1980s. Tasaka characterizes urbanization in developing countries as "urban involution", referring to "various powers that were distortions of low development". Tasaka also uses three terms to describe the characteristics of urbanization in developing countries: "concentrated urbanization" (urbanization occurs while the rural population level is higher than that in developed countries); "primate cities" (over-concentration of economic, political and cultural functions in primary cities); and "over-urbanization" (inflow of population beyond a level the city can productively absorb). Among the factors associated with over-urbanization are high levels of unemployment and employment insecurity; large-scale inadequacies of infrastructure such as mass transportation systems, water supply and sewerage systems, and waste treatment facilities; environmental pollution; severe stress on urban governance; and overall poverty levels that hamper the formation of financial mechanisms that could facilitate urban environmental infrastructure improvements (Kidokoro 1998). Designing market-based financing tools for urban centers with substantial levels of urban poverty is a challenge for policymakers in Asian countries.

2. Environmental issues and underlying factors in Asian cities

With so many cities at different levels of economic development and social conditions, Asia is experiencing a wide diversity of urban environmental problems. In this section, we will look at three key urban environment issues: air quality management and urban transportation; solid waste management; and water supply and sanitation.

2.1. Air quality management and urban transportation

Three major sources of air pollution—industry, automobiles, and construction—are pillars of economic development. A study of the largest East Asian cities by Dhakal and Kaneko (2002) shows that the share of the tertiary sector in urban economies has been growing over the last two decades. At the same time, heavy industry has been moving out of residential areas and towards peri-urban areas. Thus the major source of urban air pollution is shifting from industrial pollution like oxides of sulfur (SOx), dust fall/total suspended particulate matter (TSP) to non-industrial pollution like oxides of nitrogen (NOx) and smaller particulate matter (PM_{10}/SPM).

With non-point sources dominating the emissions, SPM and PM_{10} have become the most important air pollutants in Asian cities. Figure 4 shows the annual average concentrations of air pollutants in 15 major Asian cities in 1999. PM_{10} concentrations in the ambient air of many cities of this region—among them Beijing, Kolkata, Chongqing, Jakarta, and New Delhi—exceed World Health Organisation (WHO) standards. In addition, NOx concentrations are higher than SOx concentrations in most of these cities, which clearly indicates the domination of non-point source pollution.

The urban transport sector is one of the major non-point sources of pollution and needs special attention in air quality management. $PM_{10,}$ $PM_{2.5,}$ and NOx are serious concerns and the transport sector is a major source of all three. Large numbers of vehicles, poor emissions-control standards, and low quality of available fuel are the primary factors adding to transport-related pollution in Asian cities. In some cities, the prevalence of three-wheelers with two-stroke engines has further aggravated the situation. In highly developed countries of the region like Japan, the problem of NOx pollution is very clear.

The solution to urban transportation problems lies, to a large extent, in good city and transportation planning. However, unlike cities in Europe, Asian cities lack proper city planning and the growth of urban centers has been haphazard. Transportation issues are addressed reactively, resulting in a lack of sustainable solutions.

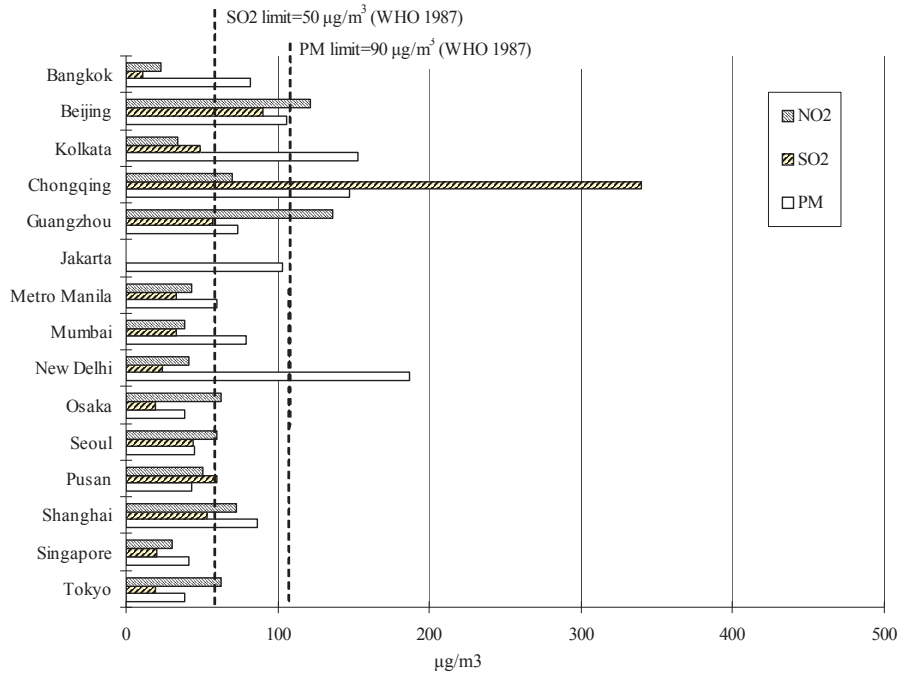


Figure 4. Annual average air pollution concentrations in Asian cities (1999)

Source: World Bank 2004.

Asia, with its prospects of continued rapid economic growth, is set to witness a parallel surge in urban transportation. Increasing inter-regional and intra-regional trade as a result of globalization have increased transportation activity (UN 2001) since the late 1990s. To date, several factors have hindered adequate provision of transportation services to match the increasing demand. These factors vary from country to country depending on economic growth levels. However, the major determinants are: population growth and urbanization, and investment gaps in infrastructure. The developing countries of the region show an infrastructure investment shortfall of perhaps 50 percent of the estimated total investment requirement in the transport sector. The huge capital costs and the time required to develop high-capacity mass-transit systems have prevented their timely implementation in rapidly growing urban areas (IGES 2003). With the recovery of the region's economies, the private sector and international financing agencies have a major role to play in making up the shortfall in infrastructure investment.

With the forces outlined above driving change, Asia is confronted with a variety of transportation problems and challenges (AIT 2002; IGIDR 2001; UN 2001). The following sections look at some of the major issues in urban transportation.

a. Growing motorization and congestion

There has been a considerable increase in motorization in almost all countries in this region (World Bank 2004). The number of vehicles in Bangkok grew more than sevenfold between 1970 and 1990, while in Beijing there was a threefold increase between 1991 and 2000. Similar trends are observable in

South Asia. In India since the mid-1990s, following the introduction of economic reforms that lowered costs and increased the affordability for private cars (Ramanathan 1999), Delhi's total motor vehicle population grew from 2.4 to 3.3 million (Iyer 2001; IGIDR 2001).

Two other indicators of increased motorization are vehicle density (measured in vehicles per kilometer of road) and cars per 1,000 persons. Rapid increases in numbers of cars combined with slow road development have resulted in increasing vehicle densities in nearly all countries of the region. The highest vehicle density can be found in Hong Kong, at 283 vehicles per road km, while at the lower end, India shows a ratio of only four vehicles per road km (World Bank 2003b). Brunei Darussalam and Japan have the highest rates of cars per 1,000 population, with about one private car for every two persons. India, China, Myanmar, Nepal, and Bangladesh have the lowest motorization, with rates of less than five private cars per 1,000 people. However, the vehicles in these countries are concentrated in a very few major cities, resulting in high levels of localized air pollution. The exponential growth of motorized two- and three-wheeled vehicles is another visible trend in Asian cities; they now account for over half of all motor vehicles, and the number is expected to grow very rapidly in China, Vietnam, India, and the other low-income countries (AIT 2002).

Such vehicle densities and poor infrastructure result in congestion, a common characteristic of motorization in most growing cities of the region. The centers of many capitals, including Bangkok, Delhi, Dhaka, Jakarta, Metro Manila, and Seoul, are particularly congested, with weekday peak-hour traffic speeds reportedly averaging 10 kilometers per hour or less. One estimate put the average travel time for work trips in Asia at 42 minutes, and as high as 90 minutes in some cities (UN-HABITAT 2001; World Bank 2004).

These high levels of congestion result in significant social losses. A study on Bangkok (UN-HABITAT 2001) estimated that the direct economic costs of congestion could be as high as 163 billion baht (around US$4.1 billion), annually. A World Bank study estimated that a 10 percent reduction in peak-hour trips in Bangkok would provide benefits of about US$400 million per year (cited in UN 2001).

b. Inadequate public transport services and increased burden on the state

Public transport is crucial to millions of poor and otherwise disadvantaged people in the region. However, inadequate and poor-quality services have exacerbated the growth of private modes of transport. In cities like Bangkok, Jakarta, Manila, and Mumbai the modal share of public transport varies between 40 and 60 percent of total person trips, which is far lower than in the developed cities of the region, Hong Kong, Singapore, and Tokyo, where the share is 70 percent (AIT 2002; UN 2001).

Public transport is capital intensive, and lack of sufficient investment and inappropriate pricing policies make it difficult to provide better service. Transport infrastructure development has remained chiefly the responsibility of the public sector, putting an enormous financial burden on national and urban governments. Inappropriate pricing policies not only burden the state but also result in significant impacts on real estate values, prices of essential commodities, and cost of living, and can influence the

dynamics of slum development in major cities. Private-sector investment has been very small even in megacities like Bangkok and Mumbai.

c. Other factors

Two other important issues hindering better transportation services are (1) low institutional capacity, and (2) lack of participation by stakeholders in the planning process. Local governments in most cities have serious capacity limitations in planning, development, and management of transport systems, resulting in delays in project implementation, wasteful investment, and other problems. Lack of appropriate institutional arrangements to form partnerships with the private sector is another major capacity limitation observable in the region. However, few Asian cities have any plans for, or have made any progress towards, developing their capacity and institutional arrangements. With only few exceptions, institutional mechanisms to ensure the participation of all social groups, including women and the poor, in the development of the transportation system are non-existent.

2.2. Solid waste management

High population growth and urbanization coupled with rapid economic growth greatly accelerate consumption rates in Asian developing cities. A concomitant to this consumption, municipal solid waste (MSW) generation is also accelerating; at the same time, the composition of the waste is changing. Figure 5 shows the relationship between per capita MSW generation and per capita gross domestic product (GDP) in Asian countries. In cities in Japan, South Korea, and Malaysia, the income level of residents has increased rapidly and the quantity and quality of waste generated is similar to that of western countries. In industrialized cities, more than 1 kilogram of solid waste is generated per person per day; in developing cities the corresponding figure is around half of that (IGES 2001). There is thus a significant difference in waste management challenges facing industrialized and developing cities in Asia. Table 2 presents the typical characteristics of waste management in Asian cities at different levels of development.

Table 2. Typical characteristics of MSW management in Asian cities

	Less-developed cities	Rapidly developing cities	Developed cities
GNI-PPP* per capita (2002)	Less than 2,000	2,000–15,000	16,000–30,000
MSW generation (kg/capita/day)	0.3–0.7	0.5–1.5	>1.0
MSW collection rate	<70%	80–95%	95–100%
Recycling	Informal	Formal and informal	Formal
expenditure from municipal budget (%)	15–40	5–25	1–5

* NGI-PPP: Gross national income in purchasing power parity.

Source: Mendes and Imura 2004b.

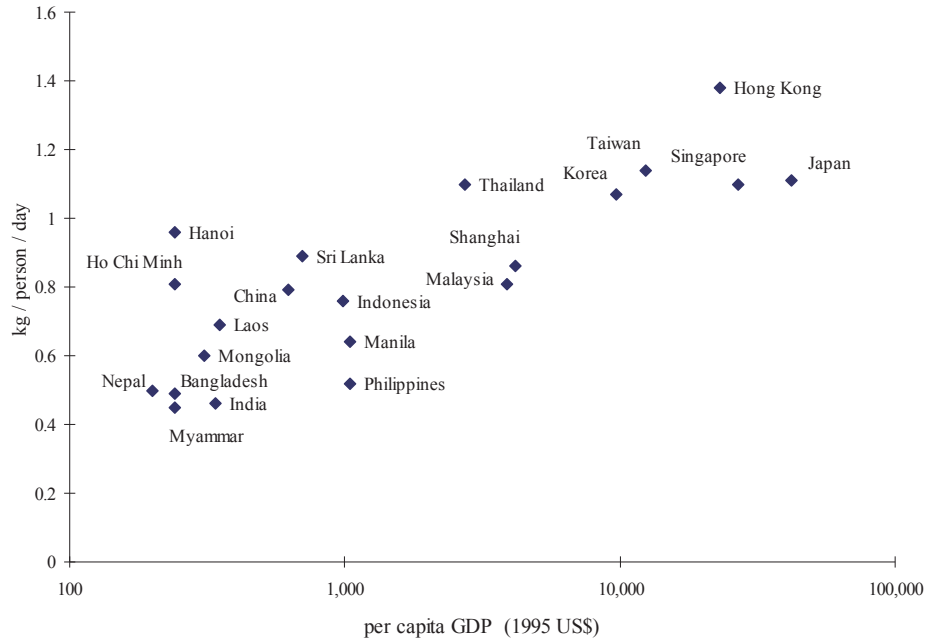


Figure 5. Relationship between MSW generation rates and per capita GDP in Asia

Source: World Bank 1999.

In developing cities, waste management systems tend to fail at the collection stage, and in all but a few isolated cases, proper means of disposal are missing. In developed countries, on the other hand, waste management tends to be efficient; the challenge is coping with a much larger volume of waste that is highly inorganic and recyclable, and the scarcity of land for waste disposal. Waste in these cities contains a great proportion of voluminous materials such as food containers and packaging materials (Mendes and Imura 2004a). Later on, we will discuss moves being made towards minimizing waste and more rational cycling of materials.

In poor cities, waste management is characterized by inefficient collection and unsanitary conditions. Waste treatment and disposal usually consist of open dumps, but some cities are adopting controlled dumps and partially engineered landfills. Composting and recycling are receiving more attention (Enayetullah and Sinha 1999). Due to its high costs, incineration usually is not practiced, except for hospital waste. Even in cities where high economic growth is being achieved, income disparities are often wide and growing. Poverty persists and leads to irregular settlements and people using scavenging as a very hazardous way of earning a living (IGES 2001).

Low systemic efficiency and lack of public participation further aggravates the already grave situation (Ogawa 1996; IGES 2001; Zurbrugg et al. 2002). To provide these basic civic services for the ever-increasing urban populations, financing is badly needed, and lack of private-sector participation and inability of the state to devote more resources has been the main cause of poor waste management in many Asian cities. These issues are examined in more depth below.

a. Lack of institutional capacity and regulation and poor systemic efficiency

Poor government policy and response, lack of political will, lack of appropriate economic and human resources, and weak institutions at the local level result in poor management of waste, especially in large but poor cities like Dhaka, Kathmandu, and Phnom Penh. Inefficient collection of waste (collection rates between 30 and 70 percent) and inadequate waste disposal cause serious environmental degradation and affect public health. Many cities are yet to institute waste-management regulations, so the sector operates without rules. However, national policies are now being formulated in several developing countries. Several national and local governments, in the Philippines, India, and Indonesia, for example, are developing policies towards proper waste management, but enforcement and monitoring remain deficient (United Nations Environment Program 1996).

b. Lack of financial mechanisms

Among less-developed and rapidly developing cities, lack of sufficient financial resources is a major constraint in waste management. This is true despite the fact that MSW management services account for a high percentage of municipal budgets in many cities of the region. In some Asian cities, MSW management costs can reach 40 percent of the total municipal operating budget, and of these costs, 70–90 percent is spent on collection. However, even this has proved to be insufficient to achieve the necessary level of services, and the absence of any sort of user fees and income-generation measures make waste management a virtually impossible task for the state.

c. Lack of private sector, community, and NGO participation

Although in Asia there are recycling activities promoted by communities, non-governmental organizations (NGOs), and the private sector, these activities, in general, are informal in nature and are not supported by the municipal authorities. Moreover, the level of private-sector participation is not sufficient to make a noticeable impact on overall waste management. Lack of institutional support limits the penetration of private-sector participation in solid waste management. Unclear regulations and division of roles between public sector and private sector restrict the formation of partnerships, which could play a crucial role (Chang, Ren, and Imura 2001). Although a few countries and cities, such as Malaysia, Singapore, Hong Kong, and Thailand, have started encouraging private-sector participation (World Bank 2003a), it is still long way from realizing its full potential.[1]

2.3. Water supply and sanitation

Many urban dwellers in Asia are still without access to adequate water supply and sanitation services. The WHO and the United Nations Fund for Children (UNICEF) have shown that although absolute numbers of people with access to water supply have increased due to rapid urbanization, in fact a smaller portion of the total urban population is now covered (World Health Organization and UNICEF 2000). Table 3 shows that many cities are still far behind the regional average coverage figures for urban

1. More information on different cases of private sector participation in the countries listed can be found on the Kitakyushu Initiative home page: http://www.iges.or.jp/kitakyushu. The Kitakyushu Initiative was adopted during the Third Ministerial Conference on Environmental and Development held in Kitakyushu, Japan, in 2000.

water supply. Because the supply of safe water is assigned a high priority, municipal water supplies are generally established before sewerage systems. As can be seen, in the Pacific coastal cities of Korea and China, coverage in 1997 was nearly 100 percent and water was available 24 hours a day. Some Southeast and South Asian cities, on the other hand, suffer from serious infrastructure inadequacies. For example, coverage in Jakarta was only 27 percent and water was available 18 hours a day. In Mumbai and Chennai (India), coverage was 100 percent and 97 percent[2] respectively, but water was available for only four or five hours a day.

In recognition of the severity of the problem, water and sanitation was given high priority in the United Nations Millennium Development Goals (MDGs), which include the goal of halving by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation. With efforts to realize this goal, it is expected that, in Asia, water supply connectivity will increase from the existing 93 percent to 96 percent, and basic sanitation from the existing 78 percent to 89 percent. Operational and management inefficiency is considered to be the major problem in water supply systems in Asian cities, and immediate action is necessary to improve the overall situation. Asian cities are experiencing major challenges in achieving these urban water supply and sanitation goals, in the form of lack of investment and poor governance. These two issues are examined below.

a. Lack of investment

According to the *Global Water Supply and Sanitation Assessment Report 2000* (World Health Organisation and UNICEF 2000), annual investment in urban water supply in Asia is about US$3 billion, comprising $2 billion from domestic investment and about $1 billion from external support. For sanitation, total investment is about $1 billion, where $900,000 is domestic investment. Looking at the share of total investment for water supply and sanitation in the total investment of the state, which is 3.6 percent in Asia compared to 5.3 percent in Africa and 8.3 percent in Latin America and the Caribbean, it would be very difficult to arrange massive additional investments from domestic sources to achieve higher water supply and sanitation targets, on top of the existing subsidies on water supply and sanitation services.

Most of the cities in this region suffer either from lack of infrastructure or from poor systemic efficiency in wastewater treatment. In China, only 16 percent of wastewater is treated (Song 1997). Though countries like India and Thailand enjoy a high percentage of their wastewater being treated (83 percent in Bangalore City, India and 70 percent in Chiang Mai City, Thailand), the performance efficiency of the treatment plants is very low. Other countries in this region suffer from serious lack of wastewater treatment; for example, Bandung in Indonesia has only 23 percent of its wastewater treated, Penang in Malaysia has only 20 percent treated, only 10 percent is treated in Karachi, Pakistan, while there is no record of wastewater treatment anywhere in Bangladesh (UN-HABITAT 2003). Wastewater, mostly domestic, entering water bodies without proper treatment makes water purification expensive, increasing water supply costs further. Massive external investment in water supply and sanitation infrastructure is required, alongside policies on wastewater disposal and control of water pollution.

2. It is possible that this figure does not include slum areas (Satterthwaite 2003).

b. Poor governance

Poor governance in the water supply and sanitation sector mainly stems from lack of policies on tariff schemes and on the roles of service regulators and service providers. Insufficient tariffs mean that public investment only subsidizes the existing levels of service rather than being used to improve coverage and quality. Low uniform tariffs also encourage wastage of water by the more affluent sectors of society, with the end result that the poorer sectors subsidize the rich (McIntosh 2003). Different departments and levels of government have taken on conflicting roles in many cities. Poor governance has also resulted in high levels of non-revenue water due to poor construction, operation, and maintenance of the infrastructure. Many of the urban poor are not yet served with piped water and do not have access to safe sanitation. As a result, they suffer more from water- and sanitation-related health risks. City administrators in developing cities are facing a rapid influx of poor migrants for whom employment tends to be temporary and insecure and who enter informal settlements.[3] Devising institutional

Table 3. Water supply coverage, availability, and consumption in major Asian cities, 1997

City	Coverage (%)	Water availability (hours/day)	Consumption (liter/capita/day)
Bandung	42	6	120
Bangkok	82	24	265
Beijing	100	24	96
Colombo	58	22	165
Delhi	86	4	209
Dhaka	42	17	95
Hanoi	76	18	45
Hong Kong	100	24	112
Jakarta	27	18	135
Karachi	70	4	157
Katmandu	81	6	91
Manila	67	17	202
Mumbai	100	5	178
Seoul	100	24	209
Shanghai	100	24	143
Singapore	100	24	183
Taipei	99	24	262

Source: McIntosh and Uniguez 1997.

3. The authors are grateful to the reviewers for their valuable inputs in improving this section in the revised version.

arrangements and allocating roles for different actors according to the changing needs, so as to cater for the needs of the poor while creating the right environment and incentives for the service providers, is a governance challenge faced by most cities in Asia.

3. Urban environment and economic growth: The environmental Kuznet's curve

It is accepted that environmental degradation is inevitable in a growing economy, but it has also been observed that the rate of this degradation does not continue to rise indefinitely. The environmental Kuznet's curve (EKC) hypothesis states that after continued economic growth and development, the incidence of environmental pollution levels off with GDP growth and then starts to fall. The "curve" takes the form of an inverted U. A variety of factors influence when the peak is reached and how far and quickly the pollution declines: economic growth; sources of pollution; policies and regulations; political and social characteristics; and institutional arrangements. Understanding these factors and the relationships between them will help in deriving sustainable solutions to the impending environmental problems in the region, even while rapid growth continues.

Economic growth alone cannot improve environmental quality (Stern, Common, and Barbier 1996). Environmental quality is influenced by many factors, both direct and indirect. Panayotou, in his study on 30 developed countries from 1982 to 1994 (Panayotou 1998), demonstrated that if the profile of economic growth remains the same, the level of pollution will be worse with greater GDP per square kilometer, higher share of industry in GDP, and faster pace of economic growth. With respect to the enforcement of contracts as a representative policy variable, Panayotou concluded that better-quality institutional arrangements not only made the turning point of the EKC occur earlier in economic development, but also tend to reduce the level of pollution. Environmental performance also depends on political rights and income inequalities (Torras and Boyce 1998). The level of environmental pollution is reported to be lower when political rights are stronger in a particular city. Torras and Boyce report that environmental quality (measured by sulfur dioxide and smoke) deteriorates as income disparities widen (as implied by an increased Gini Index)[4].

In addition to the factors above, technological innovation and individual preferences are major determinants that move an economy toward the EKC turning point (Lopez 1994, McConnell 1997). However, when the interests of different stakeholders cannot be easily reconciled, solutions to environmental problems will be delayed even if individual environmental awareness is high (Roca 2003). Hence, if institutional arrangements exist that enable reconciliation among the interests of stakeholders, it is possible to bring forward the EKC turning point. Shifting from industrial production toward tertiary industries in major cities would also help to reach the EKC turning point earlier. Such trends have been noticed in a few cities though in many of them it is still in the initial stages.

4. The Gini Index measures the extent to which the distribution of income (or consumption) among individuals or households within a country deviates from a perfectly equal distribution. A value of 0 represents perfect equality, a value of 100 perfect inequality

Thus, by establishing necessary institutions, stronger political rights, sound environmental policies and legislation, and multi-stakeholder partnerships, and moving industry outside urban centers, it should be possible to control pollution in Asian cities even as rapid economic growth and urbanization continue.[5] The following sections look at recent developments in urban environmental management.

4. Recent developments: Hints for solutions

National and metropolitan city governments in Asia have begun to recognize the need for urgent action to limit the environmental impacts of urbanization. In both developed and developing cities, a variety of responses are being tried, taking in both policy and action, to offset current trends and to move towards sustainable solutions. This section looks at some of these responses, focusing on the three areas looked at earlier: air quality management and urban transportation, solid waste management, and water supply and sanitation.

4.1. Air quality management and urban transportation

Several Asian cities have taken up or are considering measures to improve their urban transport systems and initiated measures to integrate urban transport in development planning. A few of these efforts are described below.

a. Improving public transport

With the increased awareness of the advantages of public transport, many cities in the regions have been actively considering ways to strengthen their public transport systems through improving existing services and introducing new services.

Recognizing the shortcomings of road-based transport systems to meet the growing demand for mobility, several larger cities in the region have developed, or are in the process of developing, rail-based transport systems. Bangkok; Busan, Incheon, and Seoul in the Republic of Korea; Kuala Lumpur; Manila; China's Beijing, Guangzhou, Shanghai, Shenzen, Daegu, and Tianjin; and Delhi, Kolkata, and Mumbai in India have all implemented new rail-based projects or are extending their existing networks. Almost all cities with existing rail-based systems are considering possible extensions to meet the growing demands (AIT 2002; IGIDR 2001; UN 2001; World Bank 2004).

Premium (air-conditioned) bus services are now available in a large number of cities in the region. Wealthier cities such as Bangkok, Kuala Lumpur, Shanghai, and Shenzhen, have introduced higher-quality buses on their roads. Some low-income cities also have introduced premium bus services, though on an experimental basis (IGIDR 2001; UN 2001). Cities with more advanced forms of transportation such as Singapore and Hong Kong have successfully integrated public transport services, such as subways and bus systems, provided by multiple operators (PADECO 2000). Delhi has been planning to introduce a metro network system fed by a bus network (IGIDR 2001).[6]

5. This observation is made based on the literature presented in this section. The authors do not intend to draw any conclusions or make policy recommendations on this point.
6. More information can be obtained from the Indira Gandhi Institute for Development Research, Mumbai, India or from the authors of this paper.

b. Switching to cleaner fuels

Present levels of air pollution have prompted many cities, among them Bangkok, Delhi, and Manila, to take measures to improve vehicle emissions. The most common measures include the introduction of lead-free gasoline and low-sulfur diesel; the introduction of vehicle emissions control standards and mandatory regular vehicle inspection systems; promotion of cleaner fuels, such as liquefied petroleum gas (LPG) and compressed natural gas (CNG) for commercial vehicles; banning and phasing out of certain types of vehicles; and restrictions on diesel vehicles and superannuated gasoline-powered vehicles.

Delhi has imposed a complete ban on diesel-powered buses and trucks and ordered the conversion of the entire bus fleet to CNG. Now, all public transport vehicles, including feeder services, run on CNG (Government of National Capital Territory of Delhi 2003). Several other major cities, including Dhaka, Kathmandu, and Mumbai, are following similar conversion programs (Yedla 2004). India has also successfully implemented a nationwide lead-free gasoline program. Similar efforts to control pollution from urban transport in different cities include: implementation of an air quality management project in Bangkok; Anti Smoke Belching Program in Manila; inspection and maintenance program for private cars in Jakarta; restricting entry of older vehicles into the city, and mandatory inspection and maintenance programs in Delhi and Mumbai; and phasing out of two-stroke engined three-wheelers in Dhaka (AIT 2002; IGIDR 2001; UN 2001; Yedla 2004). Unleaded gasoline is common in most cities in Asia; however, in a handful of developing cities, it is only slowly gaining momentum due to improper pricing.

c. Technology application

The application of intelligent transport systems (ITS) technology is an important next stage in transport-sector development for cities with relatively advanced transportation systems. The major application areas of ITS technology include electronic road pricing, traffic management, integrated ticketing systems for different public transport modes, and traveler information. Electronic toll collection (ETC) is in use in some countries with stronger economies: China, Malaysia, the Philippines, and Thailand. Hong Kong and Singapore have introduced more comprehensive electronic toll and parking fee management systems (UN 2001). The introduction of smart-card integrated ticketing systems for public transport systems is another significant development. The first such large-scale system was introduced in Hong Kong in 1997; the contactless[7] cards offer a common ticketing system for more than 30 transit operators providing bus, ferry, and rail services (Frost 2001).

d. Private-sector participation and partnerships

The increased participation of the private sector in providing urban transport infrastructure and services is an encouraging feature of transport development in many Asian cities. Major toll roads and rail transit systems have been developed in Bangkok, Kuala Lumpur, and Manila with private-sector

7. A contactless card is a chip card that can be used in applications such as public transport, where commuters do not have to physically insert or closely swipe a card in front of a reader. It offers multiple functions.

participation. The private sector is also assuming a greater role in providing public transport services. The number of standard (non-air-conditioned) buses operated by private companies in Bangkok increased during 1996–2001. The deregulation of bus fares has encouraged private operators in Dhaka to introduce a large number of buses (UN 2001). Partnerships among major actors—in the public and private sectors, national and foreign governments—in providing urban environmental infrastructure is on the rise and gaining momentum in Asian cities (Chang, Ren, and Imura 2001).

e. Participatory approaches to urban transport planning

Asia's rapid urbanization presents city planners and urban transport departments with urgent challenges. The conventional approach to environmental management, in which problems are handled on a top-down, sectoral basis, needs to be replaced by an integrated metropolitan-wide approach (IGES 2003), including to urban transportation. Involving the community in planning processes provides better scope for successful implementation of projects. Integrated approaches are based on methodologies that develop a broad-based consensus on an achievable vision of the future and clearly articulate the means by which these visions can be realized. As has been mentioned, reconciling the opinions of multiple stakeholders can help to reduce pollution without compromising economic development. These insights have been guiding the implementation of a pilot project in the Ko Rattanakosin area of Bangkok, which is being jointly implemented by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the Bangkok Metropolitan Administration, working closely with the Government of the Netherlands (UN 2001).

f. Integration of local pollution control and greenhouse gas mitigation measures

The urban transport sector in Asia has contributed substantially to greenhouse gas (GHG) emissions. However, it is difficult to consider GHG mitigation in urban transportation planning due to the fact that developing cities in Asia are not under any obligation to control their GHG emissions. The priority for city policymakers is controlling localized pollution resulting from transportation. However, by integrating GHG-mitigation considerations with local pollution control measures, policymakers can find themselves in a "win-win" situation, able to access FDI and the Clean Development Mechanism funding to invest in capital-intensive urban transportation development. Some Asian cities already seem to be showing interest in integrating GHG mitigation and local pollution control within their urban transportation strategies, with substantial benefits in both areas (Yedla, Parikh, and Shrestha 2003).[8]

4.2. Solid waste management

As described earlier in this paper, developed and developing cities are facing different sets of issues in MSW management. The major new trends of MSW management in developing cities are improved community participation and private-sector involvement in service provision. Trends in developed cities are toward strategies to realize a "sound material-cycle society".

8. The IGES Urban Environmental Management Project Team, under its third phase research plan, will study developing strategies for the integration of GHG mitigation options into local pollution control measures in selected Asian cities.

a. Private-sector participation

As financing is one of the major constraints in MSW management, along with lack of efficiency, appropriate partnerships between the public and private sectors is potentially one of the most viable solutions, bringing in new resources and business know-how. Efforts are being made to introduce such partnerships in several Asian cities.

In East and Southeast Asian countries, the private-sector is playing an increasing role in construction and operation of MSW-disposal facilities under lease and concession contracts. MSW-related business in Malaysia, including construction and operation of waste collection and disposal facilities, has been transferred to several private companies under concession contracts. Similar contracts have been tendered to private companies for construction and operation of MSW-disposal facilities, such as landfill and incineration plants, in the Philippines, Thailand, Hong Kong, Macao, and Singapore. However, the requirements for advanced technology and emissions control in such projects tend to be stricter than for those operated by local governments (IGES 2001). For this reason, the role of the private sector is mainly limited to collection and transfer of waste.

Two more prominent examples illustrate how much the success of private-sector participation in MSW management waste depends on context. Since 1994, the Municipality of Phnom Penh has entrusted its waste-management services to private contractors with franchise agreements allowing them a monopoly. However, the service provider has changed six times, mainly due to financial constraints (Japan International Cooperation Agency 2003). Macao, with less than half a million population, has effectively involved the private sector in MSW collection and disposal. Since 1992, the collection and transportation of MSW and incineration have been contracted out to two private companies. This has improved both systemic and financial efficiency (UN 2003).

One more initiative getting a good deal of attention is in waste composting in Dhaka, Bangladesh. Waste Concern, a Dhaka NGO, started an initiative to promote community-based efforts for primary collection of waste, as well as to encourage composting to reduce final waste disposal quantities. By developing a partnership with a private fertilizer company, they have managed to successfully market their compost, which is a key to the success of any composting project (Zurbrugg et al. 2002).

Although most of the initiatives described here have been ultimately successful, they have faced many bottlenecks in their implementation. Moreover, such measures are situation specific and need to be devised on a case-by-case basis. For the most part, the public sector is likely to continue playing the dominant role in MSW management.

b. Promoting public awareness and participation

Increasing public participation at the collection stage is crucial to improve waste management. In Asia there is a general trend towards raising public awareness and increasing participation, though significant public participation is still far from a reality.

The government of Nonthaburi City on the outskirts of Bangkok launched a pilot project under the Kitakyushu Initiative,[9] to reduce final waste by increasing the level of recycling through public participation. Through active dialogue with the public; distribution of information materials to every household about recycling through source segregation; and providing plastic bags and bins for recyclable material to every household, a 20-percent reduction was achieved in waste needing disposal (UN 2003). Some similar efforts that have been documented include one by Waste Concern in Dhaka (Enayetullah and Sinha 1999), Stree Mukhthi Sanghatan, and Exnora in Mumbai, India (Yedla and Kansal 2003).[10]

c. Efforts towards achieving a sound material cycle society

In developed cities, the need has been felt for waste minimization and resource recovery in order to cope with the increasing volume and variety of waste, increased difficulty of processing, and shortage of landfill space. In several places, the "3 Rs"—reduce, reuse, and recycle—are being adopted (Mendes and Imura 2004a); better use of natural resources has been incorporated into national policy agendas with the intention of moving toward a "sound material-cycle society" or "cycling economy".

The sound material cycle is an extension of the traditional waste management line both backwards, including the stages before the resource became waste (that is, consumption, production, natural resource extraction); and forwards, through recycling. A sound material-cycle society is characterized by the cycling of resources, by a lower input of natural resources, smarter design of products, more efficient manufacturing, and more efficient consumption, as well as reuse, recycling, and proper treatment of materials that cannot be further utilized. Strategies towards a sound material-cycle society affect all stages of the life-cycle of a product, influence several industrial segments, and involve several actors, including governments, the private business sector, development organizations, media, public groups, and individual consumers (Ministry of Environment, Japan 2003).

Since the late 1990s, Japan, South Korea, Singapore, and Taiwan have been implementing policies for the promotion of recycling and more efficient use of resources. Japan enacted the Law for the Promotion of the Recycling Oriented Society in 2000 (Ministry of Environment, Japan 2003), renamed as Promotion of the Sound Material Cycle Society in 2003. In South Korea, the Act relating to Promotion of Resources Saving and Reutilization was revised in 1999 with stronger fines and regulations (Seoul Metropolitan Government 2000). Singapore and other developed regions in Asia are following the same trend by launching specific policies promoting waste minimization and recycling. China, as well, has developed an ambitious development plan with the objective of attaining an overall well-off (*sha kong*) society involving the concept of a circular economy by the year 2020 (Cleaner Production China 2004; China Council for International Cooperation on Environment and Development 2004). However, these visions are still a long way from the reality, and developed cities continue to be confronted with very high waste-generation rates.

9. See footnote 1.

10. Most of these efforts are local in nature and carried out by NGOs and community-based organizations. However, the role of the state in such efforts is not inconsiderable. More information on such "best practices" can be found at http://www.iges.or.jp/kitakyushu.

4.3. Water supply and sanitation

As described above, many cities are having problems providing adequate water supply and sanitation to fast-expanding city populations. Many people are without piped water and in numerous places, most if not all wastewater runs untreated into natural water courses. Governments are barely able to invest enough to maintain existing levels of service. Because developing water infrastructure is capital intensive, with very slow rates of return, it is unattractive to private-sector investors. In addition, the changing nature of the urban centers and the population to be served makes such projects even more complex and risky. At the same time, poor governance and operation of water infrastructure has led to inefficiency, which in turn hinders development. This section looks at some of the steps Asian cities have taken to overcome these constraints.

a. Financial mechanisms in providing environmental services

The gap between supply and demand for urban environmental infrastructure and services is widening with rapid urbanization and economic growth. The existing government budget allocations could be used more efficiently, but the need for new financing mechanisms is unavoidable. User charges could be an important source of extra finance. However, at present, user charges tend to be quite low in relation to cost-recovery targets; in many countries, user charges are too low even to meet operation costs. In Japan, revenue from user charges covers only about 40 percent of the operation and maintenance costs of the sewerage system (Imura, Morishima, and Inui 2005). Because of the current levels of user charges and the perception of water supply and sanitation as essential public services, increased public awareness and political will be essential elements for successful introduction of higher user charges (Memon 2004). Panayotou (1998) outlines a number of other possible financing sources, including property rights, market creation, fiscal instruments, charging systems, financial instruments, liability systems, performance bonds, and deposit-refund systems, that can be used for water and sanitation infrastructure as well as a range of other environmental applications.

Environmental funds and investment bonds are becoming popular in some of Asian countries (European Bank for Reconstruction and Development 1999; United States Environmental Protection Agency 1999). Environmental funds are created at either national level or at local level with national support. They provide financial assistance to improve environmental infrastructure and services at low interest rates and easy terms. Environmental funds can take several forms. China, for example, is trying to replicate the United States' experiences of using revolving funds to support wastewater infrastructure. One important factor in environmental funds is that the regulator and monitor should be independent of the service provider. One way to do this is to have a multi-stakeholder board to monitor transparency. Microfinance models like the Orangi Pilot Project[11] and Bangladesh's Grameen Bank may provide good guidelines for management of these funds.

Investment bonds are commonly used in many developed countries. The World Bank has developed a useful list of pre-conditions (Daher 1997) for successful issuance of municipal bonds, including, among

11. More information on these projects can be obtained from the Kitakyushu Initiative website. See footnote 1.

others: well-developed capital markets, a history of macro-economic stability, availability of sound local government institutions, and predictable fiscal relations with central government. Few developing countries can yet meet all of these pre-conditions. However, India and Indonesia are taking the lead in trying municipal bonds (Phelps 1997; Daher 1997; Varma 1999). Many Asian countries, especially in East Asia, are moving toward strong capital markets and regulation; thus, they should be able to introduce municipal bonds much earlier than other countries in the region. Local governments are gaining more independence through decentralization processes in many countries, and this is likely to see them generating resources for local development and services through a variety financial mechanisms, including municipal bonds.

Among other possible financial instruments, emissions taxes are currently being used in China and Thailand, while effluent charges are in place in China and the Philippines (Anderson 2002). Market creation through emissions trading, tradable permits, quotas, and shares is also a popular concept, especially to address industrial wastewater and air pollution. This helps to generate finances for wastewater treatment infrastructure. Though no one has yet put this idea into practice, groundwork is being done, especially in China, to introduce it.

Allocating clearly defined roles is the key for partnerships, and many Asian countries do not have sufficient institutional support to implement active private-sector participation in environmental services. Communities and consumers are not taken into confidence while devising the agreements. According to Kwak (2000), such efforts, including information dissemination and public hearings, would help to reduce various risks involved in partnerships. Improving much-needed private partnerships in providing environmental services is a bigger challenge to Asian cities facing high inflows of poor migrants.

b. Changing roles: Civil society, private sector, governments, and international cooperation

According to the World Bank (2000) an integration of availability of infrastructure, financial mechanisms, institutional set up, and stakeholder participation is vital to improve the environment and sustain it over the time, without compromising economic development. To develop effective urban environmental governance, it is very important to identify the roles of the various actors. Governments, changing from their role of service providers, have to formulate regulations and set up impartial regulatory bodies and monitoring systems. Restructuring and strengthening of the institutions is needed to support such partnerships. Governments have to confront equity and efficiency issues and take the initiative to create enabling environments for community and private-sector participation in delivering urban environmental services.

There are many potential benefits if the private sector, be it international, local, or community groups, can be persuaded to play a bigger role in environmental infrastructure and services. It should bring in investment to increase the coverage of the services. It should also introduce technological innovation, leading to lower production costs and improved quality of drinking water and/or treated wastewater for discharge. Private-sector participation is also expected to control losses and improve efficiency. When the international private sector brings in new technology, it should capitalize on local knowledge and foster local expertise.

Civil society organizations, including research groups and academia, have an important role to play in supporting systemic assessment capacity of cities. They can also usefully carry out awareness-raising campaigns to have a significant impact on citizens' willingness to pay for services and in changing consumers' lifestyles to support environmental conservation. These groups can also play a vital advocacy role, raising important environmental issues to be considered by governments and the private sector.

International cooperation will remain crucial to developing urban environmental governance in developing countries. This role is being strengthened further in the wake of the rethinking of international cooperation models, away from purely donor-driven approaches using foreign expertise and focusing on physical projects rather than capacity building (Berg and United Nations Development Program 1993; Cassen and Associates 1985; Fukuda-Parr, Lopes, Malik 2002; Koppel and Orr 1993; Matsuoka 1996; Organisation for Economic Co-operation and Development 1991, 1992, 1995; Rix 1990; United Nations Development Program 2001). Inter-city cooperation has immense potential to contribute to environment, and most of this inter-city cooperation is aimed at strengthening local capacity, as evident from the activities of Kitakyushu Initiative (www.iges.or.jp/kitakyushu).[12]

5. Conclusions

Changes in the urbanization processes that have been observed since the late 1980s may accelerate the pace of urban economic growth, but they also aggravate environmental pollution. The growing gap between demand and supply of urban environmental infrastructure and services is very significant in Asia. With further rapid economic growth and urban clustering expected, the environmental situation can only worsen unless countermeasures are adopted in time.

Research to date on the relationship between economic growth and environmental problems shows that factors such as institutional arrangements, stronger political rights, environmental policies and legislation, technology adoption, multi-stakeholder partnerships, and narrowing social inequalities can have a larger impact on environmental improvement than urban infrastructure itself. In other words, it is not just "hardware" that determines the extent of urban environmental problems, but more importantly, the maturity of the "software", including economic and governing capacity. Maintaining a balance between efforts to improve infrastructure and to create good governance is an immediate challenge for city administrators and policymakers in Asia.

As has been seen, cities in Asia are starting to take the initiative to improve environmental quality. Alongside the more sector-specific changes, there are some more general trends: promoting public awareness and participation in environmental planning and provision of environmental services; moving of heavy manufacturing industry out of cities; encouraging private-sector participation in civic and environmental services to increase investment and efficiency; multi-stakeholder partnerships; introduction of innovative finance mechanisms; improving environmental governance and

12. This issue of *IRES* features another paper, "Inter-city Environmental Cooperation: The Case of the Kitakyushu Initiative for a Clean Environment", by Mushtaq Ahmed Memon, Christine Pearson, and Hidefumi Imura, which looks in more depth at this kind of inter-city cooperation in Asia.

environmental management capacity at different levels; and South-South cooperation for better exchange of information and cooperation. Although these trends are often only in the initial stages of testing and are sometimes facing implementation bottlenecks, there is evidence to show that Asian cities are learning from one another, with increasing frequency. Continuous and persistent efforts in these directions are essential to achieve better environmental management and services.

According to the literature on the EKC, these are the kinds of trends that should be able induce an earlier peak, allowing economic development to continue and at the same time reducing the environmental cost. As already observed, the development of Asia's cities is unpredictable and diverse. The fate of environmental quality and services in Asia will depend on sound judgment and realistic measures. Probably the key challenges currently facing Asian cities are to find how best to devise and execute multi-stakeholder partnerships with appropriate role and risk sharing; and how to find the ideal balance between provision of public goods and user charges in light of the ever-increasing populations of urban poor with high levels of insecurity in their lives. Urban environmental management strategies in this region need to be focused not just on improving basic services but also on ways to make those services reach the urban poor.

6. References

AIT. *See* Asian Institute of Technology.

Anderson, R. C. 2002. Incentive-based policies for environmental management in developing countries. Issue Brief 02-07. Washington, DC: Resources for the Future.

Asian Institute of Technology (AIT). 2002. *Analysis of technical options for mitigating environmental emissions from the urban transport system in selected Asian countries*. Bangkok: Swedish International Development Agency-AIT.

Berg, E. and United Nations Development Program (UNDP). 1993. *Rethinking technical cooperation: Reforms for capacity building in Africa*. New York: UNDP.

Cassen, R., and Associates. 1985. *Does aid work: Report to an intergovernmental task force.* 2nd ed. London: Oxford University Press.

China Council for International Cooperation on Environment and Development. 2004. Strategy and mechanism study for promoting of circular economy and cleaner production in China. http://eng.cciced.org/ (retrieved 27 August 2004).

Chang, M., Y. Ren, and H. Imura. 2001. Financing urban environmental infrastructure in East Asia: Current situation, challenges and strategies. *International Review for Environmental Strategies* 2(1):79–105.

Cleaner Production China. 2004. The circular (recycling) economy in China. http://www.chinacp.com (retrieved 27 August 2004).

Daher, S. E. 1997. *Municipal bond markets prospects for developing countries*. Infrastructure Notes, Urban no. FM-8b. Washington, DC: World Bank. http://www.worldbank.org/html/fpd/urban/publicat/rd-fm8b.htm.

Dhakal, S. and S. Kaneko. 2002. Urban energy use in Asian mega-cities: Is Tokyo a desirable model? In *Proceedings of Workshop of IGES/APN Mega-city Project on Policy Integration of Energy Related Issues in Asian Cities, 23–23 January 2002, Kitakyushu, Japan,* 173–181. Hayama, Japan: IGES.

Douglass, C. M. 1995. Global interdependence and urbanization: Planning for the Bangkok Mega-urban region. In *The mega-urban regions of Southeast Asia,* ed. T. G. McGee and I. M. Robinson, 45–79. Vancouver: University of British Columbia Press.

Enayetullah, I. and A. H. M. M. Sinha. 1999. *Community based decentralised composting—Experience of Waste Concern in Dhaka*. Delhi: All India Institute of Local Self Governance.

European Bank for Reconstruction and Development (EBRD). 1999. *Municpal and environmental infrastructure*. London: EBRD.

Frost, M. 2001. The future of ticketing. *Public Transport International* 50 (May): 12–14.

Fukuda-Parr, S., C. Lopes, and K. Malik. 2002. *Capacity for development: New solutions to old problems.* New York: Earthscan/UNDP.

Government of National Capital Territory of Delhi. 2003. Newsletter. New Delhi: Chief Ministers Secretariat.

IGES. *See* Institute for Global Environmental Strategies.

IGIDR. *See* Indira Gandhi Institute for Development Research.

Institute for Global Environmental Strategies (IGES), Urban Environmental Managament Project. 2001. Urban environmental challenge in Asia: Current situations and management strategies. Part I: The summary of UE first phase project. Hayama, Japan: IGES.

———. 2003. *Proceedings of the IGES-KEI International Workshop on the Role of Planning Practices towards Sustainable Urban Environment in Asia: Environmental Consequences of Metropolitan Expansion in Asia, 11 March 2003, Seoul, Korea.* Hayama: IGES.

Indira Gandhi Institute for Development Research (IGIDR). 2001. *Analysis of technological options for mitigation of environmental emissions from the urban transport systems in selected Asian cities*. Mumbai, India: IGIDR.

Imura, H., A. Morishima, and T. Inui. 2005. Japan's environmental policy: Financial mechanisms. In *Environmental Policy in Japan*, ed. H. Imura and M. Schreurs, 256-275. Cheltenham, Edward Elgar.

Iyer, N. V. 2001. Measures to control vehicle population: The Delhi experience. Paper presented at the Workshop on Fighting Urban Air Pollution: From Plan to Action, Bangkok, 12–14 February 2001.

Japan International Cooperation Agency (JICA). 2003. Solid waste management in Phnom Penh. http://www.phnompenh.gov.kh/JICA/SWM.htm.

Kidokoro, T. 1998. Toward development of Asian-type urban management model (in Japanese). In *Global environment and mega-city,* ed. K. Takeuchi and Y. Hayashi, 219–248. Tokyo: Iwanami.

Koppel, B. and R. Orr. 1993. *Japan's foreign aid: Power and policy in a new era.* Boulder, CO: Westview Press.

Kwak, Y. H. 2002. Analysing Asian infrastructure development privatization market. *Journal of Construction Engineering and Management*, 128(2):110–116.

Leitmann, J. 1999. *Sustaining cities: Environmental planning and management in urban design*. New York: McGraw-Hill.

Lopez, R. 1994. The environment as a factor of production: The effects of economic growth and trade liberalization. *Journal of Environmental Economics and Management* 27:163–184.

Matsuoka, S. 1996. Japan's ODA and environmental cooperation in Southeast Asia. *Journal of International Development Studies* 2 (1): 35–57.

McConnell, K. 1997. Income and demand for environmental quality. *Environment and Development Economics* 2:383–399.

McIntosh and Uniguez. 1997. *Second water utilities data book*. Manila: Asian Development Bank.

McIntosh, A. C. 2003. *Asian water supplies: Reaching the urban poor*. London: Asian Development Bank and International Water Association.

Memon, M. A. 2004. Public private partnerships for environmental management structures: Analysis of three models from Asian cities. Paper presented at the Second International Symposium on Southeast Asia Water Environment, 1–3 December 2004, Hanoi.

Mendes, M. R. and H. Imura. 2004a. From end-of-pipe approach to the creation of a sound material-cycle society: Asian cases. In *Proceedings of the ISWA 2004 World Congress, Rome, Italy, 18–20 October 2004.* CD-ROM. ISWA.

Mendes, M. R. and H. Imura. 2004b. Municipal solid waste management in Asia. *Waste Management World* 4 (4): 145-154

Ministry of the Environment Japan. 1995. *The challenge to establish a sound material-cycle society*. Tokyo: Government of Japan.

Organisation for Economic Co-operation and Development (OECD). 1991. *Principles for new orientations in technical co-operation*. Paris: OECD.

———. 1992. *Principles for effective aid: Development assistance manual*. Paris: OECD.

———. 1995. *Development cooperation report* 1994. Paris: Development Assistance Committee, OECD.

Ogawa, H. 1996. Sustainable solid waste management in developing countries. Paper presented at the 7th ISWA International Conference and Exhibition, 28–31 October 1996, Yokohama, Japan.

PADECO Co. Ltd. 2000. Study on urban transport development: Final report, prepared for the World Bank Urban Transport Strategy Review. http://www.worldbank.org/transport/utsr/yokohama/day2/padeco.pdf.

Panayotou, T. 1998. Demystifying the environmental Kuznets curve: Turning a black box into a policy tool. *Environment and Development Economics* 2:465–84.

Phelps, P. M. 1997. Municipal bond market development in developing countries: The experience of the U.S. Agency for International Development. Finance working paper, USAID and Research Triangle Institute.

Ramanathan, R. 1999. Urban transportation. In *India Development Report 1999-2000,* ed. K. S. Parikh. India: Oxford University Press.

Rix, A. 1990. *Japan's aid program: A new global agenda*. Sydney: Australian International Development Assistance Bureau.

Roca, J. 2003. Do individual preferences explain the environmental Kuznets curve? *Ecological Economics* 45 (2): 3–10.

Satterthwaite, D. 2003. The Millennium Development Goals and urban poverty reduction: Great expectations and nonsense statistics. *Environment and Urbanization* 15 (2):181–190.

Song, X. 1997. Urban infrastructure development in contemporary China. In *Urban infrastructure development*: Proceedings of the First International Expert Panel Meeting on Urban Infrastructure Development, 21–22 June 1996, Jakarta, Indonesia, ed. Y. Yeung and H. S. Sheng, UNCRD Proceedings Series 15, 31–51. Nagoya, Japan: United Nations Centre for Regional Development.

Seoul Metropolitan Government. 2000. *Waste management in Seoul*. Seoul: Waste Management Division, Office of Environment.

Stern, D. I., M. S. Common, and E. B. Barbier. 1996. Economic growth and environmental degradation: The environmental Kuznets curve and sustainable development. *World Development* 24 (7):1,151–1,160.

Tasaka. 1998. *Bangkok and world city hypothesis in Tasaka. H. ed. Asian Megacity: Bangkok* (in Japanese). Tokyo: Nihon hyoron sha.

Torras, M., and J. K. Boyce. 1998. Income, inequality, and pollution: A reassessment of the environmental Kuznets curve. *Ecological Economics* 25 (2):147–60.

UN. *See* United Nations.

UN-HABITAT. 2001. *The state of the world's cities* 2001. Nairobi: United Nations Centre for Human Settlements (UN-HABITAT).

———. 2003. *The challenges of slums*. [PLACE]: UN-HABITAT.

United Nations. 2001. *Review of developments in transport and communications in the ESCAP region 1996–2001*. Bangkok: UN Economic and Social Commission for Asia and the Pacific (UNESCAP).

———. 2003. *Cities and sustainable development: Lessons and experiences from Asia and the Pacific*. Bangkok: UNESCAP.

United Nations Development Program (UNDP). 2001. *Development effectiveness: Review of evaluative evidence*. New York: UNDP.

United Nations Environment Program (UNEP). 1996. *International source book on environmentally sound technologies for municipal solid waste management, v*ol. 6. Osaka, Japan: UNEP International Environmental Technology Centre.

United States Environmental Protection Agency (US EPA). 1999. *Guidebook of financial tools: Paying for sustainable environmental systems*. Washington, DC: US EPA.

Varma, K. 1999. Financing through partnerships. In *Asian Cities in the 21st Century: Contemporary approaches to municipal management, vol. 1: Leadership and change in city management,* ed. J. Martin and N. Hamid, 93–102. Manila: Asian Development Bank. http://www.adb.org/Documents/Conference/Asian_Cities_1/chap7.pdf.

World Bank. 2000. *Cities in transition.* Washington, DC: World Bank.

———. 2003a. *Thailand environment monitor* 2003. Washington, DC: World Bank.

———. 2003b. *World development indicators* 2002. Washington, DC: World Bank.

———. 2004. *World development indicators* 2003. Washington, DC: World Bank.

World Health Organisation and United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply and Sanitation. 2000. *Global water supply and sanitation assessment 2000 Report*. Geneva: WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation.

Yedla, S., J. K. Parikh, and R. M. Shrestha. 2003. Sustainable urban transportation: Impact of CO_2 mitigation strategies on local pollutants. *International Journal of Environment and Pollution* 19(5):475–482.

Yedla, S. and S. Kansal. 2003. Economic insights into municipal solid waste management in Mumbai: A critical analysis. *International Journal of Environment Pollution* 19(5):516–527.

Yedla, S. 2004. Urban transportation trends, alternatives and policy issues. In *India Development Report* 2004-2005, ed. K. S. Parikh and R. Radhakrishna, India: Oxford University Press.

Yeung, Y. and F. Lo. 1996. Global restructuring and emerging urban corridors in Pacific Asia. In *Emerging world cities in Pacific Asia,* ed. Y. Yeung and F. Lo, 17-47. Hong Kong: United Nations University Press.

Zurbrugg, C., S. Drescher, I. Rytz, M. Sinha, and I. Enayetullah. 2002. Decentralized composting in Dhaka, Bangladesh, production of compost and its marketing. Paper presented at the ISWA 2002 Annual Congress, Istanbul, 8–12 July 2002.

IGES

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 383 – 398, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

Sustainability Assessment and Cities

Peter Newman[a]

Sustainability assessment is growing as a new way to integrate environmental matters with economic and social considerations. The emerging techniques and processes are examined in terms of their application to cities on three levels: projects, plans, and buildings. The global context is used to examine the development of sustainability assessment in Australia, in particular Western Australia and New South Wales where innovative work has recently been done in cities.

Keywords: Sustainability assessment, Cities, Triple bottom line, New South Wales, Western Australia

1. Introduction

There are three types of sustainability assessment emerging which have relevance to urban systems:

- Sustainability assessment of complex and strategic projects;
- Sustainability assessment of policies, programs, and plans; and
- Sustainability assessment of buildings and developments.

This paper will examine all three within a global context and within the local context of what has been happening in Australia, especially Western Australia, based on the recent State Sustainability Strategy (Government of Western Australia 2003), the first sub-national strategy of its kind, and in New South Wales (NSW) through the Metropolitan Strategy (Government of NSW 2004).

2. Sustainability assessment of complex and strategic urban projects

The approach to sustainability assessment adopted in Western Australia was created as part of the State Sustainability Strategy over the period 2001 to 2003. The newly elected state government led by Premier Geoff Gallop had a commitment to develop a sustainability strategy across all sections of government, and much public discussion led to a definition of sustainability as: meeting the needs of current and future generations through integration of environmental protection, social advancement, and economic prosperity. The Strategy identified what sustainability could mean for assessment. The approach adopted in the Strategy was to develop a series of background papers on contentious issues. Eventually two covering sustainability assessment were placed on the website of the Sustainability Policy Unit of the Department of the Premier and Cabinet, "Sustainability in Western Australia"

a. Professor of City Policy and Director, Institute for Sustainability and Technology Policy, Murdoch University, Western Australia; Chair, Western Australian Sustainability Roundtable; New South Wales Sustainability Commissioner.

(http://www.sustainability.dpc.wa.gov.au). The second of these background papers covers the findings of a working party which developed ideas from industry and the community, including the detailed approach adopted by Hammersley Iron (a subsidiary of Rio Tinto) for sustainability assessment of projects, which the company had developed for integrating social, environmental, and economic factors into their internal project development framework (Stanton-Hicks 2002). This approach is relevant to all sustainability assessment of projects whether they be large resource projects in remote areas or complex infrastructure projects in the city.

A parallel government process evaluating the approvals process for major projects (the "Keating Review") generated commitment to sustainability assessment in Western Australia; this was based on the potential to speed up and integrate decision-making by changing to an assessment process where economic and social factors could be considered in parallel to the environmental assessment process. A commitment was made to try to create a demonstration project and, rather than shy away from controversy, it was decided to set up the assessment of the Gorgon gas development as a sustainability assessment (see http://www.doir.wa.gov.au/investment). This project is one of the world's largest gas development projects but was controversial as it intended to use a nature reserve as its land base.

The sustainability assessment of the Gorgon gas project saw government agencies and consultants on a steep learning curve. It has been criticized for not including enough options for assessment and instead simply trying to develop a detailed and integrated approach to the one option favored by the company (Pope 2003, 2004). Thus in the review of the sustainability assessment process within government it was decided that much greater emphasis had to be placed on the "scoping" stage of project assessment and on the final integration if a sustainability approach was going to work. This reflects a lot of the international discussion on sustainability assessment (for example, in Gibson 2001) and has been examined in some detail by Pope et al. (2004) in a paper that uses the Western Australia sustainability assessment experience to further develop the concepts.

Essentially what was proposed in the Western Australia Sustainability Strategy was an approach to policy based on 11 "principles of sustainability":

Foundation principles

Long-term economic health
Sustainability recognises the needs of current and future generations for long-term economic health, innovation, diversity and productivity of the earth.

Equity and human rights
Sustainability recognises that an environment needs to be created where all people can express their full potential and lead productive lives and that significant gaps in sufficiency, safety and opportunity endanger the earth.

Biodiversity and ecological integrity
Sustainability recognises that all life has intrinsic value and is interconnected, and that biodiversity and ecological integrity are part of the irreplaceable life support systems upon which the earth depends.

Settlement efficiency and quality of life
Sustainability recognises that settlements need to reduce their ecological footprint (i.e., less material and energy demands and reduction in waste), while they simultaneously improve their quality of life (health, housing, employment, community, ...)

Community, regions, "sense of place", and heritage
Sustainability recognises the significance and diversity of community and regions for the management of the earth, and the critical importance of .sense of place. and heritage (buildings, townscapes, landscapes and culture) in any plans for the future.

Net benefit from development
Sustainability means that all development, and particularly development involving extraction of non-renewable resources, should strive to provide net environmental, social and economic benefit for future generations.

Common good from planning
Sustainability recognises that planning for the common good requires equitable distribution of public resources (like air, water and open space) so that ecosystem functions are maintained and a shared resource is available to all.

Process Principles

Integration of the triple bottom line
Sustainability requires that economic, social and environmental factors be integrated by simultaneous application of these principles, seeking mutually supportive benefits with minimal trade-offs.

Accountability, transparency and engagement
Sustainability recognises that people should have access to information on sustainability issues, that institutions should have triple bottom line accountability, that regular sustainability audits of programs and policies should be conducted, and that public engagement lies at the heart of all sustainability principles.

Precaution
Sustainability requires caution, avoiding poorly understood risks of serious or irreversible damage to environmental, economic or social capital, designing for surprise and managing for adaptation.

Hope, vision, symbolic and iterative change
Sustainability recognises that applying these principles as part of a broad strategic vision for the earth can generate hope in the future, and thus it will involve symbolic change that is part of many successive steps over generations.

(Government of Western Australia 2003).

These principles were then applied to 42 areas of government, one of which was sustainability assessment. It was proposed that assessment should move from minimizing impacts to promoting positive outcomes in an integrated way. The Sustainability Strategy therefore suggested a set of criteria for sustainability assessment, set out in table 1, based on the sustainability principles and contrasting the impact assessment approach (in the column headed "Managing the negative") and the sustainability assessment approach (in the column headed "Promoting the positive"):

Table 1. Criteria for sustainability assessment

Managing the negative	Promoting the positive
Provides short-term gain but long-term economic gain is uncertain.	Provides both short and long-term economic gain.
Minimises impacts on access, equity and human rights in the provision of material security and effective choices.	Increases access, equity and human rights in the provision of material security and effective choices.
Avoids damage to biodiversity, ecological integrity and life support systems.	Improves biodiversity and ecological integrity and builds life support systems.
Minimizes the increase in ecological footprint while improving quality of life.	Reduces ecological footprint while improving quality of life.
Minimizes impacts on community and regions, "sense of place"and heritage protection.	Builds up community and regions, "sense of place" and heritage protection.
Minimizes conservation loss and social impact while providing economic benefit.	Provides conservation benefit and net social-economic benefit.
Minimizes the reduction of "common good" resources.	Increases "common good" resources.
Minimizes the risks which are not understood.	Ensures there are acceptable levels of risk with adaptation processes for the worst scenarios.
Brings change without hope for the future as it is not part of a broader strategic vision.	Brings change and a sense of hope for the future as it is linked to a broader strategic vision.

Source: Government of Western Australia 2003.

This framework for decision-making is a challenge for any government and certainly is not simple to adopt in Western Australia. It will require institutional changes to create expertise in the two bottom line areas (social and economic) as well as the normal environmental assessments done through Western Australia's Environmental Protection Authority. Surprisingly there is very little economic analysis done of projects and all social assessment has been stripped from the bureaucracy; also there is recognition of the need to create an integrative function within the Department of the Premier and Cabinet before options are taken to Cabinet. These institutional ideas are still being worked through, though in general it is considered that sustainability assessment will emerge as the major way that complex and strategic projects are evaluated in Western Australia.

The next phase of sustainability assessment in Western Australia is to apply it to a major new port development in the outer harbor of Fremantle. The rationale behind a sustainability assessment process being adopted, rather than using an ordinary environmental assessment process, is that the state government wants to see how it can address complex and strategic projects in a way that enables trade-offs to be minimized. Politicians are used to having to address the full triple bottom line on projects,

even if the major work has been done on the environmental impacts rather than the socio-economic considerations. Increasingly in urban systems the distinction between these areas is blurring and the need to provide more detailed analysis of options for politicians has become apparent. Other large industries which need to expand in the resources boom currently underway in Western Australia are also asking for sustainability assessments. Sustainability assessment of complex and strategic projects is thus the next stage upon which sustainability assessment will be trialed and developed in Western Australia.

The political will for sustainability assessment is now quite strong in a state which has a history of environmental and social awareness and which is under considerable pressure for economic expansion (8 percent growth in gross state product in the past year). However, the language and the institutions for providing the integrative approaches are lagging well behind this political will.

This process of examining the institutional framework whilst trialing the process reflects the methodological questions that are being asked in academic circles around the world, including:

- What are the best ways to enable the scoping stage to include all the critical factors?
- How can these be integrated to enable pre-feasibility studies to be carried out on the best options?
- How can agency consideration and public participation be integrated into this phase of assessment so that a sense of the critical issues can be determined?
- What models can be used to provide integrated advice that evaluates options for decisions based on sustainability criteria that can then be evaluated by Cabinet?
- How can social issues be brought into the process in a meaningful way?

These issues will be examined further in the next two areas of sustainability, which are starting to suggest some solutions because of the scale at which they are being applied.

3. Sustainability assessment of urban policies, programs, and plans

The application of sustainability to the evaluation of policies, programs, and plans is a major thrust in international literature, as the importance of strategic environmental assessment emerges and questions are raised about why the other elements of the triple bottom line should not also be included in any strategic analysis of the future (Verheem 2002). The Dutch and the Canadians are doing a lot in this area, as is the United Kingdom.

For any urban system, application of sustainability considerations to the evaluation of policies, programs, and plans is critical, as the planning system has developed to ensure that cities are able to adjust to any new factors in their future. Planning developed in the late nineteenth century as a way to integrate health issues related to waste and water into the design of cities and neighborhoods, as well as other issues such as public open space and transport. Planning has since become a complex system of legal and bureaucratic processes that is reviewed every decade or so to check for any changes in strategic direction. Sustainability assessment is now emerging in this process in a different way to the assessment of projects discussed above.

Strategic planning is based on an assessment of the underlying values guiding the long-term planning of a city as well as how the city can best accommodate the expected number of houses and businesses in an economically, socially, and environmentally acceptable way. Thus it is not unexpected that strategic planning exercises on cities in the past decade have increasingly looked to sustainability as a guiding concept. In Australia sustainability is at the heart of the Melbourne Metropolitan 2030 Strategy, the Sydney Metropolitan Strategy, the Perth Network City Plan, the Tasmania Together Plan, the Brisbane SEQ 2010 Plan, and the yet to be finalized Adelaide Metropolitan Strategy.

The United Kingdom has probably gone as far as any place in directing its planning agencies to incorporate sustainability into the planning system (Benson and Jordan 2004; Selman 1996; Owens and Cowill 2003). Its "sustainability appraisal" is well established in law and in the culture of managing change in the United Kingdom.

In the next sections, the sustainability assessment process, as it is being applied to the strategic planning process, will be discussed in terms of the role of politics in this process and the roles of indicators and stories, as well as regional planning. This will be examined as a way of trying to see how the required language and institutions for sustainability assessment can begin to catch up to the political need for action in sustainability.

3.1. Politics and sustainability assessment in planning

Owens and Cowill (2002) stress the importance of recognizing that planning for sustainability cannot be divorced from politics. Any process in which policies, programs, and plans are subjected to a sustainability audit, integrated with a whole new set of assumptions, and then opened to public consultation and discussion, is bound to be a highly political exercise. Technical inputs will always be needed, but in the end the changes demanded for sustainability—requiring reduced resource consumption, less impact and greater benefit to the common good—cannot occur without some pain and some resentment from those whose financial, environmental, or social interests are threatened by them. This highlights the importance of underlying principles to guide the process, as well as recognition that sustainability assessment can never become a monolithic mechanism that removes the need for elected politicians to make hard decisions. It is hoped, however, that it can help in those decisions.

Nothing is more evident in supporting this proposition from Owens and Cowill than when sustainability assessment is associated with the strategic planning of a city in relation to transport, and especially reducing car dependence, which has been the subject of my main research (Newman and Kenworthy 1999). No city that wishes to address its future can any longer ignore the impact of the car on energy, greenhouse gases, air quality, land-take from rural and bushland, noise and physical separation due to large roads, community and health impacts from excessive car dependence, and loss of economic competitiveness. Yet when issues related to car dependence are raised in strategic planning reviews there is an immediate rush to defend political interests, within and outside government, in land development and priorities in infrastructure provision, as well as the so-called love affair with the car and the suburb.

Given that political realities cannot be sidestepped, what can sustainability assessment do? It is important to ensure first that good sustainability analyses are conducted of all the urban options for the future, showing data on all the variables outlined; and second that a large-scale public consultation process is conducted to help provide an evaluation of the options. There is substantial evidence that public servants and planning bureaucracies interpret options to overcome car dependence in much less radical ways than the public. This was demonstrated in Perth's recent Dialogue for the City, where it was found that environmental issues were much more significant for the city's residents, and the need for public transport far more a priority, than had been realized. This process involved 1,100 people over a weekend in a sophisticated planning process (http://www.dpi.wa.gov.au/dialogue). Box 1 shows the priority issues identified by the public for re-planning of the city:

Box 1. Vision priorities from the Dialogue for the City process in Perth, 2003

1. Strong local communities (city of villages);
2. Clean, green city;
3. Urban growth boundary;
4. Connected, multi-centered city;
5. Reduced car dependence—better public transport, especially more rail, better local bike/walk and integrated transport/land use;
6. Housing diversity (more options);
7. Access to city services for all.

The development of strategies to deliver this will always be contentious, but it is possible to translate these priorities into transport and land-use plans with a degree more confidence after a public dialogue. It is, of course, also a two-way process and the educational value of delving into such issues with a large cross-section of the community cannot be discounted as a means of driving change. The other thing that such processes do is to help develop a set of sustainability indicators for the city.

3.2. Indicators and stories

Indicators have become part of the sustainability assessment toolbox in all three areas looked at in this paper, but most of all in the context of policies, programs, and plans. Sustainability indicators are gathered by most nations.[1] In some countries, these are now being supplemented by states' own sustainability strategies, and these strategies are often much more urban oriented, as the state governments are closer to their cities.[2] Few of these are as well developed for cities as the New Zealand report "Quality of Life in New Zealand's Eight Largest Cities" (http://www.bigcities.govt.nz).

Now sustainability indicators are being extended to regions and local governments within cities. Especially well developed are the sustainability indicators of the City of Melbourne

1. Canada and the United Kingdom have perhaps the most developed examples, which can be seen, respectively, at www.nrtee-trnee.ca/eng/programs/Current_Programs/SDIndicators and www.sd-commission.gov.uk/pubs /assessment; the Australian report can be seen at www.deh.gov.au/esd/national/indicators/report/; the United Nations also has a set of guidelines: www.un.org/esa/sustdev/natlinfo/indicators/isd.
2. Examples are Oregon and Minnesota in the USA (http://egov.oregon.gov/DAS/OPB/docs/BdUp02/Nov/Hal.pps and http://www.eqb.state.mn.us/SDI/progressind.html, and in Australia the Australian Capital Territory (http://www.sustainability .act.gov.au/), Victoria (http://www.dpc.vic.gov.au/), and Tasmania (http://www.tasmaniatogether.tas.gov/).

(http://www.melbourne.vic.gov.au/) and of regions in Western Australia (http://www.dlgrd.wa.gov.au/statisticInfo/regionTrendsIndicators.asp). Sustainable Seattle was probably the first such initiative to show how indicators developed in a sustainability context could be used for assessing how decisions are made across a city. Alan AtKisson, who worked on Sustainable Seattle, has moved from that pioneering work to being one of the most sought-after consultants on sustainability indicators in cities (AtKisson 1999; http://www.AtKisson.com). The process of developing these indicators requires a public process of engagement similar to Perth's Dialogue for the City, and is to all intents and purposes a way of carrying out sustainability assessment of a city's plans for the future.

A problem that arises quite quickly when indicators are seen as part of the toolbox of sustainability assessment is that they rapidly grow into a totally unmanageable list. The key to moving from a broad set of sustainability indicators to effectively using them in assessment is to identify which are the critical indicators that are going to change a system—for better or for worse. Every sustainability indicator in the vast lists will all be of interest to particular people, but they often will be only marginal in the change process that is needed for sustainability. Choosing the critical indicators requires an understanding of the system being evaluated. In urban systems this will invariably include an emphasis on transport infrastructure and urban design, as they shape the way that people live in cities (Newman and Kenworthy 1999).

Planning is one of the key ways that social issues can be considered by governments when they envision future development. Yet social issues remain the least well integrated methodologically into sustainability assessments of policies, programs, and plans, especially those that identify a set of measurable sustainability indicators. This is because not all social factors can be reduced to quantifiable data. Social issues such as equity, housing, health, and education can be quantified, but there are other issues, such as identity and sense of place, heritage, and belonging, which are not measurable because they are about values and worldviews. The dilemma of how these may be integrated into sustainability assessment has been characterized by Bradbury and Rayner (2002) as "reconciling the irreconcilable". They see the descriptive approach of the sciences and social sciences as having fundamental disciplinary differences to the interpretive approach of the humanities, but suggest that there are emerging techniques that allow the two to be reconciled in sustainability assessment.

The main approach I have found to be of value for reconciling the interpretive approach and the descriptive approach into sustainability assessment is to highlight and prioritize stories alongside the statistics. Stories are an emerging technique in social sciences for integrating issues and enabling their values and political scope to be mainstreamed. As Leonie Sandercock says in her book *Cosmopolis II*, which is a plea for better integrating the social dimension into city planning:

> For the longest time, "story" was thought of in the social sciences as "soft", inferior, lacking in rigor, or, worst insult of all, as a "woman/native/other" way of knowing…. But as Alasdair MacIntyre put it: "I can only answer the question 'What can I do?' if I can answer the prior question, … 'of what story or stories do I find myself a part?'" (Sandercock 2003, 182)

In their book *Story and Sustainability*, Eckstein and Throgmorten (2003) have provided a collection of edited papers that seeks to establish the links between story and sustainability. The papers form a coherent collection, rich in theory and real stories about the way sustainability is being approached in

American cities. However, the conceptual approach is such that it can be applied to any city or to any region. The main value in the book is that it offers a way to reinvigorate democracy at the scale of the community, city, and region. The global economy is making nation-state democracies impotent as it moves more and more towards being a group of competing global cities. But as the authors say in the Introduction, "sustainability, story and democracy mutually construct one another" (ibid., 4). The main way this happens is by giving back to social sciences a sense of values and ethics. The triumph of the descriptive over the quantitative has meant that not only are economic capital and natural capital understood, through measurement only, but social capital has now been added. Thus sustainability could be seen in such a model as the integration of these three forms of capital. Story emphasizes the importance of interpretation, of making sense of these forms of capital, and, most of all, of giving them policy direction.

This is not an easy exercise. Bringing together the descriptive and the interpretative is the most important policy challenge that has been opened up by the sustainability agenda. However, examples of approaches to doing this are rare and the simple model of storytelling usually does not appear on the policy radar. Eckstein and Throgmorten's book is therefore of great significance as it fills a need that is being felt by both academics and policymakers who are seeking the holy grail of integration.

The emerging area of sustainability challenges all disciplines and professions to think more holistically, more globally, and more long term. However, it can still be an expert's game, involving the collection of data to describe a problem and the development of technical options for solutions. Important as this is, the issues of sustainability in cities and regions go broader and deeper than such analysis. Only through stories can the will to change be generated in such matters as racially segregated cities, car dependence, consumerism, declining community, the loss of habitat, and climate change. The power of the story is in its empowerment of ordinary people, the setting of boundaries around "place", and the ability to "imagine communities" thus creating a "shared sense of moral purpose at a regional scale" (ibid, 5).

Leonie Sandercock tells a number of stories in her chapter of the Eckstein and Throgmorten's book, and expands on them in her later publication (Sandercock 2003). She tells of a social planner, Wendy Sarkissian, going to a new suburb in Australia where families were struggling. After collecting statistics she felt nothing in her report truly reflected their situation and instead told the story of a typical family, their hopes and their pain as the place did not fulfill their dreams. When she took the story back to them they said that finally someone had understood them. But that was the beginning of a process to try and change their future and redeem some of their lost dreams. This was the real power of the story.

3.3. Regional planning and sustainability

Applying the idea of story to a methodology for sustainability assessment seems to make most sense when it is applied to a region. Thus each major bioregion which has natural resource boundaries that help define its natural capital, and economic plans and markets that help define its economic capital, can now have a process that will help to define its social capital through telling the core story of the place. This was the conclusion of the Western Australian Sustainability Strategy on regional sustainability. It now has been applied initially in a Sustainability Strategy for the Pilbara region, in which 23 stories

were written around fictional characters and were used in a community visioning process called Dialogue with the Pilbara. The aim is to make this the kind of strategic planning process that can form a basis for any future project assessment work. It is believed that this can go beyond social impact assessment processes that tend only to list problems.

Most regions comprise a city set within a bioregion. The kind of principles needed to make regional sustainability into a valuable addition to the planning system require a coherent set of sustainability principles to guide the integration process. One newly emerging set of principles is the Melbourne Principles for Cities, which were developed through the United Nations Environment Program (www.unep.ietc.jp.or). The Melbourne Principles are named after the site of the international charette where they were developed. They were adopted by Local Government at the World Summit on Sustainable Development in Johannesburg in August 2002. The Melbourne Principles are part of an approach called Cities as Sustainable Ecosystems (CASE) and a book explaining them has been written by Newman and Jennings (2004).

Box 2. The Melbourne Principles for Sustainable Cities

1. **Vision**
   Provide a long-term vision for cities based on: intergenerational, social, economic and political equity; and their individuality.
2. **Economy & Society**
   Achieve long-term economic and social security.
3. **Biodiversity**
   Recognise the intrinsic value of biodiversity and natural ecosystems, and protect and restore them.
4. **Ecological Footprint**
   Enable communities to minimise their ecological footprint.
5. **Model Cities on Ecosystems**
   Build on the characteristics of ecosystems in the development and nurturing of healthy and sustainable cities.
6. **Sense of Place**
   Recognise and build on the distinctive characteristics of cities, including their human and cultural values, history and natural systems.
7. **Empowerment**
   Empower people and foster participation.
8. **Partnerships**
   Expand and enable co-operative networks to work towards a common, sustainable future.
9. **Technology**
   Promote sustainable production and consumption, through appropriate use of environmentally sound technologies and effective demand management.
10. **Governance & Hope**
    Enable continual improvement, based on accountability, transparency and good governance.

Source: Adapted from United Nations Environment Programme 2002.

Regional-scale sustainability assessment linked to the planning system is the process adopted by the New South Wales (NSW) state government for its Metropolitan Strategy. The exercise intends to create a visionary planning strategy, which is being evaluated by three NSW sustainability commissioners as it is developed. This enables more input on sustainability at the scoping stage, as was suggested by Western Australia's review of the Gorgon gas sustainability assessment processes discussed in section 2.

The model of a regional plan that sees the city in the context of its bioregion and seeks to minimize its ecological footprint, while simultaneously improving its quality of life, is at the heart of this approach to sustainability assessment. This "extended metabolism model" of cities in their regions was first adopted by the author and Jeff Kenworthy in our book *Sustainability and Cities* (Newman and Kenworthy 1999) and has been applied in the two most recent Australian State of Environment Reports for the chapter on settlements. The approach we adopted was to gather as much data as possible on cities so that best practice could be found, and to outline case studies (stories) that enabled us to see how cities can change. The combination has the power of an integrated approach.

Perhaps the most advanced sustainability assessment methodology along these lines has been developed by British Columbia in Canada, which reviews its settlements, mostly in the Greater Vancouver region.[3] Called the *BC Sprawl Report: Economic and Livable Communities, 2004*, the approach it has used is to examine a range of indicators in each of 24 settlements, and then to combine them into three composite indicators and one overall index: the "Urban Form Index", the "Livability Index", the "Economic Vitality Index", and then the "Overall Smart Growth Index". The power of the report is that it first tells a short story about each place to enable its indicators to have policy meaning. The story and indicators are easily understood as the overall composite index is shown diagrammatically in a spider web of the indicators, where it is possible to tell immediately those indicators that the settlement does well on and those on which the settlement performs poorly. Thus policy responses are drawn out of the sustainability assessment very directly. As the indicators have been collected from 2001 up to 2004, it is possible to get a sense of the direction in which each area, and the region as a whole, is moving. The report concludes:

> …communities that are developing smarter and with less dependency on automobiles, also tend to be associated with a higher quality of life, and seem to be more adept at attracting the leading edge sectors of the economy.

Such a result would suggest that sustainability assessment of strategic policy directions in British Columbia has been very worthwhile. Some of the language and the institutions appear to be in place, perhaps because British Columbia has been grappling with these issues as long as any city (at least since the UN Habitat conference in 1976).

The questions that arise from strategic planning and sustainability include:

- How can stories and statistics be made to fit into a coherent, integrated sustainability strategy?
- How can the sustainability assessment priorities chosen be validated, given the political consequences of any such choices?

3. For more information, see the website of SmartGrowthBC: http://www.smartgrowth.bc.ca.

- What are the best institutional arrangements for providing integrated advice from across government?
- How can this sustainability assessment be translated into a land-use plan?
- Can sustainability assessment be regulated or must it always be facilitated only?

4. Sustainability assessment in buildings and developments

Buildings and groups of buildings (developments) are heavily regulated in most advanced country planning systems. The process of seeking approval for even the simplest addition to a family dwelling is a revelation to most people. These regulations have been developed based on experience over many years with health, safety, environmental, and social issues, and are a collection of national building by-laws, state planning requirements, and local town plans. The system together is called the statutory control system, to differentiate it from the strategic planning system described above.

The statutory control system is the latest target of sustainability assessment. Innovative local governments after the Rio Earth Summit[4] signed up to a commitment to Local Agenda 21, or Cities for Climate Protection, and began seeking ways to apply sustainability. The main power of local authorities is through the statutory planning system and hence it should be no surprise if in the absence of national and state sustainability guidelines for development they seek to define their own.

Across Australia and the world, local authorities have created sustainability assessment systems for development control decisions. Often they concentrate on how to achieve green buildings (for example, in the City of Scotsdale in the United States). Sometimes these schemes have become rather arbitrary; for example, in NSW one local authority would not approve any development unless it had a worm farm, and in another, a mayor was elected on the platform that all developments had to use photovoltaic lighting in their streets (one of the least cost-effective ways to reduce greenhouse gases).

Much of the debate about these systems centers on similar questions to the debate about the statutory control system in general:

- Are these regulations really needed?
- Do they stifle good design and in fact sometimes work against good sustainability outcomes?
- How can a system of control be more outcome or performance oriented?

National approaches to green buildings have been mostly on a voluntary basis, with accreditation provided to any innovative builder. The United States system is called LEED (Leadership in Energy and Environmental Design);[5] there are many others, several of which, including LEED, are outlined in Beyer (2002).

Because of the chaotic approach to these issues in Australia, there has been increased interest among state governments in how they can create a state-based “sustainability scorecard” for all developments. This has the potential to help industry have greater certainty, communities to have a better way to reduce

4. United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, 3–14 June 1992.
5. For more information, see the US Green Building Council website’s section on LEED: www.usgbc.org/leed/ leed_main.asp.

their ecological footprint, and government to have a coherent way of achieving its sustainability objectives. This is the kind of partnership that the World Business Council for Sustainable Development calls "jazz", and is an alternative to leaving the market to find its own way or imposing heavily from above.[6]

The system that has been adopted in New South Wales to provide a sustainability scorecard for residential development is called "BASIX", an abbreviation for "Building Sustainability Index" (see the website http://www.basix.nsw.gov.au). Other models have been developed in Australia, such as "First Rate" and "NatHers", but BASIX is the first system with all of the following characteristics:

- A tool for developers and councils (regulated and in operation since 1 July 2004 in Sydney).
- Web-based (this removes the huge need for documentation on most sustainability issues but allows information to be found for any particular problem through the links and the toolkit provided).
- Measures potential performance against sustainability indices (this is via a stepwise process and although it so far only is applied to water and energy, it will be developed for other important areas like construction materials, waste in construction, site ecology, and universal design for disability access).
- Applicable to all residential dwellings (this applies to new buildings and renovations).

Local councils grant BASIX certification once it is clear that a development can meet the requirements of 40 percent less water usage and 25 percent less energy usage (measured as greenhouse gas emissions) than the average Sydney home. These are heroic goals in the sustainability arena and few other places in the world could claim such a system, yet it has happened in just a few years and with a partnership between key stakeholders. A benefit-cost analysis shows it has a positive outcome for the economy. Considerable concern is now being expressed by elements of the housing industry who had not anticipated that they would indeed have to change from the normal project home. BASIX is due to be applied to other areas of NSW from 1 July 2005. As far as current housing goes, it is hoped that BASIX certification will be seen by homeowners as a way to upgrade their homes before selling, or simply to make their contribution to sustainability. It could be imposed in future on all homes that are to be re-sold.

Across Australia there is considerable interest in the BASIX system. National seminars have been held and the Western Australia Minister for Planning has announced that Western Australia will be the second state to adopt BASIX. Others are likely to follow, although state government bureaucracies are often taking the position that they would prefer to keep their own voluntary rating tools to be kept. Some scientific work to validate the BASIX model for different areas is needed. This should not prevent its application in trials, as the approach to assessing the outcomes of different designs is still relevant, only the level of savings will be uncertain. The idea of BASIX as a tool for sustainability assessment in buildings could be extended to commercial construction

6. For more information, see the World Business Council for Sustainable Development website: www.wbcsd.ch.

The next phase of sustainability assessment is at the sub-division or neighborhood scale, where urban design issues can be dealt with, such as: water-sensitive urban design, solar orientation of streets, transit orientation, walkability and permeability of streets, level of mix in terms of housing diversity and commercial/services, and other community-oriented issues. In NSW, a new system is being developed called METRIX with which these neighborhood-scale issues can be assessed in the same way as with BASIX.

There are a number of experiments in this area; indeed, local governments and non-governmental organizations are developing them all across Australia. State governments are beginning to create these subdivision-scale models, such as Western Australia's Liveable Neighbourhoods Design Code (see http://www.wapc.wa.gov.au/udmp/liveable.html) and a new form of sustainability accreditation based on web processes, developed by the Armadale Redevelopment Authority.[7] The Total Environment Centre in NSW (http://www.tec.nccnsw.org.au/) developed a set of criteria for subdivisions (Alexandra and Associates 1998) and the Australian Housing and Urban Research Institute (http://www.ahuri.edu.au) has a new project to compare affordability and sustainability in traditional developments and in master-planned communities (Blair et al 2004). This latter study has concluded that:

- The methodology of using sustainability assessment via a set of sustainability indicators does work, though the indicators need to be reduced in number and integrated more;
- Designed communities are better off in sustainability terms than traditional developments (which are car dependent and have mostly monocultural project homes);
- The most significant measures for achieving affordability and sustainability are increasing development densities and starting a trend to smaller houses.

The more radical notions of having more cooperative systems for house construction, using unconventional materials, and introducing full-cost pricing on housing developments, are also raised as ways to assist urban design in achieving sustainability outcomes.

The language and the institutional processes for dealing with sustainability assessment down at the building and neighborhood scales are starting to appear as quite manageable. This is mostly because local government has had a much longer history of dealing with these issues. Whether it can be scaled up for the larger, more bioregional level of sustainability issues remains to be seen. City-wide and bioregional groupings of local governments will almost certainly be needed for this.

Monitoring remains an issue in all urban sustainability matters. Sustainability assessment can deliver ways of designing better suburbs and better houses, even mandating better appliances and new efficient and renewable infrastructure technologies. However, the operational aspects of all this depend on household behavior as well as management systems that can monitor and report on progress. Often such monitoring has to be done by utilities and agencies whose main task is to sell more, not reduce consumption of, resources such as water, energy, or urban land.

7. For more information, see: www.landcorp.com.au/pls/portal/url/page/ARA/SUSTAINABILITY.

5. Conclusions

1. The value of sustainability assessment is so obvious that it is bound to develop as a methodology and as a priority for government, business, and the community. However, disciplinary and professional understanding of how to carry out sustainability assessment is lagging behind the political will to implement it, especially in cities.
2. Sustainability assessment in urban systems needs to progress at all levels, from the assessment of complex and strategic projects to the strategic planning process associated with policies, programs, and plans, and the statutory planning process associated with buildings and developments.
3. Demonstrations are still needed in all three areas, and as state governments are the main authorities that manage cities and their bioregions, it is necessary for strong leadership to be shown at this level. Only in this way can an integrated, partnership approach be developed.
4. Sustainability assessment needs to be seen as an aid in the politics of more sustainable decision-making rather than a monolithic process that somehow will avoid politics. Change will still require hard decisions, though it is still hoped that sustainability assessment will provide politicians with better options to consider.
5. Regulating for sustainability assessment should be seen as a goal to be implemented when the various demonstration projects have been evaluated and it is clear that benefit can be derived overall.
6. Institutional processes are not proceeding quickly enough to cope with the integrative processes required within government to enable sustainability assessment to occur. The importance of local government and regions of local government in sustainability assessment will grow.
7. The language for sustainability assessment continues to lag behind the need. The importance of finding a balance of statistics and stories to adequately express all the disciplines cannot be underestimated. Disciplinary and professional change may have to be led by institutional change or the political opportunity for sustainability assessment may be lost.
8. Monitoring of the results of sustainability assessment should be instituted to ensure that indicators and stories of sustainability can be evaluated and communicated.

References

Alexandra and Associates. 1998. The ESD of subdivision: An assessment framework for urban development. Sydney: Total Environment Centre.

AtKisson, A. 1999. *Believing Cassandra: An optimist looks at a pessimist's world.* White River Junction,Vermont: Chelsea Green Publishing Co.

Benson, D. and A. Jordan. 2004. Sustainability appraisal in local land use planning: Patterns of current performance. *Journal of Environmental Planning and Management* 47(2): 269–286.

Beyer, D. 2002. Sustainable building, design and construction sector in Western Australia. Honors thesis, ISTP Murdoch University. http://www.sustainability.dpc.wa.gov.au/BGPapers/DavidBeyerSustainableBuildingAndConstruction.pdf

Blair, J., D. Prasad, B. Judd, R. Zehner, V. Soebarto, and R. Hyde. 2004. *Affordability and sustainability outcomes: A triple bottom line assessment of traditional development and master planned communities—Volume 1*. Melbourne: Australian Housing and Urban Research Institute. http://www.ahuri.edu.au/global/docs/doc655.pdf.

Bradbury, J. and S. Rayner. 2002. Reconciling the irreconcilable. In *Implementing sustainable development: Integrating assessment and participatory decision-making processes*, ed. H. Abaza and A. Baranzini, 15–31. London: Edward Elgar.

Eckstein, B. and J. A. Throgmorten. 2003. *Story and sustainability: Planning, practice and possibility for American cities.* Boston: MIT Press.

Gibson, R. B. 2001. Specification of sustainability-based environmental assessment decision criteria and implications for determining 'significance' in environmental assessment. http://www.sustreport.org/downloads/Sustainability,EA.doc.

Government of New South Wales (NSW). 2004. Metropolitan strategy. Discussion paper. Sydney: New South Wales Government, Department of Planning, Infrastructure and Natural Resources.

Government of Western Australia. 2003. Hope for the future: The Western Australia Sustainability Strategy. Perth, Western Australia: Department of the Premier and Cabinet. http://www.sustainability.dpc.wa.gov.au/docs/Final%20Strategy/SSSFinal.pdf

Newman, P. and I. Jennings. 2004. *Cities as sustainable ecosystems.* Osaka: UNEP-IETC.

Newman, P. and J. Kenworthy. 1999. *Sustainability and cities: Overcoming automobile dependence.* Washington, DC: Island Press.

Owens, S. and R. Cowill. 2002. *Land and limits: Interpreting sustainability in the planning process.* London: Routledge.

Pope, J. 2003. Integrated strategic assessment of the proposed Gorgon gas development in Western Australia. Paper presented at the 23rd Annual Meeting of the International Association for Impact Assessment, Marakech, Morocco, June 2003.

———. 2004. Conceptualising sustainability assessment—three models and a case study. Paper presented at the 24th Annual Meeting of the International Association for Impact Assessment, Vancouver, Canada, April 2004.

Pope, J., D. Annandale, and A. Morrison-Saunders. 2004. Conceptualising sustainability assessment. *Environmental Impact Assessment Review* 24: 595–616.

Sandercock, L. 2003. *Cosmopolis II: Mongrel cities in the 21st century.* London and New York: Continuum International Publishing Group.

Selman, P. 1996. *Local sustainability: Managing and planning ecologically sound places.* London: Paul Chapman Publishing.

Stanton-Hicks, E. 2002. The move towards sustainability by the Western Australian minerals sector and the role of state government in the process. Background paper prepared for the Western Australia Sustainability Strategy. Perth: Government of Western Australia Department of the Premier and Cabinet, Sustainability Policy Unit. www.sustainability.dpc.wa.gov.au/docs/BGPapers/ErikStantonHicks.pdf.

United Nations Environment Programme (UNEP). 2002. Melbourne principles for sustainable cities. Integrative management series no. 1. Osaka, Japan: UNEP Division of Technology, Industry and Economics International Environmental Technology Centre (UNEP-IETC). http://www.unep.or.jp/ietc/Focus/MelbournePrinciples/English.pdf.

Verheem, R. 2002. Recommendations for sustainability assessment in the Netherlands. In *Environmental impact assessment in the Netherlands. Views from the Commission for EIA in 2002.* Utrecht: Netherlands Commission for Environmental Impact Assessment.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 399 – 424, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

Transport and Environment in Asian Cities: Reshaping the Issues and Opportunities into a Holistic Framework

Shobhakar Dhakal[a] and Lee Schipper[b]

Asian cities have witnessed rapid urbanization and an unprecedented rate of motorization in the last decade. Because of this, negative externalities of urban transport such as congestion and environmental impacts have become serious concerns. A number of past studies in this field have shown that health risks are high in key Asian cities, especially from particulate matters and other pollutants for which urban transport is gradually becoming the dominant source. In this context, this paper presents an overview of the environmental implications of urban transport in Asian cities and what is behind them. It also discusses the emerging policy issues and the commonalties and differences in these cities, including discussions of successes and failures and what have been the underlying reasons. Since mitigation of greenhouse gases has become an international concern in recent years, issues and opportunities for mitigation from the Asian urban transport sector are presented. Finally, this paper discusses ASIF (activity, structure, energy intensity, fuel factors), a holistic transport policy framework for cities, and further proposes a broader framework that adds new dimensions to the ASIF framework. This paper shows that such a framework not only provides guidelines to policymakers on where to start on the transport-environment puzzle but also provides a framework to evaluate the implications of various policies on environment and associated factors.

Keywords: Transport, City, Asia, Greenhouse gas, Air pollution

1. Introduction

The impacts of urban transport on air pollution are evident in Asian cities and have been gradually increasing over the last few decades (ADB 2003). In Japanese cities such as Kitakyushu, Kawasaki, Osaka, and Tokyo, traditional air pollution from industries—sulfur oxides, smoke, and dust—have dramatically declined in the last four decades, but urban transport-related air pollution, in the form of nitrogen oxides, suspended particulate matter (SPM), and others, are increasingly posing serious challenges to policymakers. A similar trend is being seen in rapidly industrializing cities of North Asia such as Beijing and Shanghai and in cities of Southeast Asia such as Ho Chi Minh, Hanoi, Bangkok, Jakarta, and Manila (Dhakal 2004). Due to rapid motorization and reduced competition to private motorized modes of transport, problems that evolved gradually in last 40 years in developed cities are developing in just 10 years in rapidly industrializing cities, making managing air pollution an urgent and heavy burden.[1] In big cities, industries have been slowly but steadily relocating towards the peripheries

a. Senior Policy Researcher, Urban Environmental Management Project, Institute for Global Environmental Strategies, Kitakyushu, Japan.
b. Director of Research, EMBARQ, the World Resources Institute Center for Transport and Environment, Washington, DC, USA.

1. For more discussion of the "telescopic time-space compression" of urban environmental issues, see Marcotullio and Lee 2003.

or outside city boundaries. One study shows evidence of a consistent growth of the tertiary sector and decline in primary industry in 22 East Asian cities (Dhakal and Kaneko 2002). Existing key cities are slowly transforming to become more and more commercial in nature. Accordingly, urban mobility is gradually becoming the dominant factor determining urban air pollution.

The demand for mobility has been a constant among human beings and has taken various forms through the millennia. In the Stone Age, mobility was needed to secure safe places and to hunt animals. In the modern age, the demand for mobility is driven by various physical, psychological, and other needs such as work, shopping, education, and leisure. In essence, the reasons remain the same: the desire to access demanded services and to reach service locations. The modern world has two fundamental options; the first is to bring the locations of services such as work, shopping, education, and leisure closer in physical space, thus reducing the need for mobility; the second is to improve the efficiency of travel to dispersed service locations (in terms of physical comfort, travel time, necessary infrastructure, resource consumption, environmental implications, and so forth), without necessarily reducing the need for mobility. The choice does not seem difficult, but cities are simply too complex. Each city has followed its own evolutionary path, which impedes any easy solution because over time, cities have expanded and sprawled, trade within and across the city boundary has flourished, service demand has grown in physical and non-physical senses, and service locations are spread out all over cities and beyond them. With higher population densities, cities become ever more complex to manage, although opportunities exist to maximize infrastructure efficiency and to take advantage of economies of scale.

The purpose of the preceding paragraph was to put the issue of mobility in perspective and to introduce the idea that a fair balance needs to be struck between reducing the need for mobility and improving the efficiency of mobility—over the last few decades, the focus of discussions in urban mobility has shifted disproportionately from *improving access* to *meeting travel demand efficiently*, . With the gradual modernization of human society and economic growth, demand for mobility has tremendously increased yet our approaches have not been very successful in reducing the need for it. Cities in Asia are increasingly becoming motorized and are looking for ways to efficiently meet mobility demand using motorized transport modes, which is gradually overshadowing the alternative of reducing the need for transport. Making this distinction is necessary in contemporary policy discussions as public policies need to give fair attention to both of these issues.

The chief negative externalities of rapidly growing urban mobility demand have emerged as congestion and environmental impacts. However, the major issues in urban mobility are not limited to these two dimensions. Daunting challenges lie in providing mobility opportunities in a just and equitable manner, sustaining infrastructure financing, and governing mobility. However, this paper only aims to discuss and present the issues and challenges around providing environmentally sustainable mobility. For this purpose, the paper discusses implications of urban transport and emerging policy issues in Asian cities. It looks at emissions at the level of local air pollution and the global issue of greenhouse gases. It then tries to conceptualize the chains of cause and effect and their driving forces through the ASIF (action, structure, energy intensity, fuel factors) framework, which has been presented by researchers investigating the transport-energy-emissions conundrum (see Schipper, Marie-Lilliu, and

Gorham 2000). This paper draws upon many past research works, successful and failed cases, empirical evidence, and observations in related fields to broaden this framework by including policy tools, temporal, and stakeholder dimensions. This paper does not aim to completely address all the related issues or to be ambitiously prescriptive; rather it aims to be diagnostic and to discuss existing policies.

2. Environmental implications of urban transport in Asian cities

2.1. At the local level

Epidemiological studies show that air pollution costs thousands of deaths and leads to a number of health problems in cities. This results in added healthcare costs and loss of productivity. The pollutants linked to urban transport that are typically health concerns are lead (Pb), dust (due to re-suspension), particulate matter (PM), oxides of nitrogen (NO_X), and volatile organic compounds (VOC).[2] Photochemical oxidant (ozone), another important pollutant, forms from NOx and VOCs in the presence of heat and sunlight. Of course transport is only one of the contributors to urban air pollution. But as household cooking switches to modern fuels (natural gas, liquefied petroleum gas, electricity); lower-quality industrial fuels like lignite, low-grade coals, and dirty heavy diesel are replaced by cleaner coals or oils and natural gas; and industries are moved out of cities, the role of transport grows dramatically. One important difference is that stationary sources of air pollution are easy to spot and regulate, and they often cause annoyances to the polluters themselves, while mobile sources like vehicles are harder to spot and regulate, and rarely cause annoyances directly to the polluters.

The impacts from these pollutants are very much location-specific in cities; the more dispersed impacts of carbon dioxide emissions are dealt with later on in this section. Before the phasing out of leaded gasoline, lead was a major health issue. In Bangkok, studies estimated 400 additional deaths per year due to lead's effect (Michaelowa 1997). Several other studies have shown the costs of air pollution in cities. The UrbAir study by the World Bank, conducted in Greater Mumbai, Kathmandu Valley, Jakarta, and Metro Manila, found that urban transport accounted for the majority of air pollutants and the health impacts costs millions of dollars (Shah and Nagpal 1997). Another World Bank study, on Mumbai, Shanghai, Manila, Bangkok, Krakow, and Santiago, showed that the total social cost of air pollution in these cities was as high as US$(1993)2.6 billion (Lvovsky et al 2000). One 1998 study of Delhi, where the transport sector accounted for over 70 percent of air pollution, suggested that 7,500 premature deaths, 4 million hospital admissions, and 242 million incidences of minor sickness could be avoided if air pollution were brought within World Health Organization (WHO) suggested levels (Xie, Shah, and Brandon 1998). A recent report by the Asian Development Bank stated that in Asian cities, SPM and PM_{10} (particulate matter below 10 microns) levels in particular were higher than WHO limits and US Environmental Protection Agency (USEPA) 1997 limits respectively (1990–1999 average, citing WHO's Air Information Management Database). The report showed that SPM concentrations in Shanghai, New Delhi, Mumbai, Guangzhou, Chongquin, Calcutta, Beijing, and Bangkok exceeded WHO limits (90 $\mu g/m^3$) by three, five, three, three, four, four, four, and two times respectively (ADB

2. There are a few other pollutants, such as carcinogens like poly-nuclear aromatic hydrocarbons and aldehydes.

2003). It also showed that PM_{10} exceeded the USEPA limit (50 μg/m^3) by several times in a number of cities, most notably over four times in New Delhi and Calcutta. Similarly, a benchmarking report of the Air Pollution in Mega-cities of Asia Project[3] shows that NOx and particulate matters are a serious challenge for Asian cities (Air Pollution in Mega-cities of Asia 2002). Data from Tokyo shows that SPM increased rapidly from 40 μg/m^3 in the early 1980s to over 70 μg/m^3 in the early 1990s; after that SPM has been decreasing or stagnating, but it is becoming increasingly challenging to contain SPM and NOx (Tokyo Metropolitan Government 2004).

All of the above reports show that SPM, $PM_{10,}$ and NOx are particularly problematic, and the transport sector is one of the major contributors of these pollutants. It is important to note that the health impacts are determined by dose response of the pollutant concentration to the exposed population; ironically, policies in many Asian developing countries are driven by emissions estimates that are reasonable but less efficient. Apart from local air pollution, growing motorization takes a significant toll on traffic flow. In many cities, income is rising but the pace of improvements in efficiency of public transport, especially mass transport systems, has been slow. As a result, Asian cities such as Bangkok, Jakarta, Beijing, Manila, Delhi, and Kathmandu are increasingly dominated by personal lower-occupancy vehicles, exacerbating congestion and pollutant concentrations. Such problems are further aggravated by lack of expansion and improvement of roads. The new challenges facing policymakers now demand mitigating not only air pollution but also congestion.

2.2. At the global level

Many of the issues linked to urban transport revolve around energy use. Oil supply is a major factor in world politics, while rapid motorization threatens energy security. There is a general consensus that oil is going to remain a major transport fuel, and that the world has to confront the environmental implications oil-based transport, for at least the next three to four decades. The latest figures indicate that oil accounts for more than 95 percent of total energy use in transport in almost all Organisation for Economic Cooperation and Development (OECD) countries (Fulton 2001). The situation in Asian cities is little different. Energy use in oil-based urban transport has dramatically increased in Asian cities owing to rapid motorization. In Ho Chi Minh City, the share of transport in total energy use stands at 20 percent. In commerce-dominated cites such as Tokyo and Seoul, the share is well over 35 percent. The rate at which the share of transport in energy use is growing has been phenomenal, too. While in the rapidly growing megacities such as Beijing and Shanghai, the transport sector's share in total energy consumption stands at only seven to nine percent (Dhakal 2004), it doubled between 1990 and 2000, as did the share in Delhi. Energy use by the transport sector has even continued to increase moderately in relatively mature cities such as Tokyo (by a quarter) and Seoul (by a half).[4]

3. The Air Pollution in the Megacities of Asia (APMA) project was initiated in November 2000 by the United Nations Environment Programme and the WHO in collaboration with the Korea Environment Institute and the Stockholm Environment Institute.

4. Based on presentations by a number of local experts at the International Workshop on Policy Integration Towards Sustainable Urban Energy Use for Cities in Asia: Integrating Local Air Pollution and Greenhouse Gas Emissions Concerns, organized by IGES, 28–30 January 2004, Kanagawa, Japan. For details see http://www.iges.or.jp/kitakyushu/megacity_workshop /index.htm.

There is some speculation that vehicles powered by hydrogen fuel cells will evolve in the foreseeable future, but major questions remain over how long this will take and how the hydrogen will be obtained. Fuel-cell systems will definitely be more efficient than the internal combustion engine (ICE) but costs, energy loss, and greenhouse gas emissions in production of hydrogen will determine their real benefits. Some researchers argue that even if hydrogen fuel-cell automobiles became cost-effective today (they are still in the stage of technology development), it would take 50 years before we see improvements in air quality, if we take into account the time required for design, technology refinement, cost reduction through economies of scale, development of supporting infrastructure, marketing, and penetration of the existing fleet.[5] Heywood and Bandivadekar (2003) show that the new technology must account for over 35 percent of new vehicle production and over 35 percent of total mileage driven to have an impact. Penetration into the fleets of the cities of developing Asian countries will take even longer than in the developed economies of the world.

After the Rio Earth Summit, the issue of climate change has been gaining momentum in political, scientific, and all other sectors. The recent ratification of the Kyoto Protocol by Russia has paved the way for the protocol to enter into force in early 2005. Now Annex-I countries[6] are obliged to fulfill Kyoto commitments, and instruments such as the Clean Development Mechanism, joint implementation, and carbon trading will be operational. The role of cities, and especially of urban transport, will be very important because they are major emitters of greenhouse gases.

In a recently published report entitled *Mobility 2030: Meeting the Challenges to Sustainability*, the World Business Council for Sustainable Development (WBCSD) estimated that worldwide transport-related greenhouse gas emissions (well-to-wheel, including air, water, and road transport) would increase from slightly over six gigatons of carbon dioxide (CO_2)-equivalent in the year 2000 to over 14 gigatons by the year 2050. It also showed that light-duty vehicles were responsible for the majority of emissions, followed by freight trucks and air transport (WBCSD 2004). The International Energy Agency estimates that road transport accounts for the majority of global CO_2 emissions from the transport sector. Road transport alone contributed some 18 percent of the world's total CO_2 emissions from fuel combustion in the year 2000 (International Energy Agency 2002). In OECD countries, this share stands at 23 percent, less in developing countries. At city level, a study carried out by the Institute for Global Environmental Strategies showed that the transport sector contributed only between five and 10 percent of CO_2 emissions from fuel combustion in Beijing and Shanghai in 1985–2000, but the rate of growth was over 10 percent and was accompanied by high levels of PM_{10} and NO_x and by congestion (Dhakal 2004).

The WBCSD study also projected that CO_2 emissions from each mode of transport and each region would increase, with the majority of the additional growth coming from developing regions of the world. It showed that the volume of vehicle activity was a major problem. For example, the drop in energy consumption achieved by improving the energy efficiency of light-duty vehicles and heavy-duty trucks

5. Personal communications with Prof. John Heywood, Professor of Automotive Science, Massachusetts Institute of Technology, during the OECD Ministerial Roundtable on Sustainable Mobility, September 2004.
6. Developed nations listed in Annex I of the UN Framework Convention on Climate Change.

(by 18 and 29 percent respectively between 2000 and 2050, which is the only expected reducing factor for emissions) would not be able to offset the increase from the projected 123-percent and 241-percent growth in use of these types of vehicle.[7] Indeed, this trend explains why in some cities, for example Mexico City, dramatic improvements in new car emissions have failed to lead to a dramatic improvement in air quality—too many daily travelers are shifting from large buses to cars and minibuses (Schipper and Golub 2003).

The WBSCD report states that China and India alone surpassed the transport-related emissions from the rest of Asia due to their size and rapid rate of motorization in the year 2000, and will continue to do so in 2050. The report assumes that the role of public transport will be undermined by private modes of transport, but it brings the following issue to the forefront: the present need to cope with growing motorization and to find solutions to increasing CO_2 emissions through air-pollution mitigation, energy saving, and congestion mitigation in dense and growing Asian metropolises.

Asian cities, unlike North American and European cities, tend to become denser and to sprawl towards their peripheries. This sprawling can lead to the creation of largely unorganized peri-urban areas that stretch the distribution and transport systems of the city. The emergence of Bangkok's peri-urban areas and Beijing's construction of 14 satellite towns outside its Fifth Ring Road may put additional burdens on these cities if urban functions are not well allocated. On the other hand, the trend of cities to become denser may be desirable from a number of viewpoints, such as higher utilization of urban infrastructure, cost-effectiveness of public transport systems, and compact distribution and supply networks for energy and other services. However, as cities become denser, management challenges increase, especially for air pollution from motor vehicles, congestion, and management of other urban environmental services such as water supply, wastewater, and solid waste disposal.

Recent estimates by the UN Population Division suggest that about half of the megacities (over 10 million population) and medium-sized cities (over 1 million population) worldwide will be in Asia by 2015 (UN 2002). This will certainly mean a huge rise in CO_2 emissions from Asian countries for the reasons already discussed. Sustainable mobility in Asian cities will require an appropriate balance of private and public transport (including mass transport systems) that takes into account air pollution (local and CO_2 emissions), energy saving, and congestion. Although safety, equity, financial stability, and other issues are also prominent in the sustainability-mobility debate, the authors believe that congestion, emissions, and development of public transport (in particular mass transport) will pose more serious challenges than any other issues in the next 20–30 years. The WBCSD study cited above (WBSCD 2004) also supports this argument, as its modeling results indicated that transport-related conventional emissions will decline sharply in OECD countries over the next two decades, while in non-OECD countries lead, carbon monoxide (CO), and VOCs will gradually decrease during this period, but NOx and PM_{10} will not start to decline for another two decades.

7. These are global averages. There are variations from region to region.

3. Emerging policy issues in Asian cities: commonalities and differences

3.1. Underlying issues

Global and regional discussions of transport and environment policy often show too generalized pictures. These discussions often discount the vast differences that exist amongst cities, countries, and regions. While there are certainly issues that are common to many or all cities, there are also significant differences that can be presented from a number of viewpoints.

a. Motorized and non-motorized transport

One of the commonalities between cities is the diminishing role of non-motorized modes of transport. Travel patterns in the USA are dominated by automobile use, while non-motorized modes still account for the largest share of transport use in China (about 40 percent in Beijing and Shanghai). Historically, walking and bicycling have been declining and travel demands are shifting towards faster modes. However, there have been numerous attempts to revive non-motorized modes in certain places. Contrary to the general image of North America, the city of Boulder, Colorado in the United States prides itself upon being a bicycle-friendly city in which any part can be accessed through dedicated cycle lanes. However, the example of human-powered tricycles in Dhaka shows that non-motorized modes do not always produce desirable solutions if they are not well managed, especially if they are mixed with other modes of travel, adding to congestion. Even in Shanghai, bicycles are banned on major roads to reduce congestion.

b. Infrastructure issues

Another commonality amongst Asian developing countries is the shortage of road infrastructure in relation to vehicle numbers. For example, the total road length in Beijing nearly doubled in 1979–1999, but vehicles increased by 17 times (He, Zhang, and Huo 2004). The number of vehicle per kilometre of road length (note: not area) in Beijing is over 350, compared with about 200 in Tokyo and about 130 in Shanghai (all figures for the year 2000; see Dhakal 2004). There is, in most cities, a gap between travel demand and transport infrastructure, which is not only limited to normal roads but to expressways, railways, and other modes of travel.

With rising incomes and delays in development of mass transport systems, an increasing number of cars has become a major problem for cities such as Bangkok, Delhi, and Beijing, while in Delhi, Kathmandu, Karachi, and Dhaka, a surge in two-wheelers (motorcycles and mopeds) in addition to cars is choking road networks. To counter the growth of private modes of transport, development of mass transport is essential, but it requires long-term planning. In recent times, some cities have been planning aggressive development of rail-based mass transport systems; for example, Bangkok's expressways and its Bangkok Transit System Skytrain and subway; Delhi's subway; and Beijing's expressways and subway expansion plans to prepare for the 2008 Olympics. This has confronted them with another common challenge: procuring infrastructure financing. Bangkok's failure to build its MRTA subway planned in 1976 and subsequent failure to realize the Hopewell Project (combined MRT and expressways) is generally attributed to financing-related difficulties. In the least-developed countries especially, infrastructure financing is challenging owing to cost-recovery problems. There has been a

trend towards public-private partnerships in the infrastructure sector in recent years. For such mechanisms to work, a sound system needs to be in place that allows the private-sector partners to recover their investments and to reduce the investment risks. Most cities in Asia are still struggling to create appropriate environments for private-sector investment.

Per capita ownership of vehicles in developed cities such Tokyo and Seoul has already reached saturation (2.8 and 4.5 people per vehicle, respectively, in 1999). Per capita vehicle ownership, especially for cars and light-duty vehicles, in Beijing, Shanghai, Bangkok, Jakarta, Manila, Delhi, and Kathmandu, is well below that in OECD countries or Tokyo (people per vehicle for Beijing was 13, for Shanghai 34 in 1999). However, the rate of increase in vehicle ownership in these cities is high (Dhakal 2004). It is also enough to sound alarms given the prevailing levels of air pollution and congestion. The rates of motorization at prevailing household income levels in these cities are higher than at similar levels in Seoul or Tokyo in the past. Only very few cities have tried to cap vehicle numbers as a part of government policy, notably Singapore and Shanghai. Very few have tried to put any direct restrictions on vehicle use besides Singapore; Hong Kong tried in 1983–85 in a pilot scheme that was later dropped (Dhakal 2004).

c. Vehicle mix

Traditionally, analyses of urban transport have looked only at private cars; however, examining the role of two-wheelers is essential to understand motorization in Asian developing countries. Asia accounts for 75 percent of the two-wheelers in the world. China and India alone account for 50 and 20 percent respectively in it (WBCSD 2004). Two-wheelers in Chennai, Shanghai, and Wuhan account for 80 percent of those cities' total vehicle fleets. They account for 50 percent in Mumbai, over 65 percent in Kathmandu, and 40 percent in Kuala Lumpur (WBCSD 2004; Dhakal 2003a).

Two-wheelers are among the most polluting vehicles in the world. Among two-wheelers, two-stroke engines, which dominate fleets in South Asia and much of Southeast Asia, have inferior emission performance since 15 to 40 percent of the fuel-air mixture escapes from the engine through the exhaust port. Poor vehicle maintenance, misuse of lubricants, and adulteration of gasoline exacerbate emissions from two-wheelers (Kojima, Brandon, and Shah 2000). In recent years, there has been an increasing trend toward banning two-stroke two-wheelers for environmental reasons from key cities in Nepal, India, Thailand, and Bangladesh. Shanghai has already banned two-wheelers from major roads. Yet two-wheelers continue to make substantial contributions to air pollution and create traffic chaos in cities.

Two-wheelers skew the perception of motorization too. The WBCSD report notes that when motorized two-wheelers are considered, Mexico City's motorization becomes lower than Chennai's while its per capita income is 10 times higher than Chennai's. In India, two-wheelers are cheap (about US$200 for a moped or scooter), and as incomes rise, a much larger proportion of the population can own one, which drives the motorization process (WBCSD 2004). Delhi, with US$800 per capita income, has 120 two-wheelers per thousand population, while Shanghai, with US$4,000 per capita income, has only 60 two-wheelers per thousand (WCTRS 2004). Vehicle ownership in some Indian cities, Kuala Lumpur, Hanoi, Taipei, and Ho Chi Minh City leaves roughly every household with a private vehicle,

most likely a two-wheeler. It should be noted that real purchasing power in Asian countries is much higher than it looks when per capita incomes are converted into other currencies. Based on purchasing power parity, the per capita GDPs of China and India are closer to four and five times respectively what they are in dollar terms (World Bank 2004). In short, the spread of two-wheelers, for better or worse, has afforded a high degree of individual mobility in urban areas, a level that may be hard to reverse with buses and rail. However, only Asia seems to be inundated by two-wheelers, which are largely absent in other developing regions of the world such as Latin America and Africa. This phenomenon can be attributed to economic protectionism, topography, security, and socio-cultural factors, among others (WCTRS 2004).

Besides the prominence of two-wheelers, the modes of public transport in developing Asian countries are more diverse than in developed countries. In Tokyo and Seoul, modes of transport are largely limited to cars, taxis, buses, surface rail, and subway, while in India, two-wheelers, motorized three-wheelers, bicycles, pedi-cabs, and animal-pulled carts share roads with buses, taxis, and cars (WCTRS 2004). This means there is a wider variety of stakeholders in urban transport bringing more complexities; poverty, equity, political, and social dimensions are all mixed up with transport problems. Looking at the different travel modes and their shares, private transport's modal share in Asian cities is much smaller than it is in developed parts of the world (WCTRS 2004, chapter 2). This brings in the issue of how to avoid the mistakes of developed countries, especially those of North American cities, and how to develop congestion-free and pollution-free transport systems in Asia.

d. Technology issues

From the technology side, mitigating air pollution from vehicles does not necessarily require further innovations; existing technologies can play a substantial role in achieving this. Since the majority of Asian countries are adopting existing technology rather than creating new technology, one of the central tasks in developing urban transport is finding and utilizing the right technologies to improve emission performance on the streets.

Almost all past studies in the field of vehicular pollution control in Asia have emphasized improving inspection and maintenance systems for vehicles in use (for example, ADB 2003; Faiz, Weaver, and Walsh 1996; Gorham 2002; Kojima, Brandon, and Shah 2002; Kojima and Lovei 2000; Schipper, Marie-Lilliu, and Gorham 2000; Shah and Nagpal 1997; Xie, Shah, and Brandon 1998). This requires improving enforcement mechanisms to ensure high operating fuel efficiency and meeting existing emissions standards. In some cases, such as New Delhi, a complete change in fuel choice (from diesel to compressed natural gas (CNG) for all public transport vehicles) has taken place, with one of the strongest arguments in its favor being that it requires a less stringent inspection and maintenance regime. In Mexico City, private-sector operation of inspection and maintenance systems is being tried (Kojima and Lovei 2001). In Singapore, a scheme of certifying automobile workshops is in place. In Jakarta, computerized inspection and maintenance for non-complying vehicles is being trialed. For new vehicles, at least Euro 1 (European Union Emissions Standard 1) or higher emissions standards have already become the norm in a number of Asian countries (ADB 2003). In India, higher standards for selected cities are being enforced: Delhi, Chennai, Mumbai, and Kolkata introduced Euro 2 in 2001 and Euro 3 is

targeted for 2005 (ADB 2003). Despite the introduction of these standards, inability to phase out decades-old vehicles and non-compliance with emissions standards among both new and old vehicles remain key barriers in many Asian cities.

Studies have reported that information technology can greatly help to reduce congestion. Computerized signal-coordination systems are in place in a number of cities, such as Tokyo, Singapore, and Hong Kong. Dhakal (2004) shows that Singapore's taxi-calling system and electronic road pricing, which use the global positioning system (GPS), have been effective in curbing congestion.

End-of-pipe technologies for gasoline and diesel vehicles, such as three-way catalytic converters and particulate traps, may help to curb local air pollution but they are not effective for reducing greenhouse gases. At vehicle level, greenhouse gas emission can be reduced through energy-efficiency improvements or fuel choice (see a series of reports published by the Pew Center between 2001 and 2003, especially Sperling and Salon 2002). If altogether new vehicle technologies or fuel types are used, only lifecycle analyses can ascertain their overall greenhouse gas emissions. One such study done at the Massachusetts Institute of Technology showed that diesel could help the United States to cut greenhouse gases, but stringent diesel emissions standards for NO_X and particulate matter threaten this (Weiss et al. 2000). The WBCSD report cited above (WBCSD 2004) provides detailed analyses of various technologies and their well-to-wheel greenhouse gas emissions. It shows that propulsion systems using bio-fuels such as ethanol and bio-diesel have negative well-to-wheel emissions. Hydrogen fuel-cell vehicles have zero tank-to-wheel emissions, but total emissions depend on the source of hydrogen.

3.2. Policy and institutional issues

a. Successes, and the underlying reasons

Despite the enormous challenges to policymakers in developing environmentally sound transport sectors, there have been successes in a number of areas in Asia. One successful case is the removal of lead from gasoline, which was used as an octane enhancer. Thailand, Bangladesh, India, Nepal, and other countries in Southeast and North Asia have already phased out leaded gasoline successfully. While this process took decades in the early days, for example almost three decades in the United States, Thailand took four to five years to completely phase it out, while Bangladesh took less than a year (Kojima and Lovei 2001).

The second area where significant progress is being made these days is quality of diesel, which is usually determined by its sulfur content. In Japan, distribution of diesel containing less than 50 parts per million (PPM) of sulfur started in 2003 (Dhakal 2003b). Progressively, developing Asian countries are aiming to adopt Euro 2 standards, which essentially require lower than 500 PPM sulfur in diesel. Together with diesel improvements, increasing use of CNG as a substitute for diesel is taking place in cities where CNG is available at reasonable cost. Judicial interventions in Delhi have mandated CNG substitution of diesel for public buses and taxis. A number of other cities are showing increasing interest in CNG as a substitute for diesel to reduce NOx and PM_{10} levels in the air. However, at the same time, a vigorous debate is taking place, with more people supporting not mandating specific technologies or fuels in cities and instead setting emissions standards regardless of fuel choice. Internationally, Europe is championing the use of low-sulfur diesel and views diesel as a potential fuel for CO_2 mitigation.

Small interventions can play important roles in driving policy in positive directions. There are many examples. One is the successful replacement of smoke-belching diesel three-wheelers by battery-powered electric three-wheelers in Kathmandu in the late 1990s. Kathmandu had had some of the worst air pollution in the previous few years. Since electricity there comes from hydroelectric plants (run-of-river type), use of the new vehicles reduced local pollution as well as greenhouse gas emissions (Dhakal 2004, appendix 2). Jakarta's computerized vehicle inspection and maintenance system (which comes under its Blue Sky Program) is another successful example which closes the loopholes in the inspection and maintenance regime for potential free riders. Successes in controlling two-stroke two-wheelers in South Asian cities are also significant, as these have posed serious air pollution problems for a long time.

Singapore's success in integrating land-use and transport planning is well documented (Lye 2002; Menon 2002; Willoughby 2000). In addition, Singapore's vehicle quota system limits the stock of registered vehicles while congestion charging limits their use (Dhakal 2004 appendix 1). The current debate in Singapore is how to maintain a sound balance in restricting vehicle stocks and congestion charging, because financial resources from the auctioning of vehicle quotas and road pricing exceed what is needed for infrastructure development. There is also disagreement about whether a similar approach would work in other cities, as Singapore is in several ways a unique case. The potential reasons for Singapore's successes are described in box 1. In the past, governments in Thailand, Malaysia, and Indonesia have rejected the results of various studies favoring road pricing as implemented in Singapore, saying that it was locally not feasible. Hong Kong implemented electronic road pricing in the early 1980s on a pilot basis and later scrapped it. However, recent experiences in London and a number of European cities have inspired renewed debate about its feasibility and utility.

Outside Asia, the integrated planning of land use and the bus system in Curitiba in Brazil has been successful. It uses an express-bus system with 58 km of exclusive bus lanes, coordinated with residential and commercial development, with diminishing density of settlement and well-designed road systems (Matsumoto 2003). This does not mean that bus rapid transit (BRT) systems cannot be implemented in already well built-up cities. Bogotá's BRT system is a successful experience in bus-based mass transportation (Matsumoto 2003). Experiences with BRT are few in Asian cities, although one was recently implemented in Jakarta (12.9 km). However, interest in BRT is increasing owing to its less capital-intensive nature and because BRT systems can be implemented in already built-up cities, with proper management.

What determines the success of integrated land-use and transport planning, and of mass transport systems such as BRT and rail, is difficult to say, as each city has unique characteristics. The case studies done at the Institute for Global Environmental Strategies for a wide range of cases dealing with urban transport and emissions suggest that major factors for success are the following:[8]

- Political will and leadership for environmentally friendlier infrastructure development;
- A sound mixture of technology, management, and investment strategies;

8. The detailed report and case studies are available at http://host-3.iges.or.jp/APEIS/RISPO/inventory/db/index.html.

- Right use of economic and fiscal instruments such as single fare-pricing systems for public transport, vehicle taxation, and congestion charging;
- Organizational arrangements for emissions and transport management, especially efficient division of labor and rules for operation in the organization;
- Stakeholder-based planning processes; and
- Capacity to enforce regulations.

b. Failures, and the underlying reasons

Unfortunately, unsuccessful cases are far more abundant than successes in Asian cities. The most important failures have been in controlling the numbers and use of vehicles in the majority of cities. As a city develops and its income grows, its car ownership and investment in normal roads and expressways both also increase. Often, development of expressways and normal roads is more demanded than providing solutions to congestion and emissions. Experiences in the United States show that the gains from improving fuel economy standards for individual vehicles are exceeded by increases in mileage traveled, attributed largely to needs and behavioral factors. (Fortunately, financial savings from fuel efficiency have not greatly increased travel demand, because fuel is relatively cheap in the United States (Greene and Schafer 2003).) This phenomenon is often referred to as the "rebound effect" (*Energy Policy*, special issue, June 2000).

Box 1. Why did integrated land-use and transport planning work in Singapore?

Integrated city planning is the keyword in Singapore's success. All the measures it has introduced are part of a comprehensive strategy and are coordinated very closely to produce a comprehensive solution. No single measure can work alone. The right to travel is a basic human right; however, government policies can offer options that encourage travelers to choose modes that are both sustainable in the long term and acceptable to residents. When electronic road pricing (ERP) was implemented in Singapore, commuters had five choices: (1) pay the charges and drive freely, (2) change the time of travel to pay lower charges, (3) use alternative roads, (4) use public transport, or (5) use other schemes, such as park-and-ride (Menon 2002).

Singapore's success also comes in the context of favorable economic, social, and urban conditions. The small size of both the land area and the population has allowed flexible planning. As a city-state, Singapore has only a single tier of government; thus, all the complexities that can arise from multiple layers of authority and a mismatch between local and national priorities are eliminated. The economy of Singapore relies heavily on foreign investment and on transactions related to international trade, commerce, and finance, for which efficient transport and communications are essential. The need to fulfill this condition for economic reasons has contributed to sustainable transport development and concern for the environment. Unlike in other countries, where economic growth is curbed by environmental countermeasures, economic growth in Singapore was actually fostered by improvements in environment and transport.

Box 1—*continued*

A strong government and stable and strong regulations and institutional frameworks for enforcement are other reasons why travel-demand management has worked in Singapore. From the point of view of jurisdiction, the roles and responsibilities of authorities responsible for urban and land use planning, land transport, and environment are clearly demarcated. The land reform process initiated in 1967 allowed the government to acquire most of the land and the housing estates subsequently developed on the city's periphery, and facilitated the development of infrastructure suitable for sound land-use planning. The Housing Development Board (HDB), which was set up in 1960 by the British colonial government, provided housing to just 9 percent of the population in 1960. Because the sweeping powers of the Land Acquisition Act enabled the government to acquire private land for public housing or other development activities, today 85 percent of the population lives in HDB housing complexes.

Another reason for Singapore's success is the periodic adjustment of policies using feedback from the public and other stakeholders, made possible by transparency in policy formulation. Singapore has learned by doing. It recognizes that policies are never perfect and provides for periodic adjustments. For example, ERP charges are subject to review every three months, and charge structures and times change depending on traffic and economic conditions.

Another key to success has been investment in infrastructure. Demand-side management was supplemented by constructing additional road infrastructure, maintaining roads well, coordinating traffic-light systems, and building expressways and MRT. The taxes and fees imposed on vehicles generated huge financial resources, which were used not only invested in demand- and supply-side management but also applied to reducing less-desirable taxes. Willoughby (2000) estimated that annual revenue from road transport was at least three–four times greater than road expenditure.

Some technology factors have also played important roles in Singapore. ERP, for example, depends on sophisticated technology that allows time-of-day pricing which reflects traffic conditions. Its prototype Area Licensing System, in contrast, was a non-technology measure. A computerized traffic control system was already in place by 1986 in central business districts. It was replaced with a more advanced automated traffic signaling system called GLIDE (for "Green Link Determining System"), a traffic-adaptive signal control system monitored centrally to adjust to changing traffic conditions. Efforts are now being made now to create a Global Positioning System (GPS)-based coordinated public taxi-calling system which dispatches taxis automatically from the nearest location. Individual taxi operators are already using GPS. These high-technology measures have provided support to non-technology restrictions on car ownership and use. Some researchers, however, claim that the overall effectiveness of high-technology measures is questionable.

A final reason for the success of Singapore might have been the fact that it is a migrant society with citizens who originated from many countries. Since most were economic migrants in the first place, their opposition to government policies was minimal. Thus, there were no barriers in the form of an organized force of resistance.

Source: Dhakal 2004.

Another area of failure of most cities (with Singapore a notable exception) is integrating urban and transport planning. The rates of urbanization in Asian cites are much higher, but planning mechanisms are much weaker, than in other regions of the world (World Bank 2004). Dense Asian cities had developed haphazardly without serious infrastructure planning in the past. Carrying out effective land-use planning for already built-up cities is a difficult task, especially when developing-country governments have scant financial resources and no ownership of land. For more downstream issues such as promoting public/mass transport and emissions standards, the experiences of cities are a combination of failures and successes, from case to case. Broadly, the major reasons for failure of policies in cities of developing countries can be summarized as follows:

- Policy inadequacy: Over-dependency on end-of-pipe solutions and short-term measures; failure to see long-term perspective and accompanying mechanisms; and overwhelmingly negative rebound effects of poorly formulated policies;
- Weak enforcement of existing standards and regulations: Weak inspection and maintenance systems for energy and emissions performance of vehicles;
- Transport and poverty: Complex interrelationship between transport policies and the interests of low-income groups, and little political will to touch this sensitive area;
- Resource constraints: Limited financial and technical resources; and
- Institutional failures: Lack of political will and commitment; lack of management capacity; wrong market signals; and inter- and intra-institutional coordination problems, such as unclear demarcation of authority and responsibilities.

3.3. Harnessing local-global benefits: Their synergies and conflicts

As outlined earlier, mitigating greenhouse gas emissions from the rapidly growing transport sector is essential for the future. Given that the Annex-I nations are still struggling to achieve this, very little is expected from Asian cities. The challenges for Asian cities' policymakers in mitigating greenhouse gases from urban transport range from raising awareness, overcoming resource constraints, and obtaining scientifically sound research and information (Dhakal 2004).

Although cities do not fall into obvious groups, for the sake of highlighting the priorities and differences that affect emission policies Asian cities can be divided into the following three categories:

Developing cities: In these cities, the capacity and authority of local policymakers are weaker, resources are scarce, institutions for urban environmental management are less developed, policy-enforcement mechanisms are weaker, the involvement of stakeholders in decision making is less evident, local pollution issues are the priority, and problems are often intricately interwoven with poverty issues. A number of cities in South Asia and Southeast Asia could come into this category, for example Dhaka, Kathmandu, Delhi, Calcutta, and Karachi.

Rapidly developing/industrializing cities: In these cities, the capacity of local policymakers is improving rapidly, resources are scarce but starting to build up locally, local institutions are being built up, and while local issues still receive the most attention, there is growing awareness among urban

policymakers of the need to consider emerging issues such as global warming. Beijing, Shanghai, and Bangkok, among others, may belong to this category.

Relatively developed/mature cities: In these cities, conditions are better than in the rest of Asia and local governments are under growing pressure to tackle emerging global environmental issues. However, these cities still struggle with finer particulate matter and ozone pollution, and their standards are very stringent compared with those in cities in the other categories. Cities in Northeast Asia, including Japan's cities and key Korean cities, could be examples.

Policymakers in developing countries still view greenhouse gas mitigation as a diversion from their immediate needs and as a barrier to economic growth. The keys to changing such perceptions are to link greenhouse gas mitigation with clear local benefits such as reduced air pollution and energy saving and to facilitate transfer of financial resources from developed countries to developing countries for local benefits (Kojima and Lovei 2001). However, developing integrated policy responses for reducing air pollution, promoting energy efficiency, and mitigating greenhouse gas emissions is an easy task. Energy-efficiency improvement in particular provides an easy entry point for such an integrated response (OECD 1995). In developed countries, while the level of motorization is unparalleled, improvements in the fuel economy of vehicles have played a major role in suppressing air pollution (Kojima and Lovei 2001). Another common entry point for an integrated response is mitigating traffic congestion, which increases vehicle speeds and potentially reduces fuel consumption and emissions. Some studies have reported that an increase in traffic speed from 10 to 20 km/h can cut 40 percent of CO_2 emissions (Kojima and Lovei 2001).

While there is optimism, studies from Mexico and Chile have shown that locally favored options do not always match greenhouse gas mitigation objectives and so the global benefits are limited (Eskeland and Xie 1998). The example of Tokyo is also salutary. In Tokyo, vehicle growth has almost stagnated, vehicles miles traveled are largely unchanged, and there are continued fuel efficiency improvements in all sizes of vehicles. However, CO_2 emissions from transport are still rising in the city, primarily because car owners are progressively shifting towards bigger cars. The conflict between local and global priorities becomes even more evident as NOx and SPM pollution remain major issues in Tokyo requiring interventions to control diesel vehicles, which have lower greenhouse gas emissions (Dhakal 2003b). A close look at Asian developing countries shows that technology fix at car tailpipes is a common solution to air pollution problem, but this has no effect on greenhouse gas mitigation. In reality, the precise impacts on greenhouse gas emissions of those measures that are best suited to mitigate priority air pollutants have not been much studied, and their synergies and conflicts are largely unexplored in practice.

Table 1 provides a rough sketch of the potential synergies and conflicts between local pollution and greenhouse gas mitigation measures. The first steps for any integrated approach (apart from fuel efficiency and average vehicle speed improvements) are to identify the impacts and to encourage policymakers in developing countries to implement reasonable measures, providing them with financial tools, for example through the Clean Development Mechanism and/or other multilateral and bilateral

mechanisms. This cannot be achieved without strong will among international institutions and developed countries to involve themselves in developing countries' local environmental problems.

Table 1. Indicative synergy and conflicts of local pollution mitigation measures for greenhouse gas mitigation

Local countermeasures	Synergy with global concerns	Conflicts with global concerns
Introducing CNG or propane as fuels	CNG has been introduced for air quality improvement in cities such as Delhi, Beijing, and Bangkok. CNG or propane vehicles emit less NO_x, PM, and CO_2 than conventional vehicles, generally speaking.	While CNG reduces CO_2 emissions, it may also outweigh CO_2 benefits by increasing unburnt CH_4 (due to poor maintenance) in heavy-duty engines such as those in buses and trucks. A city's inspection and maintenance system may play an important role in determining the actual gains in terms of greenhouse has emissions. Therefore, engine and fuel management technologies both need to be developed. Effects would be different for dual-fuel or retrofitted vehicles and those exclusively designed for CNG.
Controlling NO_x and SPM released by diesel vehicles	High-quality diesel fuel, with a maximum sulphur content of 50 PPM, may help reduce CO_2 emissions if additional CO_2 emissions at refineries do not offset such gains.	Since diesel vehicles are major emitters of NOx and PM, stringent measures to control diesel vehicles may result in increasing numbers of gasoline vehicles, which emit more CO_2.
Promoting electric and hybrid vehicles	Electric vehicles have no tailpipe emissions, including all air pollutants and CO_2. Hybrid vehicles reduce air pollutants and CO_2 significantly.	Electric and hybrid vehicles have poor performance and/or are expensive. The CO_2 benefits from electric vehicles depend on the fuel mix in electricity generation. If most of the electricity is generated by coal, the CO_2 benefits may be negative. Only lifecycle assessments can provide a clear picture.
Introducing category-based emissions/fuel-efficiency standards for vehicles	Such standards help to reduce local air pollutants and CO_2 emissions per vehicle-km for particular vehicle categories (type or size).	If distance traveled by individual vehicles increases or if people switch to vehicles with bigger engines, the total volume of CO_2 might increase even if the standards are met. To reduce the risks of increasing both local pollutants and CO_2 emissions, additional standards based on the average fuel/emission efficiency of a fleet of vehicles (or corporate average fuel efficiency) would be useful.
Promoting mass transport and discouraging use of private cars	Usually such measures can reduce CO_2 emissions because they improve energy performance and reduce gasoline use. This further reduces congestion and associated CO_2 penalties from vehicles.	Inefficiency in operation of mass transport systems may tend to reduce their occupancy and promote private modes of transprot, which are usually more CO_2 intensive.

Table 1—*continued*

Local countermeasures	Synergy with global concerns	Conflicts with global concerns
Introducing reformulated gasoline.	Reformulated gasolines can help reduce smog, VOC, and toxic air pollutant emissions.	Reformulated gasoline compromises with fuel economy nominally by 1 or 2%; therefore, CO_2 might increase.
Improving fuel quality of existing fuels	Little effect.	Little effect.
Inspection and maintenance systems; changing driving conditions and driving behaviors	May improve fuel efficiency and thereby reduce CO_2 emissions.	Rebound effects need to be monitored.
Congestion pricing and traffic management	Reduces congestion, discourages car use, and results in fuel savings; however the exact impact on CO_2 emissions depends on various factors.	No conflict.
Controlling sprawl and promoting reasonable urban population density	Potentially, may reduce energy use (and CO_2 emissions) from urban transport and households.	Not very clear.

Source: Dhakal 2004.

4. Conceptualizing the challenges into a holistic framework

Understanding the urban transport-energy-environment conundrum is more complex than it may seem. The issues to be addressed range from urban planning to emissions control, present to future, local to global environmental issues, technical to human behavior issues, regulation to volunteerism, and a complex interplay of stakeholders from ordinary citizens to the private sector to different levels of government. At first sight, it may look chaotic and policymakers are often confused about where to start thinking about the emissions problem. One of the major limitations of measures that are implemented for curbing emissions in developing Asian cities has been that they treat emissions only at vehicle level. Therefore, they often neglect to take into account all the associated factors and ultimately discount cause-effect relationships between the various drivers, leading to failure of the policies. They may view urban planning as a very different issue from transport planning, transport planning as very different from environmental planning, public transport as very different from emissions control, and so forth. One widely used and long-established approach for emissions analysis is to view emissions in relation to travel volume, fuel efficiency, and vehicle stock. In this framework, emissions are viewed as a vehicle problem, mostly technical in nature. This pulls policymakers in developing countries towards short-term solutions, which often serve the interests of the political establishment. Therefore, a framework is needed that provides the whole picture as well as the causes and their interrelations, with simple illustrations.

Lee Schipper and his colleagues have proposed such a framework, which looks beyond vehicles and addresses issues at the level of travel modes, travel demand, and accessibility (Schipper, Marie-Lilliu,

and Gorham 2000). It searches for solutions in the context of urban transport as a whole (not only vehicles) and emphasizes integrated planning. It essentially provides the conceptual basis for all the discussions made in earlier sections. In this framework, emissions from transport are seen as the result of four factors: activity, structure, energy intensity, and fuel factors; hence its name, ASIF. Mathematically it can be represented as follows:

$$E = A \times S_i \times I_i \times F_{i,j}$$

where E is the emissions from a particular transport mode, A is total travel volume, S is a vector of the modal shares, I is the energy intensity of each mode (in pass-km or ton-km) i, and $F_{i,j}$ represents the sum of each of the fuels j in mode i. Each of these components is affected by various factors, such as prices, policies, and technologies (Schipper, Marie-Lilliu, and Gorham 2000). The ASIF framework provides a holistic way of looking into emissions problems as well as a tool for policy analysis.

Intervening in activity and structure (AS), by its nature, is a long-term and proactive approach that warrants consistent action over time. Asian cities have had some limited success in intervening in AS (for example, Singapore and a few Malaysian cities). On the contrary, interventions targeting energy intensity and fuel factors (IF) are the most attractive to policymakers in Asian cities; they are, in general, short-term measures but widely used. More importantly for policymakers, behavioral and lifestyle factors govern AS, while technology factors govern IF. A reasonable balance between interventions in AS and IF, though necessary, is rarely found. Table 2 shows a few of the factors that affect AS and IF, and related challenges in Asian cities.

Table 2. Factors and challenges in the ASIF framework

Components	Major factors/indicators	Related challenges in Asian cities
AS	• Income • Rate of urbanization • Urban form • Urban functions • Rate of motorization • Non-motorized travel modes • Modal mix, para-transit • Utilization rate of private transport modes	• Reorganizing urban activities towards reducing the need for motorized travel • Improving the efficiency of public transport and mass transport systems • Limiting private transport such as cars and two-wheelers and their rate of use • Reducing congestion by increasing the efficiency of the transport infrastructure
IF	• Energy efficiency of modes and vehicles • Size, engine type, and age of vehicles • Occupancy rates (capacity mix and utilization) • Congestion • Fuel quality: lead, sulfur content, reformulation, octane enhancement • Fuel choice: CNG vs. diesel, electricity, gasoline, bio-fuels • Emissions control technologies	• Controlling tailpipe emissions through relevant technology • Improving energy efficiency of existing vehicles and other travel modes • Choosing alternative fuels such as electricity, CNG, and bio-fuels and making them cost-efficient • Improving inspection and maintenance systems for in-use vehicles • Banning superannuated vehicles and promoting fuel-efficient vehicles

When the ASIF framework is applied exclusively to CO_2 mitigation policies, the type of issues and places where solutions should be focused is described in table 3.

Table 3. Framework for CO_2 reduction from urban transport

Nature of strategies	Action categories	Major CO_2 reduction measures	Individual strategies
Strategies largely related to behavior and lifestyle	Travel activity	Reduce travel distances.	Reduce the travel distance of travel modes that produce more greenhouse gases.
	Structure of modes	Restrain demand and use of vehicles.	Restrain demand and use of cars and two-wheelers. Promote public/mass transport modes that produce less CO_2. Promote non-motorized modes for short journeys.
Strategies largely related to technology and behavior	Energy intensity of travel mode	Improve vehicle energy efficiency. Increase vehicle occupancy. Promote intelligent transport systems.	Increase energy efficiency of conventional ICE vehicles through promoting new technology and smaller vehicles, reducing congestion, accelerating penetration of efficient vehicles in fleets, and improving inspection and maintenance systems. Switch to electric propulsion system—battery, hybrid, fuel cells. Increase vehicle occupancy through car sharing and others. Introduce leapfrogging technologies in niche sectors.
	Fuel quality and choice	Shift to fuels emitting less greenhouse gas.	Maximize benefits from fuel interventions on air pollution reduction, especially CNG and diesel retrofitting and new engines. Introduce bio-fuels such as ethanol. Improve quality of conventional fuels.

Source: Prepared by the author following Schipper, Marie-Lilliu, and Gorham 2000 and Sperling and Salon 2002 in Dhakal 2004.

The policymaking usefulness of this framework is evident. It goes beyond indicating the driving factors and provides guidelines to policymakers for where to seek solutions as well and identify the overall implications of their policies. Table 4 outlines some of the potential polices and their relationships with components of the ASIF framework.

Table 4. Interactions of selected policies and ASIF components

Policy group:	Policies to change fuel price		Policies to influence traffic flow		Policies to influence public attitudes towards transport and energy consumption
Examples:	Fuel tax	Carbon tax	Enhancing throughput (capacity expansion, computerized traffic management)	Restraining traffic flow (traffic calming, diversions, speed limits)	Media campaigns, youth education, information-exchange projects
Activity	Slightly restrains activity, low elasticity		Induces more activity	Restrains activity	Potential improvements
Structure	Slight shift, low cross-elasticities		Favors cars	Favors collective and non-motorized modes	Potential improvements
Intensity	Reduction in medium to long term; can increase utilization rate of travel modes		Not much impact, except some loss due to decrease in capacity utilization of modes	Not much impact, except some increase in capacity utilization of travel modes	Potential improvements
Fuel quality/choice	No impact	Favors low-carbon fuels	No impact	No impact	Potential improvements

Source: Gorham 1999.

An attempt to model Singapore's policies into the ASIF framework is made in table 5. It shows that the key to Singapore's success lies in the fact that its approach was balanced in terms of AS and IF. Although Singapore could be a unique case, some of the tools it employed to tackle various components of the ASIF framework were eye-openers to many countries.

The problem with too great a focus on I and F is that A and S are skyrocketing in most developing countries' urban areas. The number of two-wheelers doubled in major Indian cities in less than 10 years, and the number of cars in Chinese cities is set to double in less than five years. Even if these vehicles are relatively clean, their impact in terms of both increased distances traveled and increased pollution/passenger-km compared with bus and rail (not to mention non-motorized transport modes) means that overall pollution from transport can be rising even if actual vehicles (and their fuels) are improving. And let us not forget that while higher incomes drive the ownership and use of private vehicles, the same higher incomes permit the use of more-expensive cleaner fuels and vehicles. What is needed is a way of reining in emissions from all vehicles more rapidly than the fleet and its use grow.

As an answer, this paper proposes a broader framework for policymakers to consider while dealing with urban transport and environment issues, as shown in figure 1. This framework first requires

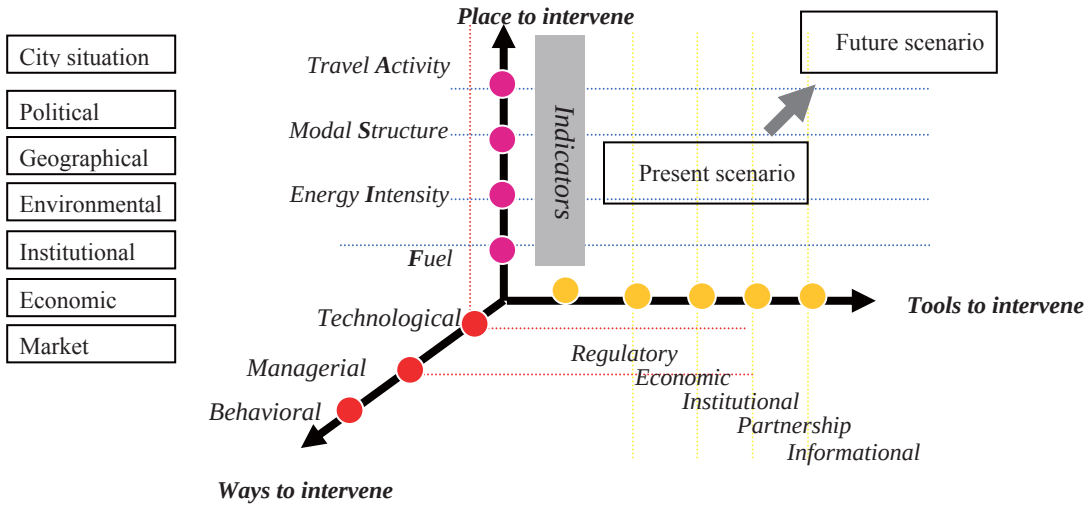


Figure 1. Proposed broader analysis framework

thinking where to intervene. The potential areas of intervention are the four components of the ASIF framework. Interventions in single components and combinations can be of three types: technological, managerial, or behavioral changes; or combinations of these. Since policies are implemented through tools, the key tools for intervening are of the following natures: regulatory, economic (market-based or fiscal), institutional, partnership, and informational (awareness raising and information dissemination). If we superimpose two more dimensions onto this framework, mainly temporal dynamics and stakeholder considerations, the framework becomes complete (see figure 2).

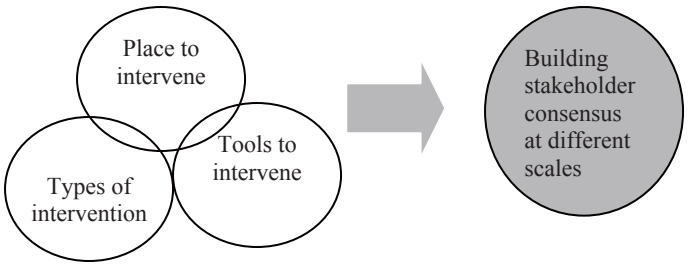


Figure 2. Additional dimensions to the broader analysis framework

Table 5. Fitting Singapore's actions into the ASIF framework (only direct effects considered)—indicative only

Impacts of: On	Economic growth	Vehicle quota system (supply-side control)	Electronic road pricing, area licensing system (demand-side control)	Reducing parking supply and raising parking charges	Developing transport infrastructure	Integrated land-use and transportation planning, including housing	Euro 2 standards (year 2001), high charges for older vehicles while reapplying for vehicle license, high penalty for smoky vehicles, video camera-based inspection for smoky vehicles, frequent mandatory inspection for older vehicles, certification scheme for automobile workshops, tax rebates for clean vehicles
Activity	Increase	Activity per car may have increased, impact on total activity by car decreased	Activity of travel by car decreased	No change	Not very clear due to quota system, congestion pricing, etc. in place	Decreased activity	No effect
Structure	Could have made car-dependent society if no strong urban policies were implemented	Increased trends towards using public transport	Increased share of public and mass transport modes	Car being expensive may have reduced their modal share	Helped to improve efficiency of public and mass transportation	Development of coordinated mass transport (rail and bus) reduced need to use cars	No effect
Intensity	Facilitated acquisition of state-of-art technology in all travel modes; could have reduced occupancy in mass transport if car-restraining policies had not been implemented	No effect	Improved due to better traffic flows and perhaps increased occupancy	No effect	Increased flow contributing to improved intensity	No effect	Significantly improved intensity
Fuel quality/mix	Facilitated use of better-quality fuels	No effect, except on electricity used by rail					Improved fuels

Note: Analysis of Singapore's successful experience and its relevance to other cities can be found in Dhakal 2004, appendix 1.

5. Conclusion

Air pollution poses serious health concerns in dense Asian cities. Urban transport is increasingly becoming the dominant contributor of this air pollution due to rapid motorization. In particular, PM_{10}, SPM, and NOx levels in many cities are already alarmingly high, while presence of finer particulates is increasing. Since the rate of motorization is already high at current income levels in key Asian cities, the potential future impacts on local and global environments from cities with fast-growing economies are causing serious alarm.

A few key observations are made in this paper. The first of these is that cities are trying to develop efficient transport, but they are not paying attention to reducing transport needs, which cause more pressures downstream, such as congestion and emissions. Limited successes have been achieved in Asian cities in integrated land-use, transport, and environmental planning.

Secondly, choice of transport modes has been skewed towards private modes in the early stages of economic development due to the slow pace of improvements in public transport and lack of mass transport infrastructure. However, on an emissions-per-passenger-km basis, public and mass transport are far preferable to private transport. Private modes include relatively expensive vehicles like cars for high-income groups as well as cheaper modes for mid- and low-income groups, such as two-wheelers (motorcycles and mopeds). In essence, all segments of city populations are driving the motorization process. As a result, non-motorized modes of transport are largely marginalized in cities. They still account for the largest shares of journeys in a few cities, but these shares are constantly declining.

Thirdly, the gap between demand for motorized travel and capacity of infrastructure such as roads remains wide in most cities, aggravating congestion as well as air pollution. This raises the need for investment strategies for developing cities that lack financial resources. The main source of investment is likely to be mechanisms such as public-private partnerships, but these require the creation of enabling environments for private investment and mitigation of investment risks. When transport is intertwined with poverty issues in less-developed cities, cost-recovery strategies must take into account equity considerations. Such complexities are indeed barriers. However, development of additional infrastructure for road transport often creates more demand for travel and is not a lasting solution to congestion and emissions problems. Policies to expand and improve road infrastructure need to give careful attention to how to restrain additional travel activity.

This raises a fourth important observation: that the major failure of cities lies in their inability to restrain growth of the vehicle stock and reduce the amount of travel by each vehicle. There have been very few bold moves in this direction in Asian cities, although Singapore is far ahead of rest of the world in doing so. Singapore may be a unique case for many reasons, but some form of restriction on the growth of vehicle stocks and travel (such as congestion pricing) is absolutely necessary in dense Asian cities.

A daunting task for reducing air pollution from vehicle emissions is shifting to cleaner vehicles, through introducing new vehicle technologies, improving energy efficiency, introducing tailpipe

emission-control technologies, or improving fuel quality and widening fuel choice. Currently, emissions standards for new vehicles in the majority of Asian countries, including many least-developed countries, conform to at least Euro 1. Efforts are now underway to bring standards in line with Euro 2 or its equivalent, and this process needs to be accelerated.

The fifth major observation of this paper is the need to improve the performance of the existing vehicles in use. Despite penetration of Euro I-compliant vehicles, the fleets in developing Asian countries are still dominated by decades-old vehicles whose fuel efficiency and emissions performance are poorer. One of the ways to do this is to implement early vehicle retirement and scrapping programs. However, inferior performance is not limited to old vehicles, but is also often seen in new vehicles that violate existing emissions standards because of corruption or weakness in the mechanisms to enforce the standards. Serious institutional strengthening is necessary in Asian cities to improve inspection and maintenance regimes for vehicles.

The sixth major observation relates to fuels. Low-sulfur diesel is slowly penetrating the market while alternative fuels such as CNG are increasingly being used. These developments are positive, as traditional diesel is a major culprit for PM_{10}, SPM, and NO_x pollution. No significant penetration of fuel-cell vehicles is expected in the next four decades in Asian cities unless a major techno-economic and market breakthrough occurs.

The prospects for reducing greenhouse gas emissions from urban transportation are mixed in Asian cities given their existing priorities. The mitigation of greenhouse gases can be achieved through improvements of energy efficiency in existing transport modes and through shifting to cleaner modes of transport and mass transport. At the level of vehicles, fuel efficiency can reduce greenhouse gas emissions only if it is not offset by growth in travel activity. Since the priorities of developing countries are on mitigating localized air pollution, greenhouse gas concerns need to be integrated into overall urban planning as well as into air pollution management. Since the synergies and conflicts between various air-pollution-mitigation measures and greenhouse gas mitigation are not yet very clear, more studies are necessary. The progress of integrated approaches or any measures to mitigate greenhouse gas emissions from urban transport in Asia largely depend on international support to developing countries, such as those under the Kyoto Protocol and other multilateral and bilateral support.

This paper notes that the environmental problems from urban transportation in Asian cities are largely viewed by policymakers at the level of emissions at vehicle tailpipes, so travel activities, their structures, and other driving forces are generally ignored. The revised ASIF framework presented in this paper is useful for policymakers since it can provide guidelines for strategic approaches to deal with emissions as well as tools to evaluate the impacts of various aspects of policies on emissions and their root causes. Although there are practical problems for implementing holistic approaches in cities because of institutional set-ups and capacities, it is essential that these barriers are overcome. Finally, the prospects for mitigating emissions from urban transport in Asia are not all bad. Many systemic, technological, and behavioral strategies are working, although their progress is a little slow.

References

ADB. *See* Asian Development Bank.

Asian Development Bank. 2003. *Reducing vehicles emissions in Asia: Policy guidelines for reducing vehicle emissions in Asia.* Manila: Asian Development Bank.

Air Pollution in Mega-cities of Asia. 2002. *Benchmarking urban air quality management and practices in major and mega cities of Asia—Stage I*. Seoul: Korea Environment Institute.

Dhakal, S. 2004. *Urban energy use and green house gas emissions in Asian mega-cities: Policies for a sustainable future*. Kanagawa, Japan: Institute for Global Environmental Strategies (IGES).

Dhakal, S. 2003b. Assessment of local strategies for countering greenhouse gas emissions: Case of Tokyo. Urban Environmental Management Project working paper. Kanagawa: IGES. http://host-3.iges.or.jp/en/ue/pdf/dhakal/dhakal_tokyo.pdf.

Dhakal, S. 2003a. Implications of transportation policies on energy and environment in Kathmandu Valley, Nepal. *Energy Policy* 31(14): 1,493–1,507.

Dhakal, S. and S. Kaneko. 2002. Urban energy use in Asian mega-cities: Is Tokyo a desirable model? In *Proceedings of IGES/APN Mega-City Workshop on Policy Integration of Energy Related Issues in Asian Cities, 23–23 January, 2002, Kitakyushu, Japan*, 173–181. Kanagawa: IGES..

Eskeland, G. S. and Jian Xie. 1998. Acting globally while thinking locally: Is global the environment protected by transport emission control programs? Policy Research Working Paper 1,975. Public Economics, Development Research Group, and Global Environment Unit.Washington, DC: World Bank

Faiz, A., C. Weaver, and M. Walsh. 1996. *Air pollution from motor vehicles: standards and technologies for controlling emissions*. Washington, DC: World Bank.

Fulton, L. 2001. Saving oil and reducing CO2 emissions in transport: Options and strategies. Paper presented at the Workshop on Good Practices, Policies and Measures, Copenhagen, Denmark, 8–10 October 2001.

Gorham, R. 1999. *Mitigation of greenhouse gas emission from the transportation sector: Analytical methods and policy measures.* Berkeley, USA: Lawrence Berkeley Laboratory (LBNL-42259).

Gorham, R. 2002. *Air pollution from ground transportation: An assessment of causes, strategies and tactics, and proposed actions for the international community*. New York: Global Initiatives on Transport Emissions (a partnership of United Nations and the World Bank).

Greene, D. and A. Schafer. 2003. *Reducing greenhouse gas emissions from US transportation*. Washington, DC: Pew Center on Global Change.

He, K., Q. Zhang, and H. Huo. 2004. *Integrating global environmental concerns into local environmental planning in Beijing: Policy analysis*. Kanagawa: IGES.

Heywood, J. B. and A. Bandivadekar. 2004. Assessment of future ICE and fuel cell powdered vehicles, and their potential impacts. Paper presented at the Tenth Annual Diesel Engine Emission Reduction (DEER) Conference, San Diego, USA, 29 August–2 September 2004.

International Energy Agency. 2002. *CO2 emissions from fuel combustion 1971–2000* (2002 edition). Paris: International Energy Agency.

Kojima, M. and M. Lovei. 2001. *Coordinating transport, environment and energy policies for urban air quality management: World bank perspectives*. Washington, DC: World Bank.

Kojima, M., C. Brandon, and J. Shah. 2000. *Improving urban air quality in South Asia by reducing emissions from two-stroke engine vehicles*. Washington, DC: World Bank.

Lvovsky, K., G. Hughes, D. Maddison, B. Ostro, and D. Pearce. 2000. Environmental costs of fossil fuels: A rapid assessment method with application to six cities. Pollution Management series. Paper no. 78. Washington, DC: World Bank.

Lye, L. H. 2002. Environmental taxation in the regulation of traffic and the control of vehicular pollution in Singapore. Paper presented at the Third Annual Global Conference on Environmental Taxation, Woodstock, USA, 12–13 April 2002.

Marcotullio, P. and Y.-S. Lee. 2003. Urban transitions and urban transportation systems. *International Development Planning Review* 24(3):325–354.

Matsumoto, N. 2003. Integration of land use and bus systems in Curitiba, Brazil. In the Asian Pacific Environmental Innovation Strategies Project Good Practice Inventory. http://host-3.iges.or.jp/APEIS/RISPO/ inventory/ db/pdf/0001.pdf.

Menon, A. P. G. 2002. Travel demand management in Singapore: Why did it work? Paper presented at the Regional Workshop on Transport Planning, Demand Management and Air Quality, 26–27 February 2002, Manila.

Michaelowa, A. 1997. Phasing out lead in gasoline: How developing countries can learn from the experiences of the industrialized world. In *World development aid and joint venture finance* 1997/98, ed. A. Fairclough, 268–272, London: Kensington Publications Ltd.

OECD. *See* Organisation for Economic Cooperation and Development.

Organisation for Economic Cooperation and Development. 1995. *Urban energy handbook: Good local practice*. Paris: OECD.

Schipper, L., C. Marie-Lilliu, and R. Gorham. 2000. *Flexing the link between transport and greenhouse gas emission: A path for the World Bank*. Paris: International Energy Agency.

Schipper, L. and A. Golub 2003. Transportation and environment in Mexico City: Reviving a bus system or giving in to the auto? In *Proceedings of the ECEEE 2003 Workshop*. ,France: European Council for an Energy Efficient Economy.

Shah, J. and T. Nagpal. 1997. *Urban air quality management strategies in Asia.* Set of four World Bank Technical Papers: Kathmandu Valley (no. 378), Greater Mumbai (no. 381), Jakarta (no. 379), and Metro Manila (no. 380). Washington, DC: World Bank.

Sperling, D. and D. Salon. 2002. *Transportation in developing countries: An overview of greenhouse gas reduction strategies*. Washington, DC: Pew Center on Global Climate Change.

Tokyo Metropolitan Government. 2004. Website of the Tokyo Metropolitan Government: http://www.kankyo.metro.tokyo.jp/kouhou/english2002/honpen/main_1.html, accessed 7 December 2004.

UN. 2002. *World urbanization prospects* (2002 revisions). New York: UN Population Division.

WBCSD. *See* World Business Council for Sustainable Development.

World Business Council for Sustainable Development. 2004. *Mobility 2030: Meeting the challenges to sustainability*. Geneva, Switzerland: Sustainable Mobility Project, WBCSD..

WCTRS. *See* World Conference on Transport Research Society.

World Conference on Transport Research Society. 2004. *Urban transport and the environment: An international perspective*, WCTRS and Institute for Transport Policy Studies.Oxford, UK: Elsevier Ltd.

Weiss M. A., J. B. Heywood, E. M. Drake, A. Schafer, and F. AuYeung. 2000. On the road in 2020: A life-cycle analysis of new automobile technologies. Massachusetts Institute of Technology Energy Laboratory Report MIT EL 00-003. Massachusetts, USA: Massechussets Institute of Technology. http://lfee.mit.edu/publications/PDF/el00-003.pdf.

Willoughby, C. 2000. Singapore's experience in managing motorization and its relevance to other countries. Discussion paper TWU-43. Washington, DC: World Bank Transportation Division.

World Bank. 2004. *World Development Indicators* 2004. Washington, DC: World Bank.

Xie, J., J. Shah, and C. Brandon. 1998. *Fighting urban transport air pollution for local and global good: The case of two-stroke engine three-wheelers in Delhi*. Washington, DC: World Bank.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 425 – 448, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

Sustainable Urban Wastewater Management and Reuse in Asia

Absar Kazmi[a] and Hiroaki Furumai[b]

The aim of this paper is to introduce the concept of sustainable urban wastewater management in the Asian context. Sewerage systems are key facilities to support public health and sound development in urban areas. They exist in most of the rapidly developing cities of Asia; however, a range of practical, financial, political, and environmental factors mean that provision is often inadequate to meet current and projected demand. To meet clean water goals and reduce the environmental impacts of urbanization, sewerage systems should be incorporated properly into watershed management plans. The paper ends by examining some of the range of new and established technologies and methods that can help Asian cities and periurban areas to minimize the burden and maximize the potential benefits of urban wastewater.

Keywords: Asia, Wastewater treatment, Sewage treatment, Sewer system, Sustainability, Wastewater reuse.

1. Introduction and background

Sixty percent of the global population lives in Asia. In 1970, just over 20 percent of those people lived in cities. In 1990, almost 35 percent were living in urban centers. Projections by demographers for the United Nations put the level of urbanization in Asia at more than 56 percent by the year 2020, which means an additional 1.5 billion urban dwellers (Chia 2001a). The governments in these Asian countries have given priority to infrastructure projects that promote economic activity, such as power plants and ports, rather than to sewerage and water-treatment plants. Now, across the region, rapidly industrializing economies are seeing millions of migrants from rural areas attracted to urban centers. With few exceptions, Asian governments are failing to provide even the most basic urban environmental services, including sanitation and piped water supply, for much of their countries' burgeoning populations. This paper focuses particularly on treatment and management of wastewater.

There are deep underlying factors involved in the generally low coverage of sewerage services in urban areas in most Asian countries. The rapid pace at which urbanization is happening, combined with the low income levels of a large proportion of the population, is a basic factor. Much of the expansion of residential and industrial areas is uncontrolled. Many cities continue to suffer from high inflows of migrants from their rural hinterlands. Uncontrolled housing and, worse still, developments of illegal squatter colonies that often line the waterways running through urban areas constitute a major problem for city administrators. Under warm equatorial conditions and especially during the summer, high

a. Department of Civil Engineering, Indian Institute of Technology Roorkee, Roorkee, Uttaranchal, India.
b. Department of Urban Engineering, The University of Tokyo, Japan.

temperatures add to the problem of rapid putrefaction in polluted water; although, conversely, such conditions boost the effectiveness of sewage treatment plants because they increase the biological activity necessary to break down contaminants and inactivate pathogens. The presence of large amounts of garbage and other blockages reduces the natural flow of water through drains, canals, streams, and rivers, leading to stagnation. It is common to see water in these channels turning green and turbid because of algal bloom. Mass fish deaths resulting from harmful algal blooms or red tides have become a serious problem in many parts of Asia, especially the Philippines and China, resulting in closure of fisheries, loss of income and employment, and damage to health. Untreated sewage is a likely cause of these conditions.

In most cities, there is only a rudimentary centralized sewerage system and the larger part of wastewater is discharged without treatment into rivers, lakes, and coastal waters. In the advanced economies of Japan, Hong Kong, and Singapore, cities have reached the standards of the best Western metropolises. Most cities in East Asia suffer from a lack of financial and technical resources to undertake the construction of large-scale centralized sewerage systems. Even though the major cities where the wealth of the nations is concentrated would have the resources to build and maintain an adequate sewerage system, several do not do so. The problem appears to be one of political will; sanitation does not directly generate revenue and it is not a visible benefit even for those urban dwellers who have their homes connected to a public sewer. It is also understandable that more attention is given to the provision of safe water through the construction of water-supply systems, which cost a tenth of the investment for a sewerage system and have more visible benefits. Some other obstacles that stand in the way of sustainable wastewater management in urban Asia are examined in section 3.

The aim of this paper is to introduce the concept of sustainable urban wastewater treatment in the Asian context. The first part provides a general overview of wastewater treatment in industrialized Asian countries and the second part discusses different sustainable examples suitable for large metropolises and for, medium-sized and small cities.

2. Sewerage, drainage, and on-site sanitation systems in urban Asia

In most situations, gravity sewers following natural topography are used for collecting sanitary sewage. The components of a typical system are described below:

- *House connections*, also referred to as building sewers, connect to building pumping systems. Normally, the house connection begins outside the building. In most municipalities, existing septic tanks are taken out of service when a building is connected to the sewerage system.
- *Laterals* are the first level of municipal sewers serving a group of houses. They usually have a minimum diameter of 150 mm and are located in streets or special easements.
- *Main sewers collect sewage from several laterals.*
- *Trunk sewers* are the largest elements of a sewerage system, delivering raw sewage to treatment facilities or disposal points.

The earliest recorded drainage and sewerage developments in the Asian region were constructed as combined systems (that is, sewerage and drainage combined) for old cities. This was an accepted design

practice in the early twentieth century and provided an economical solution to the wastewater collection problem. Many were designed to function as urban drainage systems. As communities grew, many people discharged their sanitary waste into the stormwater drainage, and raw sanitary sewage was then conveyed to natural receiving water. With increased population, the large volumes of sewage being discharge led to water pollution problems. Wastewater treatment was then necessary.

The existing drainage systems in the urban areas of developing Asia, which almost entirely consist of drains, canals, and combined sewers without pumping stations, are generally in poor condition due to lack of maintenance. They are poorly designed and constructed, without sufficient hydraulic capacity. Drainage coverage is unevenly developed in the various cities. In recent years, many Asian cities have suffered from inadequate infrastructure, including water treatment and supply. The problem has become chronic in the wake of the burgeoning of urban populations in the large cities, where sewerage and water-supply projects have lagged behind population growth. This leaves large proportions of the populations unserved, as can be seen in table 1.

Table 1. Water service and sewerage coverage in some cities in Asia Pacific areas

	Bangkok	Calcutta	Dhaka	Jakarta	Karachi	Manila	Seoul	Shanghai	Tokyo
Water service coverage, %	82	66	42	27	70	67	100	100	100
Water availability, m^3/day	24	10	17	18	14	17	24	24	–
Production, million m^3/day	3.85	1.20	0.78	0.97	1.64	2.8	4.95	4.7	4.54
Per capita domestic wateruse, L/day	265	202	95	135	157	202	209	143	245
Sewerage coverage, %	10	3.2	28	–	83	16	90	–	100

Source: UNEP 2002.

At present, sewerage and drainage systems in most of the developing countries in Asia, particularly India, Bangladesh, Sri Lanka, Nepal, the Philippines, and Vietnam, are in very poor condition. Those systems were constructed during colonial times and need to be upgraded and/or rehabilitated. For example, in India at present, the sewerage network in Mumbai consists of almost 1,381 km of main sewerage line in a combined system, and only 51 pumping stations.

Septic tanks are the most prevalent form of on-site urban sanitation in the developing countries of Asia, for both flush and pour-flush toilets. This is due to their practicality, being easier and cheaper to implement in densely populated areas. About 80 percent of the total population in urban Asia uses septic tanks.

Because of small lot sizes in typical urban areas, septic tank effluents overflow into roadside drains even where subsoil soakage is attempted. Some of these roadside drains are clogged by domestic and

commercial solid waste and other debris. In urban areas with waste-disposal systems, sewage (human excreta and bathing wastewater) are directed predominantly to septic tanks. Graywater (kitchen, laundry, and other non-toilet wastewater) may or may not be conveyed to septic tanks.

3. Key constraints in wastewater management in urban Asia

The need for modern wastewater management is now widely recognized in Asia, especially in the larger cities. However, for several reasons, systems are not sustainable and fail to meet the real demand. This section examines some of the constraints to sustainable wastewater management.

3.1. Insufficient funding

While there has been significant progress over the past decade in constructing new facilities, there remains a large backlog of unmet investment needs. With the large investments necessary, the sector would greatly benefit from additional sources of financing, including debt over the shorter term and private-sector equity investment over the longer term. These would rely on direct cost recovery from user charges.

3.2. Lack of cost recovery

User charges are implemented in only a few municipalities. The adoption of user charges by municipalities has been slow primarily due to the lack of political will and public acceptance. The lack of cost recovery is a major obstacle to private-sector participation, which could play a major role in addressing the existing funding and skills shortages in the sector. To overcome public resistance, the "polluter pays" principle should be promoted in public in the context of wastewater treatment.

3.3. Sustainability of services

In addition to inadequate collection systems and poor plant design, serious deficiencies also exist in the funding of operations and maintenance. This affects the quality and sustainability of services. This is due primarily to reliance on public-sector operation and maintenance, lack of options for cost recovery, and inadequate enforcement of existing environmental regulations.

3.4. Shortage of technical skills

Technical skill shortages are a major factor responsible for poor performance in operation and maintenance. The lack of private-sector participation and better job incentives in the private sector exacerbate this shortage. The concept of the public-private partnership (PPP) should be introduced to improve skill levels in the private sector and to find possible solutions for this shortage.

3.5. Inadequate enforcement

In developing countries, there are presently no regular programs for monitoring discharges from existing municipal wastewater facilities or for penalizing municipalities with inadequate or no treatment facilities. With low environmental awareness, active enforcement tends to be the primary catalyst in driving environmental improvement programs.

4. Overview of urban wastewater management in selected Asian countries

This section examines the status of wastewater management in several Asian countries and cities. As can be seen, in most countries wastewater treatment is an innovation of only the last few decades, a response to rapid urban development. In some countries, however, sewerage and drainage have much longer histories.

4.1. Malaysia[1]

Sewerage management in Malaysia was under the jurisdiction of local authorities prior to 1993. The standards of sewerage services varied widely around the country, due to difference in management skills and financial resources among different local authorities. To address this problem, in 1993, the Malaysian government decided to centralize management of sewerage services around the country at the federal level and introduce private-sector participation. The Department of Sewerage Services was formed under the Ministry of Housing and Local Government to act as regulator of the sewerage industry.

A national concession company, Indah Water Konsortium Sdn Bhd (IWK), was formed in April 1994 to undertake management of sewerage services in Malaysia. According to the Malaysian Sewerage Services Department, to date, IWK has taken over the management of sewerage services from all local authority areas in Peninsular Malaysia, except for Majlis Bandaraya, Johor Bahru, and Kelantan, as well as in the Federal Territory of Labuan. As of November 2003, IWK operated and maintained 12,500 km of sewers, 7,502 sewage treatment plants, and 444 network pumping stations. It also serviced septic tanks for some 350,000 customers, and was considering providing on-demand services for the remaining 600,000 septic tanks in the country.

IWK formulated the 2004–2035 Sewerage Development Plan (SDP), which is a development strategy to improve sewerage infrastructure in the country. The SDP recommends the most appropriate disbursement of capital funds to meet actual sewerage needs. It includes defined targets. The overall target for 2035 is to serve 80 percent of the population with connected services.

In addition to the SDP, Malaysia is now implementing sewerage projects under the Eighth Malaysian Plan Allocation. One of the investment sources for these projects is a loan from the Japan Bank for International Cooperation (JBIC). The JBIC projects cover 13 urban areas and includes upgrading of 10 sewage-treatment plants and seven sewerage network packages, and the provision of three new central sludge-treatment facilities. The construction of the projects comes in three packages. Construction work for Phase 1 started in January 2004. Details of the different plants being built under the projects are provided in table 2.

1. This section on Malaysia is based on Maniam 2004, with minor alterations.

Table 2. Sewage-treatment plants, centralized sludge-treatment facilities, and sewerage networks being constructed under the Malaysian sewerage projects

Code: plant name	Population equivalent (PE) and flow, m^3/day	Treatment plant type and treatment flowsheet
A1: Bunus sewage-treatment plant (STP)	352,000 PE, and flow: 87,000.	Advanced Activated Sludge Process (ASP); screen; grit plus oil and grease (O&G) removal plus rectangular primary settling tank (PST) plus aeration tank plus secondary settling tank (SST) anaerobic digestion (ambient temp, circular digesters). Mechanical dewatering of anaerobic digestion (AD) sludge by screw press plus odor control facility.
A2: Pantai STP and network	377,000 PE, and flow: 93,000.	Screen; grit plus O&G removal plus rectangular PST plus aeration tank plus SST; anaerobic digestion (ambient temperature, circular digesters); mechanical dewatering of AD sludge by screw press plus odor control facility.
A3: Damansara STP	100,000 PE, and flow: 25,000.	Activated Sludge Process (ASP) with mechanical dewatering.
A4: Bandar Tun Razak STP	100,000 PE, and flow: 25,000.	Sequencing Batch Reactor (SBR) process; screen plus grit plus O&G plus flow balancing tank plus SBR (six rectangular tanks, submersible aerators); mechanical dewatering of AD sludge by screw press plus odor-control facility.
A5: Puchong STP and network	150,000 PE, and flow: 37,000.	Screen; grit plus O&G removal plus rectangular PST plus aeration tank plus SST; mechanical dewatering of AD sludge by screw press plus odor-control facility.
B1: Sungai Nyior STP and network	150,000 PE, and flow: 37,000.	Advanced ASP with PST and SST; mechanical dewatering.
B2: Juru STP and network	50,000 PE, plus transported sludge from septic tanks and small wastewater-treatement plants (WWTPs): 300,000 PE.	ASP and mechanical dewatering.
C1: Sunggala STP and network	60, 000 PE, plus transported sludge from septic tanks and small WWTPs: 50,000 PE.	Extended aeration ASP; mechanical dewatering.
C2: Kuala Sawah STP and network	360, 000 PE.	ASP; mechanical dewatering.
D1: Southern Klang Valley centralized sludge-treatment facility (CSTF)	Sludge from septic tanks plus small WWTPs: 400,000 PE (330 m^3/day), plus 20,000 PE sludge from WWTPs.	Mechanized thickening plus screw press dewatering; STP for wastewater from sludge treatment plus 5,000 m^3/day from 20,000 PE; three-stage step aeration anoxic-aerobic process with suspended biopellets to enhance nitrification.
D2: Sungai Udang CSTF	Sludge from septic tanks and small WWTPs: 300,000 PE.	Mechanical dewatering. ; STP for wastewater from sludge treatment.
D3: Kota Setar CSTF	Sludge from septic tanks and small WWTPs: 400,000 PE.	Mechanical dewatering. ; STP for wastewater from sludge treatment.

Source: Based on personal communication from Nishihara Environment Technology, Inc. on the Malaysian sewerage projects.

4.2. Thailand

Prior to 1990, there was virtually no treatment of municipal wastewater in Thailand. By the end of 1995, 25 wastewater-treatment systems—two in the northern region; seven in the northeastern region; nine in the central region; five in the eastern region; and two in the southern region—had been constructed, with a combined treatment capacity of about 430,000 m^3/day. In spite of such progress, the available total capacity was sufficient to serve just over 10 percent of the urban population in 1995. For the period 1995–1999, the Royal Thai Government budgeted about US$950 million for capital investment for construction and/or expansion of 40 additional facilities. However, following a 38-percent reduction in capital investments due to the 1997 economic crisis, the implementation schedule suffered significant delays and in some cases investments were cancelled. To date, 57 wastewater treatment plants have been constructed in 50 municipalities at a total cost of almost 19 billion baht (US$500 million).[2] About 75 percent of the treatment capacity provided by these systems has entered service only over the past four years. Another 28 facilities are presently under construction or undergoing expansion (World Bank 2001).

Although the served population is much lower due to problems with operation and collection, it is estimated that there is enough wastewater treatment capacity to cover 29 percent of the municipal population and, after the completion of those facilities that are under construction or undergoing expansion, this will increase to 65 percent (see table 3) (World Bank 2001).

Table 3. Municipal wastewater-treatment system capacity in Thailand

Region	Existing treatment plants		Existing plants plus those under construction	
	Capacity (m^3/day)	Municipal population covered (%)[1]	Total capacity (m^3/day)	Municipal population covered (%)
North	83,600	22	139,500	37
Northeast	106,650	19	170,710	31
Central	164,350	23	399,850	57
South	102,950	35	233,650	51
East	214,400	85	326,300	85
Bangkok Metropolitan Area	270,000	27	992,000	98
Total	941,950	29	2,262,010	65

Note: Capacity in excess of the needs of the municipal population for certain tourist provinces in the eastern, southern, and central regions is not included, as this capacity is designed to cover the tourist population.

1. Refers to population covered by the capacity.

Source: World Bank 2001.

2. Calculated at 38 baht/US$.

The treatment plants primarily consist of proven and relatively simple technologies, such as oxidation ditches, aerated lagoons, and stabilization ponds (see figure 1). These systems have low upfront capital and operation and maintenance (O&M) costs. Although the activated sludge process is promising and stable, it is relatively complex and costly to build and operate. It is used in some urban areas of the central region and the Bangkok Metropolitan Region, where land prices or availability limit the application of other technologies.

Thailand has been only moderately successful in operating wastewater treatment plants. About a third of the existing plants have major malfunctions or do not operate (World Bank 2001). The major reason for this is the inadequacy of funds to cover O&M. This shortfall was revealed in a 1999 survey of 29 facilities, which showed that most facilities suffered from equipment failure or damage as well as deficiencies in staff skill levels. The effectiveness of wastewater treatment systems in Thailand is also limited by the condition of the collection systems. Typically, wastewater collection systems in Thailand rely on old drainage systems comprised of canals or open sewers and poorly maintained drainage pipe networks with limited connections. Investment has primarily focused on intercepting the flow from these systems, with little focus on rehabilitation of the drainage networks themselves. As a result, the collection efficiency of these systems is low. Performance data on 19 plants has shown that these collection systems can, on average, collect only 55 percent of the wastewater that the treatment plants are designed to treat (World Bank 2001). In addition to making almost half the capacity of these plants redundant, inadequate collection has, in many cases, interfered with proper operation of treatment plants.

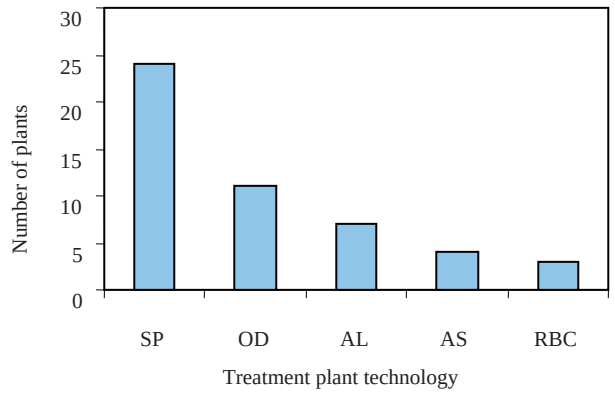


Figure 1. Types of technologies in existing wastewater treatment systems in Thailand

Key: SP = stabilization pond; OD = oxidation ditch; AL = aerated lagoon; RBC = rotating biological contactor.
Source: World Bank 2001.

4.3. Indonesia and the Philippines

At present, only five large cities in Indonesia operate centralized sewage-treatment plants: Jakarta, Bandung, Medan, Yokjakarta, and Cirebon. Construction of the Jakarta treatment plant was completed in 1992. However, it serves less than five percent of the population. Bandung started the construction of

its plant in 1980 and it came into operation in 1990, serving nearly the whole population. Medan started construction of its system in 1985 and the work was completed in 1995, covering 75 percent of the population (UNEP 2002). Cirebon required three years for the construction of its plant, which was completed in 1991. Only around 15 of the 1,500 cities in the Philippines have domestic and industrial wastewater treatment facilities. Table 4 shows details of treatment plants for selected cities in the Philippines (UNEP 2002).

Table 4. Wastewater treatment plants in the Philippines

Cities	Capacity of the wastewater treatment m3/day	Type of the treatment	Remark
Ayala	40,000	Activated sludge	Operating
South Manila	207,000	Aerated lagoon	Under construction
Central Manila	162,000	Oxidation ditch	Under construction
North Manila	282,000	Aerated lagoon	Under construction
Dagut	12,600	Aerated lagoon	Under construction
Banguio	20% wastewater	Oxidation pond	Operating
Cauayan Isabela	30% wastewater	Activated sludge	Operating

Source: UNEP 2002.

4.4. Republic of Korea

The beginnings of sewage works in the Republic of Korea can be traced to the dredging and reconstruction of the Cheong Gye River, which flows through Seoul City, in 1412 during the Lee Dynasty. Under Japanese rule, records show that large-scale construction of storm sewers was conducted. However, the construction of modern sewerage systems started only after it was realized that they were the most important counter-measure for the widespread water pollution problems being caused by rapid urbanization during the period of high economic growth in the 1970s. As a result, the first sewage-treatment works, namely the Cheong Gye River Sewage Treatment works, (conventional activated sludge process with treatment capacity of 150,000 m^3/day, presently combined with Chun Nam Jong Sewage Treatment Works), was constructed and commenced operation in 1976.

Thereafter, sewage-treatment plants have continuously been constructed to prevent pollution of public waters such as rivers as industrialization and rapid urbanization progress. As of 1998, there were 114 sewage treatment plants (with a treatment capacity of 16.62 million tons per day), serving 66 percent of the population. Figure 2 shows the growth in the total capacity of the Republic of Korea's sewage-treatment facilities between 1993 and 2002. Secondary treatment (activated sludge process) is the most common treatment method used in the country. Although sewage-treatment facilities are well established in urban areas such as Seoul, Kwangju, and Taegu, rural areas are still behind; in Chonnam, less than 11 percent are served. Most of Korea's sewage-treatment plants treat biological oxygen demand (BOD) and suspended solids (SS) from the wastewater and do not attempt nitrogen and phosphorus removal (nutrients included in the wastewater that cause algal blooms). However, introduction of advanced treatment processes for nitrogen and phosphorus removal is underway (Ministry of Environment Korea 2004; Water Korea 2001).

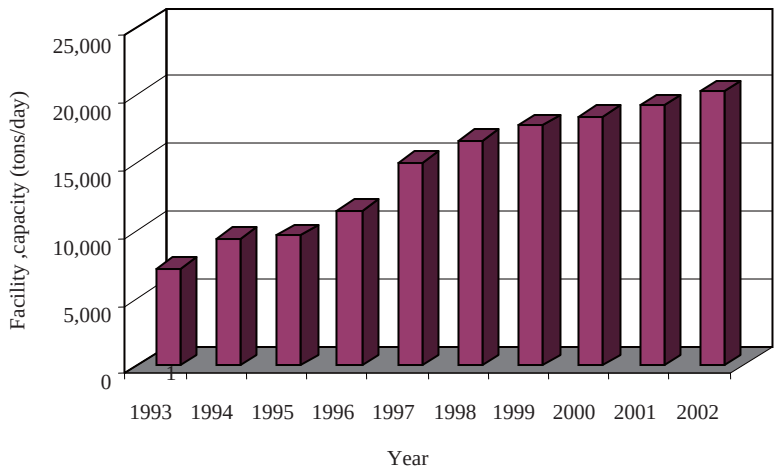


Figure 2. Sewage-treatment facilities in the Republic of Korea

Source: Ministry of Environment Korea 2004.

4.5. Japan

Modern sewer systems in Japan originated in 1884 in the Kanda district of Tokyo. The first cities to develop sewerage systems in Japan, which included Tokyo and Osaka, were located on lowlands vulnerable to flooding. These cities adopted combined sewer systems that could control both water pollution and flooding to some extent. Combined sewer systems were also easier and cheaper to construct than separate sewerage and flood-control systems. In the revised Sewerage Law in 1970, it was clearly stated that sewers were indispensable in maintaining the water quality of public water bodies. Almost all municipalities have since then adopted separate sewer systems, which are more effective in preventing pollution of public water bodies.

Investment in sewer systems has been sharply increasing since the 1970s, driven by systematic investment under five-year plans. The connected population rate increased sharply from 8.3 percent in

1965 to 66.7 percent in 2003, supported by a rapid increase in sewerage facilities. The total pipeline length is now 345,000 km; secondary and advanced treatment plants in operation number approximately 1,760 and 80, respectively (Japan Sewage Works Association 2004).

Table 5. Number of sewage-treatment plants in Japan

Sewage treatment process (number of plants)	Design treatment capacity in dry weather (1,000 m^3/day)						Total
	Less than 5	5–10	10–50	50–100	100–500	More than 500	
Primary treatment	1	–	1	–	–	–	2
Secondary treatment	906	160	383	143	155	16	1,763
Advanced treatment	22	2	23	10	23	–	80
Total	929	162	427	153	178	16	1,845

Source: Japan Sewage Works Association 2004.

While Japan has focused on development and expansion of sewerage systems, these systems have recently been expected to contribute to efforts to build a sound-water-cycle society and recycling society through utilization of the potential resources and accumulated stock of sewage. For example, treated wastewater has been utilized as a resource for various uses such as toilet flushing and restoration of streams. Although only one percent of the treated wastewater is reclaimed, the concepts of sprinkling reclaimed water onto water-retaining pavement and utilizing sewage heat have been investigated to ameliorate the "heat island" effect in Tokyo.[3] These are examples of attempts towards environmentally friendly wastewater management.

4.6. India

Discharge of untreated domestic wastewater is a predominant source of pollution of aquatic habitats in India. Urban centers contribute more than 25 percent of the sewage generated in the country. Smaller towns and rural areas do not contribute significant amounts of sewage due to the low per-capita water supply; any wastewater generated normally percolates into the soil or evaporates. The Central Pollution Control Board (CPCB) conducted a survey in 1994–95 on water supply and wastewater generation, collection, treatment, and disposal in 299 "class-I" cities (that is, with a population greater than 100,000) and 345 "class-II" towns (population between 50,000 and 100,000) (UNEP 2001). The survey findings indicated that most cities did not have organized wastewater collection and treatment facilities. Furthermore, the facilities constructed to treat wastewater did not function properly and were out of action most of the time due to flawed design and poor maintenance, together with a non-technical and unskilled approach to their management. The salient features of water supply and sewage treatment in urban India are given below, based on the findings of the 1994–1995 survey. These descriptions are

3 . The "heat island" effect is elevated temperature conditions over an urban area caused by the heat absorbed by structures and pavement.

adapted from Central Pollution Control Board 2000a (class-I cities) and Central Pollution Control Board 2000b (class-II towns).

a. Class-I cities

In 1994–1995, the total population of 299 class-I cities, including 23 metropolitan cities, was 139,966,369. Maharashtra state and the Ganga River basin had the highest concentration of class-I cities.

The total quantity of water supplied to the 299 class-I cities was 20,607.24 million liters per day (MLd) and the wastewater generated was 16,622.56 MLd.

The proportion of the population covered by organized water supply was 88 percent and the average per-capita water supply in class-I cities was 183 liters per capita per day (Lpcd), which was an improvement of about 22 percent over the situation in 1988.

Some 70 percent of the population in class-I cities was covered by sewerage facilities, and the volume of wastewater collected was 11,938.2 MLd.

Total available wastewater treatment capacity was 4,037.2 MLd—32 percent of the wastewater collected and about 24 percent of the wastewater generated. Only 76 out of a total of 299 class-I cities had sewage-treatment plants, with either primary or secondary level of treatment.

b. Class-II towns

According to the 1991 census, there were 345 class-II towns with a total population of 23,645,614. The overall population density in class-II towns in 1994–1995 worked out to 3,695 persons per km^2.

At the time of the survey, the total quantity of water supplied to 345 class-II towns was 2,030.9 MLd, and wastewater generated was 1,649 MLd. The projected generation of sewage for the year 1999 was 1,897 MLd.

The percentage of population covered by organized water supply was 88, and the average per capita water supply in class-II towns was 103 Lpcd, an improvement of about 22 percent over the 1988 water supply values.

The percentage of the population covered by sewerage facilities in class-II towns was 66, and the volume of sewage collected was 1,090 MLd.

The total available wastewater treatment capacity was just 61.5 MLd, or about six percent of sewage collected and about four percent of sewage generated. Out of 345 class-II towns, only 17 had sewage-treatment plants.

c. Pollution-reduction plans

In the late 1980s, the Government of India launched the National River Action Plan (NRAP). Under this plan, certain stretches of major rivers with high or intermediate levels of pollution were identified by the CPCB. These areas were then given their own action plans and prioritized for development of sewage collection and treatment works to reduce the pollution load to the rivers. These included schemes for better interception and diversion of sewage, construction of sewage-treatment plants, provision for low-cost sanitation, among others. In the first phase of the Ganga River action plan, 29

towns were selected along the river and 261 pollution-reduction schemes were sanctioned. At present, 156 towns are being considered under the NRAP, out of which about 74 towns are located on the Ganga; 21 on the Yamuna; 12 on the Damodar; six on the Godavari; nine on the Cauvery; four each on the Tungbhadra and Satluj; three each on the Subarnarekha, Betwa, Wainganga, Brahmini, Chambal, and Gomti; two on the Krishna; and one each on the Sabarmati, Khan, Kshipra, Narmada, and Mahanadi (UNEP 2001). To address pollution of urban lakes subjected to anthropogenic pressures, the National Lake Conservation Plan (NLCP) of 1993 was prepared. The Bhoj Lake of Madhya Pradesh is already getting assistance thanks to funds provided by the Overseas Economic Cooperation Funds, Japan.

4.7. China

Wastewater treatment and reuse in China began in 1956, in the north of the country. Municipal wastewater is treated to primary and secondary standards, with secondary treatment being provided by (i) conventional activated sludge processes; (ii) contact-stabilization processes; or (iii) pure-oxygen aeration processes. In some cases, biological treatment facilities such as oxidation ponds and sewage irrigation systems are used as secondary treatment alternatives. Presently, total wastewater from cities and towns in China amounts to about 99.6 million m^3. It is estimated that only 123 out of China's 668 cities have wastewater-treatment plants (307 plants in total), and only nine percent have secondary treatment. Of China's 17,000 towns, most do not have drainage systems or wastewater-treatment facilities. Some Chinese cities have secondary wastewater treatment plants built, but not in operation, one of the reasons being the incomplete status of the associated wastewater-collection system; the investment required to establish a well-organized wastewater system with adequate piping and pumps is much higher than the expenditure on the treatment plants themselves.

5. The watershed approach to wastewater management

The watershed approach is essential for effective water pollution control, and sewerage systems should be allocated properly in watershed management plans. A watershed can be defined as the entire land area that ultimately drains into a particular watercourse or body of water. Watersheds can be many different shapes or sizes. The watershed approach is a decision-making process that reflects a common strategy for information collection and analysis as well as a common understanding of the roles, priorities, and responsibilities of all stakeholders within the watershed. Focusing on the whole watershed helps to identify the most cost-effective pollution-control strategies to meet clean water goals, to achieve the best balance among efforts to control point-source pollution and non-point pollutant run-off as well as to protect drinking water sources and sensitive natural resources such as wetlands. Each region should make a watershed-based plan for water pollution control.

Four main features are typical of the watershed approach: (1) identifying and prioritizing water quality problems in the watershed; (2) developing increased public involvement; (3) coordinating activities with other agencies; and (4) measuring success through increased and more efficient monitoring and other data gathering. Wastewater management should be incorporated into the water cycle, coordinating with whole-watershed management.

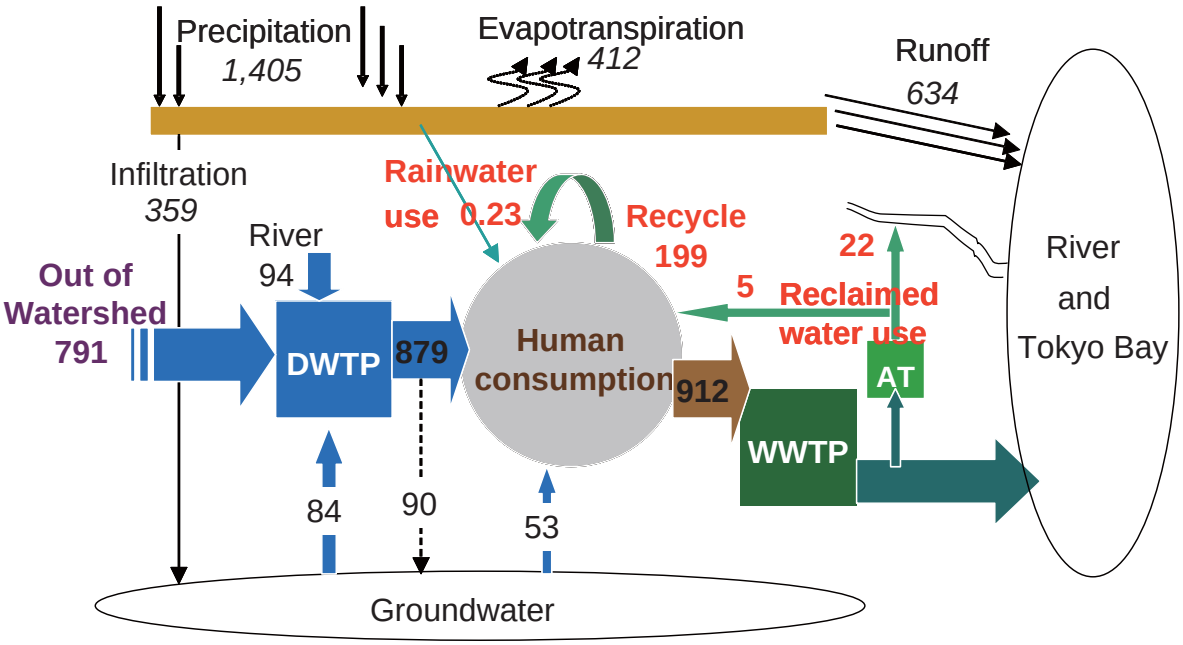


Figure 3. Water flow balance in Tokyo

Unit: mm/year.
Source: Tokyo Metropolitan Government 1999.

One example of a watershed management plan is the Tokyo Metropolitan Government's Master Plan for Water Cycle (Tokyo Metropolitan Government 1999). In making the plan, the metropolitan government figured out the water-flow balance in Tokyo. This is shown figure 3, in which the amount of water flow is expressed in rainfall equivalent annual rates (mm/year). This diagram clearly shows that a lot of water is introduced from outside the Tokyo watershed. This makes it reasonable to use reclaimed water to reduce water intake from natural waterways and mitigate the impact on the sound water cycle within the watershed.

6. Technology options for wastewater treatment

Technologies for both collection and treatment of wastewater should be selected to protect public health and the environment while ensuring the optimum use of water resources. This section looks at technology options that could be considered for wastewater treatment in Asia at three scales: large scale (for large cities such as regional and provincial hub cities, population equivalent >100,000), medium scale (for medium-sized cities such as provincial cities or towns, population equivalent 30,000–100,000), and small scale (decentralized systems for peri-urban areas, population equivalent <2000). The sections following look at some other technologies, approaches, and concepts that can complement these wastewater treatment technologies in order to move toward sustainable wastewater management.

There are cogent technical and managerial reasons for Asian countries to seek innovative solutions to the provision and management of sanitation for cities. These include the following:

- The high cost of sewerage systems;
- Lack of financial resources and availability of trained manpower;
- Dry conditions and water shortages;
- Realizing the potential value of waste materials from sewage; and
- Utilizing the untapped energies of the private sector and the people.

6.1. Large-scale urban

There are various options for centralized wastewater treatment for big cities. Large-scale municipal wastewater-treatment plants serve the larger populations of established cities and sometimes provide treatment and disposal services for neighboring sewerage districts. The advantages of large centralized systems include economies of scale; more control over operations; and a single management and workforce. There are various kinds of large-scale wastewater treatment plant. The most commonly used are the conventional activated sludge process or its variants, such as modified aeration and oxidation ditches. There are other lower-cost technologies, such as stabilization ponds and aerated lagoons, but these require a lot of space and are thus better suited to medium-sized or small cities where land is easily available. Table 6 shows the results of a comparison of the costs of various treatment processes by the Bangkok Metropolitan Authority.

Table 6. Cost comparison of various wastewater treatment processes

Ranking (1 = best)	Initial cost	O&M cost	Lifecycle cost	Operability	Reliability	Land area	Sludge production	Power use	Effluent quality
1	MA	SP	MA	SP	SP	MA	SP	SP	SP
2	AS	MA	AS	AL	AL	AS	AL	MA	AL
3	OD	AL	OD	OD	OD	OD	OD	AS	MA
4	AL	AS	AL	AS	MA	AL	AS	AL	OD
5	SP	OD	SP	MA	AS	SP	MA	OD	AS

Key: SP = stabilization pond; AL = aerated lagoon; OD = oxidation ditch; AS = conventional activated sludge; MA = modified aeration sludge or trickling filter solids contactor.

Note: Flexibility and expandability are similar for all types. Sensitive regions should be designated to protect against water pollution and eutrophication. In some cases, advanced treatment is needed.

Source: UNEP 2002.

If the treated wastewater is to be discharged into enclosed water bodies, estuaries, etc., a nutrient-reduction program should also be considered. Under EU guidelines, for rivers and streams reaching lakes, reservoirs, or closed bays that are found to have poor water exchange, whereby accumulation may take place, the removal of phosphorus should be included unless it can be demonstrated that the removal will have no effect on the level of eutrophication. Where discharges from large agglomerations are made, the removal of nitrogen may also be considered (European Economic Community 1991).

Case study: Yannawa sequencing batch reactor plant[4]

One of the most promising processes for large-scale wastewater treatment is the sequencing batch reactor (SBR) process. In the SBR process, inflow, reaction, and settling take place in one tank. By changing cycle times or providing intermittent aeration, the same plant can be used for nutrient removal. One interesting example is the Yannawa SBR plant in Bangkok.The treatment plant (phase 1), utilizing the Cyclic Activated Sludge System,from the company Earth Tech, was the first ever major multi-level wastewater facility constructed. The plant is designed to achieve a very high effluent standard, including nitrogen and phosphorus removal. The effluent limits are BOD of 20 mg per liter (mg/L), SS 30 mg/L, total nitrogen 10 mg/L, ammonia nitrogen 5 mg/L, and total phosphorus 2 mg/L. It is designed to accommodate large fluctuations in biological and hydraulic load automatically.

The Yannawa plant provides wastewater collection and treatment for the Bangrak, Sathorn, Bang Khor Laem, and Yannawa districts of Bangkok, with a combined area of approximately 2,855 hectares. The present population of approximately 500,000 is expected to double by the year 2020.

6.2. Medium-scale urban

The selection process for wastewater treatment facilities for smaller cities should factor in the costs and availability of land, labor, equipment, and building materials and the cost, availability, and reliability of support services such as utilities, equipment, and systems maintenance. Technology selection objectives that should apply in most developing countries include:

- Technological simplicity;
- Minimal capital and operating costs;
- Maximum treatment and removal efficiency for capital and recurrent investment; and
- Water reclamation and reuse capability to offset costs.

As discussed earlier, the activated sludge process and its variants are the most efficient, but their main disadvantage is in the high upfront and O&M costs. In medium-sized cities, funds are generally limited and land prices are not high. In these contexts, the most promising technologies are stabilization ponds, upflow anaerobic sludge blanket (UASB) reactor, or a UASB reactor combined with a polishing pond or other post treatment technology. These are examined in more detail below.

a. Stabilization ponds

Stabilization pond technology is eco-friendly and simple to operate. They can be constructed and maintained by the local community and are not dependent on power. Stabilization pond technology is recognized as the only cost-effective technology capable of killing pathogens to make the levels of microbial pollution in treated wastewater safe for agriculture, aquaculture, and bathing. Land is the primary requirement for waste stabilization pond technology (National River Conservation Directorate 2002).

4. This case study is based on the project description in Earth Tech 2004.

b. Upflow anaerobic sludge blanket reactor

The UASB is a high-rate suspended-growth type of reactor in which a pre-treated raw influent is introduced from the bottom of the reactor and distributed evenly. “Flocs” of anaerobic bacteria tend to settle against moderate flow velocities. The influent passes upward through, and helps to suspend, a blanket of anaerobic sludge. Particulate matter is trapped as it passes upward through the sludge blanket, where it is retained and digested. Digestion of the particulate matter retained in the sludge blanket and breakdown of soluble organic material generates gas and relatively small amounts of new sludge. The rising gas bubbles help to mix the substrate with the anaerobic biomass.

The major advantage of UASB over the activated sludge process is low capital and operating costs. In addition, the amount of sludge generated is much less and methane-rich biogas is generated that it may be economical to utilize as fuel for large scale facilities (>100,000 population equivalent). However, the major disadvantages are that the optimal reactor temperature is 20^{o}C or above (which may not be achievable in some areas in cold seasons), and additional treatment is required to meet secondary quality standards in terms of oxygen-consuming substances; methanogenic activity may be inhibited from the toxic effects of high concentrations of heavy metals, toxic organics, free ammonia (>50 mg/L) and free H_2S (> 250 mg/L); and chemical buffering may be required to maintain alkalinity in the reactor (Alearts et al. 1991).

c. UASB with post treatment

UASB followed by a polishing pond has been widely adopted as a method for treatment of sewage to achieve effluent discharge standards of 30 mg/L BOD and 50 mg/L SS, because of its low operational costs and good resource recovery in the form of biogas, excess sludge that can be used as fertilizer, and effluent rich in nutrients.

The use of a polishing pond with a one-day retention time requires an additional large area of land, which can be a constraint where land availability is limited. To address this problem , a new technology called the Downflow Hanging Sponge (DHS) Bio-tower has been tried out on a pilot scale in India for UASB effluent post-treatment. The technology was developed at Nagaoka University in Japan and has a unique design concept. The effluent from the UASB reactor is trickled through a curtain of sponge cubes linked diagonally and hanging in air. The sponge acts as a biomass immobilizer for attached growth. Active immobilized biomass consumes nutrients from the wastewater stream and simultaneously takes up dissolved oxygen, which naturally diffuses from air. Therefore, the most important feature of the Bio-tower is that it does not require external aeration and it can maintain a very long sludge/solids retention time (SRT).

A pilot Bio-tower of 1 MLd capacity was constructed at the 40-MLd UASB sewage-treatment plant at Karnal and has been in operation since April 2002. The Ministry of Environment and Forests reports that the performance of the bio-tower has been quite good, with the effluent having BOD of around 10 mg/L, SS of 10 mg/L, and fecal coliform of around 3,000 MPN/100 ml. The land requirement of the DHS Bio-tower is only one-tenth of the land requirement for a one-day final polishing pond (Ministry of Environment and Forests 2002).

d. Case study: Mirzapur 14 MLd UASB treatment plant[5]

The city of Mirzapur in India has a population of about 130,000. The plant consists of advanced primary treatment in UASB reactors and post-treatment in a polishing pond with retention time of one day. The current flow into the treatment plant is about 10 MLd and is projected to increase to 14 MLd by the year 2006 and to about 20 MLd by 2021. The construction plan called for a 14 MLd peak capacity plant with expansion capability to add reactor modules and pond space to reach the 20 MLd target. The inlet chamber of the plant receives raw wastewater through a 700 mm-diameter main from a pumping station. Two parallel grit traps operate in tandem on a two-day cycle of manual cleaning. The surface-loading rate of the grit traps is 45 m/h. The UASB reactor is comprised of two 2,400 m^3 units designed for an organic loading rate for chemical oxygen demand (COD) as volatile solids of 0.3 kg/day/m^3 of reactor capacity. The minimum height of the sludge blanket is two meters, and the average hydraulic retention time (HRT) is about eight hours. The sludge-settling compartment of the gas/liquids/solids phase separator is designed to accommodate a maximum surface-loading rate of 2 m^3/m^2/hour.

Gas production is in the order of 500 m^3/day based on a gas yield of 0.1–0.15 m^3/kg of COD removed. The gas composition is about 80 percent methane, with potential to produce 70 kW of electric power. Because the daily power requirement of the plant is 12 kW, two dual-fuel generator sets of 18 kW are provided. Excess anaerobic sludge is produced at the rate of 0.2 kg of total suspended solids per m^3 of treated effluent and is withdrawn regularly and dewatered on sludge-drying beds that have a total area of 2,000 m^2. The loading rate on the drying beds is 520 kg/m^2 of total solids per year, with a drying time of seven days. The dried sludge is removed manually and sold to farmers as a soil conditioner. Table 7 presents the average removal rates and the average quality of the influent, reactor effluent, and final effluent of the Mirzapur treatment plant.

Table 7. Mirzapur 14 MLd UASB plant average influent and effluent quality and removal rates

			Removal rates (%)	
Parameter (averages)	Influent (mg/L)	Effluent (mg/L)	Reactor effluent	Final effluent
COD	411	160	61	81
BOD_5	193	50	74	84
Total suspended solids	360	108	70	87

Source: Journey and McNiven 1996.

5. This case study is based on Journey and McNiven 1996, with minor alterations.

e. Small-scale urban/peri-urban

In most Asian cities, peri-urban areas are not yet equipped with wastewater-treatment facilities. This offers the possibility to look for decentralized solutions involving new, more-efficient biological treatment processes, local management, nutrient recycling, energy recovery, and combined management of treated effluents and storm water. In this way, trunk sewers and pumping of wastewater over long distances can be avoided and water resources locally administered and used. Integrated recycling can be the common ground for the systems to be suggested in the peri-urban context (US Environmental Protection Agency 1992). Also, building traditional-style centralized sewerage systems and treatment plants is expensive. Table 8 shows that the capital costs even in low-income countries—where labor and material costs are low—conventional wastewater treatment plants cost several times more than on-site systems (for example, septic tanks). While the average costs for capital, operation, and maintenance on a per capita basis appear to be low for centralized systems, a considerable portion of urban families of developing countries cannot afford even on-site options. There is hence a need to find innovative or alternative solutions to meet the needs of a sizeable portion of the urban population in developing countries.

Table 8. Cost range per capita of on-site and sewered options with conventional treatment

Economy type	Option	Capital cost (US$/capita)	Total cost[1] (US$/capita/year)
Low-income economies	On-site sanitation	10–100	3–10
	Treatment plant	20–80	5–15
	Sewer plus treatment plant	200–400	10–40
Middle-income and transitional economies	Treatment plant	60–80,[2] 30–50[3]	–
	Sewer plus treatment plant	300–500[3]	30–60[4]
Industrialized economies	Treatment plant	150–300[2], 100–200[3]	–
	Sewer plus treatment plant	–	100–150[4]

1. Total cost includes capital and O&M costs.
2. For primary plus secondary treatment, including land purchase and simple sludge treatment for capacity of 30,000–40,000 persons. Lower values pertain to low-cost option, such as stabilization ponds; higher values pertain to mechanized treatment, such as oxidation ditches and activated sludge plants.
3. For plant capacity equivalent to 100,000–250,000 persons.
4. For industrialized countries, this includes tertiary treatment and full sludge treatment; for other countries this includes basic secondary treatment.

Source: UNEP 2002.

There are options among several basic systems of conventional treatment systems that vary in cost depending on the level of treatment and availability of space. The Japanese Johkasou system, though not a new development, offera solutions for small to medium-sized communities from several up to tens of

thousands of households. The innovation is in how this tested system can be built with minimal costs using local materials and labor and, for example, the use of excavated material for laying pipes.

7. Incentives and technologies for wastewater reuse

Some parts of the East Asian region suffer from low precipitation and periodic or seasonal drought. Conventional sewage-treatment systems using water-based technologies do not operate effectively when water is short. Solutions need to be found for such areas, especially as pollution from untreated sewage is exacerbated by small or non-existent flow of water in streams and rivers. Reuse of wastewater holds a lot of promise for such conditions.[6]

Reuse of treated or untreated wastewater has the following benefits: it increases water supplies by reducing demand for higher-quality water; it reduces wastewater discharge, thus reducing water pollution; and it is economically efficient as it means lower water costs compared to transporting water from distant sources.

In water-short cities and "green buildings", recycled water is used for cleaning purposes and for flushing toilets. Similarly, it is used for cooling, cleaning, and dilution in industrial plants, but separate pipeline systems are required for both uses (Ogoshi, Suzuki, and Asano 2001). However, excessive silt can block pipelines and requires more expenditure on maintenance. An innovation is the processing of wastewater into ultra-clean water using new filtration technology. There is now such a plant in Singapore, and the water from it can be used for special industrial purposes that require water with a high degree of purity. Recharging of groundwater with treated or untreated water in water-scarce areas and in cities in danger of depletion of groundwater leading to soil subsidence is a matter of considerable interest. Perhaps other innovative uses could be explored and tried within the region.

Most Asia-Pacific countries are tropical and their water resources are relatively abundant. As a result, most of the developing countries in this region do not reuse wastewater. Exceptions are India, China, and Vietnam, where wastewater is being used for irrigation (Shuval 1990). Reuse of wastewater occurs most effectively with on-site or small-scale treatment systems. Thus, implementation of reuse options in local contexts with local community consultation must be seriously considered.

In India, studies on agricultural productivity have found that recycling and reuse of nutrients and other valuable materials in domestic and industrial wastewater is effective . General utilization of wastewater through reuse and recycling has become very important. In fact, wastewater is recognized as a resource rather than a burden since it contains appreciable amounts of nitrogen, phosphorus, and potassium. Stabilization ponds can be used for fish aquaculture and the effluent can be used for cultivation of short-term and long-term ornamental, commercial, and fodder crops (UNEP 2002).

Wastewater has been adopted as one of the major water resources nationwide in China, especially in the northern area of coastal cities. The main potential applications for reuse of treated wastewater in China are in the following fields:

6. The first and third paragraphs of this section are based on Chia 2001b, with minor alterations.

- Agricultural use through irrigation of crops as well as for improving river amenity;
- Industrial cooling, especially in large industrial enterprises;
- Reuse in municipal public areas, such as watering lawns and trees;
- Flushing toilets in hotels and residential districts; and
- Reuse of the treated wastewater for urban landscaping purposes.

Many municipalities set wastewater reuse as a strategy to meet increasing water demand. To identify the alternatives of wastewater reuse as well as their feasibility and implementation, some cities where water shortages and pollution are very serious problems, such as Beijing, Tianjin, Taiyuan, Dailian, and Qingtao, have been selected as pilot areas for this purpose.

Treatment and reuse of the wastewater from a guesthouse in Jinan city in Shandon Province is an example of reuse of treated wastewater for non-potable purposes in a water-short area. The wastewater is first given rotating disc biological treatment followed by filtration and disinfection. The treated wastewater is reused for watering grass, maintaining water level in a lake, washing cars, and flushing toilets. In another example, a wastewater treatment plant with a capacity of 50,000 m^3/day was built in Tai Yuan City, Shanxi Province from which 20,000 m^3/day is reused for industrial cooling and landscaping purposes after reclamation by tertiary treatment. By 2000, more than 20 percent of total discharged wastewater in municipal areas of China was treated, and 10 percent of treated wastewater was reused (UNEP 2002) .

8. Uses for excrement and sludge

There are valuable nutrients in human (and animal) excrement that for centuries have been used directly as fertilizers and soil conditioners for growing vegetables and horticulture as well as to fertilize fishponds (Chia 2001a; Fauziah and Rosenani 1996). This practice has, however, been the cause of many waterborne diseases that constitute a major health hazard in many countries. Sludge biogas reactors, designed for village-scale use, have been in existence for a long time in China, Vietnam, and elsewhere. In the construction industry, sludge is also used to make pavement bricks and other building materials. One of the most promising technologies is sludge composting.[7]

The recycling of sludge arising from wastewater treatment is to be encouraged, and disposal of sludge to surface waters should be phased out. It is necessary to monitor treatment plants, receiving waters and the disposal of sludge to ensure that the environment is protected from the adverse effects of the discharge of waste waters (European Economic Community 1991). It is also important to ensure that information on the disposal of wastewater and sludge is made available to the public in the form of periodic reports.

9. Graywater and blackwater separation

Graywater is wastewater from showers, sinks, washing machines, and similar sources, while blackwater is wastewater specifically from toilets. It is not necessary to mix graywater and blackwater.

7. This paragraph is based on Chia 2001b, with minor alterations.

Because it contains far less organic material than blackwater, graywater does not require the same treatment process. By designing plumbing systems to separate it from blackwater, graywater can be recycled for irrigation, toilets, and exterior washing, resulting in water conservation. Also, graywater decomposes much faster than does blackwater; therefore, if graywater is injected into bio-active soil near the surface, groundwater is better protected from organic pollution than it would be if combined graywater and blackwater were injected, since the treatment takes place rapidly in the soil and is practically finished two to three feet below the surface. Graywater contains only one-tenth of the nitrogen contained in blackwater. Nitrogen (in the form of nitrites and nitrates) is the most serious and difficult-to-remove pollutant affecting drinking water. Furthermore, the nitrogen found in graywater is around half organic nitrogen (that is, tied to organic matter) and can be filtered out and used by plants (Lindstrom 2000). Blackwater can be diverted from wastewater systems by introducing non-flushing toilets. This should be considered especially in water-short suburban areas as it can reduce water use and establish new nutrient cycles between urban areas and agricultural regions.

10. Urine separation

Blackwater can by further broken down by separating urine from faeces. From urine, a nutritious fertilizer can be obtained and groundwater, lakes, and sea can be protected from over-fertilization, which leads to eutrophication, which can increase algal growth and in turn lead to lack of oxygen in the water, causing seabed fauna to die and fish to migrate away. From traditional water-closet sewage, it is possible to retrieve about 98 percent of the nitrogen, 68 percent of the phosphorous, and 85 percent of the potassium in urine. These nutrients are in the perfect composition to be taken up by plants. Spreading the urine on farmlands also reduces the need for artificial fertilizers (Verna Ecology 2001). Urine-separating toilets differ from standard toilets in that they have a bowl in the front for urine, with the faeces going to the rear. In the majority, the forward bowl is flushed to a storage tank using a small quantity of water. The faeces either are flushed to a sewage-treatment system or are composted, with no contact with water at all, for use in plant cultivation.

11. Industrial waste prevention

Industrial wastewater entering collecting systems, and discharge of wastewater and disposal of sludge from urban wastewater treatment plants, should be regulated. Industrial wastewater entering collecting systems and urban wastewater treatment plants should be subjected to pre-treatment in order to:

- Protect the health of staff working in collecting systems and treatment plants;
- Ensure that collecting systems, treatment plants, and associated equipment are not damaged;
- Ensure that the operation of wastewater treatment plants and treatment of sludge are not impeded;
- Ensure that discharge from treatment plants does not adversely affect the environment, including the water bodies into which it is discharged; and
- Ensure that sludge can be disposed of safety in an environmentally acceptable manner (European Economic Community 1991).

One possible solution for industrial waste treatment is the common effluent treatment plant (CETP) for several small-scale and medium-scale industries. Under the World Bank-aided Industrial Pollution Control Project there is a provision of loan and grant assistance to proposals of construction of CETPs for the treatment of effluents from a cluster of industries, particularly small-scale industries (Central Pollution Control Board 1999).

At present, there are 18 CETP sites for tannery clusters in five districts of Tamil Nadu, India. Out of these, 11 CETPs are in operation and the rest are under construction.

12. Conclusions

There is much work to do to make wastewater management sustainable in the rapidly growing cities of developing Asia. However, experience and innovation from around world offer a range of solutions to the existing problems, if only the resources and, more importantly, the political will can be found. The first major observation is that governments need to take a watershed approach while planning wastewater management in urban areas. It helps in identifying the most cost-effective pollution-control strategies to meet clean water goals. For major cities with highly populated areas, large centralized sewerage systems are generally the most efficient and are sometimes even essential, with advanced wastewater-treatment facilities for nutrient reduction and possible reuse. For medium-scale cities with limited resources and funding, simple treatment technologies with lower O&M costs have been found to be very promising. For peri-urban areas and small cities, decentralized systems are very suitable. In addition, certain new concepts of sanitation should be considered as these can have multiple benefits, both economic and environmental. Nutrients in wastewater can be captured and reused in agriculture by separating urine, graywater, and blackwater, or by simple use of sludge as fertilizer. Reuse of wastewater in a variety of applications can significantly reduce the need for fresh water, reducing the demands urban areas make on the surrounding environment and mitigating water shortages in dry and semi-arid areas. Clearly there are many options available that might help to make wastewater treatment more sustainable. An exchange of views, scientific data, and practices to compare experiences would yield invaluable insights into better ways of managing urban wastewater in Asia.

References

Alaerts, G. J., S. Veenstra, M. Bentvelsen, and L. A. van Duijl. 1990. Feasibility of anaerobic sewage treatment in sanitation strategies in developing countries. report no. 20. Delft, Netherlands: International Institute for Infrastructural, Hydraulic, and Environmental Engineering.

Central Pollution Control Board. 1999. Common effluent treatment plants: Performance evaluation of operational projects. New Delhi: Central Pollution Control Board.

———. 2000a. Status of water and wastewater generation, collection, treatment and disposal in class-I cities. New Delhi: Central Pollution Control Board.

———. 2000b..Status of water and wastewater generation, collection, treatment and disposal in class-II towns. New Delhi: Central Pollution Control Board.

Chia L. S. 2001a. Overview of impact of sewage on the marine environment of East Asia: Social and economic opportunities. Bangkok: United Nations Environment Programme, Regional Coordinating Unit.

———. 2001b. Innovative solutions for control and treatment of sewage. Background paper no. 2, Regional Meeting on Municipal Wastewater Management in Eastern Asia and North-West Pacific, 24–28 September 2001, Toyama, Japan. http://www.gpa.unep.org/pollute/documents/SAP/regional meeting documents/Toyama Background_Paper_2 v31.pdf

Earth Tech. 2004. Yannawa—Bangkok Metropolitan Authority. http://www.sbrcass.com/yannawa.htm.

European Economic Community. 1991. The Urban Waste Water Treatment Directive and its requirements: Directive 91/271/EEC on Urban Waste Water Treatment. http://europa.eu.int/comm/environment/water/water-urbanwaste/directiv.html.

Fauziah, I. and A. B. Rosenani. 1996. Animal wastes and the environment: Malaysian perspectives. Journal of Environmental Research and Management Association of Malaysia. 9:33-41.

Japan Sewage Works Association. 2004. Sewage works in Japan 2004, Tokyo: Japan Sewage Works Association.

Journey, W. K. and S. McNiven. 1996. Anaerobic enhanced treatment of wastewater and options for further treatment. Washington, DC: ACDI/VOCA.Available at the SCDI/VOCA Web site: http://www.acdivoca.org.

Lindstrom, C. 2000. Pollution. http://www.greywater.com/pollution.htm.

Maniam, N. 2004. Report from participant in Sewage Works Engineering III: The development of sewerage systems in Malaysia. Sewerage Business Management Centre Newsletter 2(1). http://www.sbmc.or.jp/english/malaysia/malaysia01/malaysia1.html.

Ministry of Environment and Forests, India. 2002. Annual report 2001–2002. New Delhi: Ministry of Environment and Forests. http://envfor.nic.in/report/report.html.

Ministry of Environment, Korea. 2004. Intregrated system of sewage and excreta management. http://eng.me.go.kr/user/policies /4_water_supply.html..

National River Conservation Directorate, India. 2002. Technology. http://envfor.nic.in/nrcd/tech.html.

Ogoshi, M., Y. Suzuki, and T. Asano. 2001. Water reuse in Japan. Water Science & Technology 43(10):17–23.

Shuval, H. 1990. Wastewater irrigation in developing countries, UNDP/World Bank Water and Sanitation Program Technical Paper no. 51. Washington, DC: World Bank.

Tokyo Metropolitan Government. 1999. Master plan of water cycle. http://www.gesui.metro.tokyo.jp/english/sewerage.htm.

UNEP. See United Nations Environment Programme

United Nations Environment Programme. 2001. India: State of the environment 2001. United Nations Environment Programme report No.1999EE45.

———.2002. International source book on environmentally sound technologies for wastewater and stormwater management. Osaka, Japan: UNEP International Environmental Technology Centre.

US Environmental Protection Agency (USEPA). 1992. Wastewater treatment/disposal for small communities. USEPA manual EPA/625/R-92-005. Washington, DC: USEPA.

Verna Ecology. 2001. Urine separation: Closing the nutrient cycles. Final report on the research and development project—Source-separated human urine. http://www.stockholmvatten.se/pdf_arkiv/english/Urinsep_eng.pdf.

Water Korea. 2001. Water Korea website. http://www.water.or.kr/engwater/ewk_main.html.

World Bank. 2001. Thailand environment monitor 2000. Washington, DC: World Bank.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 449 – 476, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

Financing Urban Water Supply and Sanitation

Brendan Gillespie[a]

The international community has agreed to halve the proportion of people without access to safe water and sanitation by 2015. Achieving this task is a major challenge that will require strengthened efforts from all stakeholders, and, according to some estimates, a doubling of financial commitment (see Winpenny 2003). Currently, 1.1 billion people do not have access to safe water supply, and 2.4 billion do not have access to basic sanitation. Many of these people live in rural areas, but the challenge is also large, and increasing, in urban areas. The year 2005 will be crucial for the internationally agreed targets, and for other Millennium Development Goals (see Reisen 2004). On present trends it is unlikely that they will be met. To overcome the obstacles to achieving the goals, it is vital that additional measures be agreed in 2005.

Keywords: Water supply, Sanitation, Environmental infrastructure, Finance, Camdessus Report

1. Introduction

At the Millennium Summit in New York, 2000, the international community agreed a target to halve the proportion of the population without sustainable access to safe drinking water by 2015. Two years later, the World Summit on Sustainable Development in Johannesburg adopted a complementary target to halve the proportion of the population without access to basic sanitation, also by 2015. From a humanitarian perspective, these internationally agreed targets for water might be considered as modest: even if they are achieved, more than half a billion people will still not have access to safe water, and more than 1 billion people would not have access to sanitation. On the other hand, the measures that would need to be implemented to achieve the international targets are far reaching. It has been estimated that several hundred thousand people would need to be connected to water services *every day* in order to achieve the targets (see Winpenny 2003). Whether or not these estimates are entirely accurate, they give some indication of the scale of the challenge.

This paper examines the financial dimension of responding to this challenge in urban areas. It begins by examining some of the key policy issues and challenges in financing urban water infrastructure. Subsequent sections examine: the water sector as an element of public policy and the role of financing strategies in making best use of financial resources; the role of external finance; user charges and the need to mitigate or compensate adverse impacts of tariff increases on the poorest social groups; the roles of central and local government; the role of performance contracts in structuring the relations between local authorities and water utilities; and the possible contribution of the private sector.

a. Head, Non-member Countries Division, Environment Directorate, Organisation for Economic Co-operation and Development (OECD), Paris, France. The views expressed in this paper are those of the author and do not necessarily reflect those of OECD or its members.

The paper draws extensively on work conducted by the OECD Environmental Action Programme (EAP) Task Force to support reform of the water supply and sanitation sector in the countries of Eastern Europe, the Caucasus, and Central Asia (EECCA). While many features of the water sector in this region are quite different from those in other transition and developing economies, many of the key challenges and approaches for financing the sector are of general relevance.

2. The challenge of financing urban water infrastructure

Financing water supply and sanitation has two main components: (i) *capital investments* in the infrastructure required to abstract water and to deliver it to consumers, and to collect and treat wastewater; and (ii) finance to *operate and maintain* the infrastructure. A large initial capital outlay is required for water infrastructure that is normally paid off during the lifetime of the assets. Recurrent costs (for energy, chemicals, labor, etc.) are often not given sufficient attention in discussions about finance in the urban water sector. However, recurrent costs are substantial and, over the lifetime of the infrastructure may become more onerous than the capital repayments. Moreover, there are many examples where water infrastructure has been built—often with international support—but local financial resources were insufficient to operate or maintain it.

Financing wastewater collection and treatment entails some specific problems that are not present in relation to water supply. Users are much less willing to pay for treatment of their wastewater than they are for provision of fresh water, since the benefits of the former accrue to downstream communities. As a result, it is often more difficult to finance the major outlays involved in wastewater treatment, especially if fresh water has already been supplied. It is usually cheaper to develop and manage water supply and wastewater infrastructure in an integrated way. However, in many countries this has not happened.

From one point of view, financing water infrastructure is not very complicated: it is either users (present or future) or taxpayers (domestic or foreign) who ultimately pay. However, the issue is complicated by a variety of factors, including: the shared public and private character of water services; the difficulties in designing institutional frameworks and providing incentives for the efficient use of resources; the long timeframes involved, and the concomitant risks and complexity of water projects; and the affordability, and social and political acceptability, of alternative financing arrangements.

Policy principles adopted in OECD countries, such as the user-pays and polluter-pays principles, recommend that users should pay for the services that they consume. In a perfect market, consumers would demand water and sanitation services and private companies would emerge to respond to those demands. However, experience shows that markets do not spontaneously provide water services to all parts of the population, particularly the poorer segments. Moreover, water is not an optional consumer item; it is essential for human life. The UN's Committee on Economic, Social and Cultural Rights recently stated: "The human right to water is indispensable for leading a life in human dignity. It is a prerequisite for the realization of other human rights." Thus, the essential role that water services play in human well-being obliges governments to ensure that all segments of the population have adequate access to them.

Public provision of drinking water, at least up to a minimum amount, also may be justified as a cost-effective public health measure. Water can be considered as a merit good where the social benefits exceed private benefits. If people do not have access to water they will get sick or even die. This will have adverse economic and social consequences. However, beyond a certain level, the "public" character of water becomes "private". Thus, providing consumers with free water to fill swimming pools or to wash the family fleet of cars does not provide a public good; rather it subsidizes private consumption.

The provision of basic sanitation also has a public goods dimension: it is an effective way to prevent public health epidemics. Government intervention may also be needed to ensure that poor and vulnerable groups who have difficulty paying for water have adequate access, or in situations where water resources are being polluted but where it is difficult to identify and control the polluters.

Box 1. Health and economic impacts of inadequate water services

Globally, it has been estimated that polluted water affects the health of 1.2 billion people and is linked to the death of 15 million children per year. Vector-borne diseases such as malaria kill another 1.5–2.7 million people per year, with inadequate water management a key cause of such diseases. The World Health Organization estimates that the benefits of avoiding water-related diseases would amount to US$186 billion, more than three times current ODA levels. It is estimated that total welfare losses from water mismanagement in China amount to 1.3 percent of GDP, with health damage being the dominant factor.

Public-sector support and subsidies to the water sector can also impose a significant fiscal burden on developing countries. One estimate puts the total volume of water-sector subsidies in developing countries at US$20 billion, about 40 percent of total aid flows. The challenge is to ensure that the benefits/cost ratio of the subsidies is as positive as possible.

Source: Hansen and Bhatia 2004.

Thus, there is no question but that governments should be involved in the delivery of water services. The question is rather in what ways they should be involved and, in particular, what their role they should play in financing water infrastructure.

Historically, governments have been the major providers, and financers, of water services. Amongst other things, this has helped to achieve important economies of scale by developing integrated rather than multiple networks for supplying water and treating wastewater. The public utilities that resulted from this process were natural monopolies and their public character was justified in terms of the low costs associated with having one rather than multiple providers, and with the essential, social character of the services provided.

In recent years the role of governments in providing water services has been questioned. Public utilities have been found not necessarily to be either efficient or effective in delivering good-quality services to all segments of the population. In some cases, the institutional set-up has made them obstacles to efficient service delivery. Governments have also faced budget pressures and competing

demands for scarce public funds. In response, many have re-evaluated the role of the public sector, pursued deregulatory policies, and sought to engage the private sector in the provision of many services that had previously been provided by the state, including water. Debates about the relative merits of public and private provision of water services continue, often with much passion. Experience is accumulating of successful and less-successful approaches for managing water utilities. Ultimately, each country, region, or municipality must find its own solution. Disseminating information and drawing lessons learned from experience will hopefully help communities to reach better decisions.

One important conclusion that has emerged from recent debates is that, whatever the arrangement, the government will always have a vital and continuing role in relation to the water sector. However, the role of government is changing, away from direct service provision and toward the facilitation of effective and efficient service delivery. This involves planning, policy, establishing the institutional framework, regulating the monopoly character of utilities, and addressing the social issues related to affordability and access. In most countries, particularly developing and transition economies, governments will continue to play an essential role in financing the water sector.

To make the same point in a different way: *financing* water infrastructure cannot be separated from the *governance* of the water sector—that is, the public institutions that are established to oversee the provision of these services and the legal, policy, and regulatory framework that they operate within. In many developing and transition economies the existing arrangements do not use resources efficiently. Providing additional financial resources to weak or ineffective institutions is unlikely to result in efficient use of resources. In these circumstances, donors and international financial institutions (IFIs) have become more cautious about committing their financial resources—as has the private sector—and they have linked provision of funding to improved water governance.

The adoption of the internationally agreed targets for water was intended to help focus international cooperation more effectively on key challenges that need to be overcome. Many of these challenges were analyzed in the report of the World Panel on Financing Water Infrastructure, *Financing Water for All* (Winpenny 2003), often referred to as the Camdessus Report after the panel's chair, Michel Camdessus. The report has been widely recognized as an authoritative presentation of the state of the art and has become a yardstick against which all parties can measure themselves. Some of the major findings of the Camdessus Report are presented in box 2.

3. Financing options and the role of national and regional financing strategies

The Camdessus Report argued that developing and transition economies did not always assign sufficient priority to the water sector in national economic development strategies. More could be done in most developing and transition economies to assess the economic and social costs associated with inadequate water supply and sanitation services. The health impacts alone are often substantial. Documenting these impacts could help persuade economics and finance ministers to enhance the priority assigned to water issues, not least in budget allocations. Inclusion of water and other internationally agreed targets in national development strategies such as Poverty Reduction Strategy

Papers could facilitate increased flows from donors. Indeed, donors have complained that it is difficult for them to increase allocations for water when this issue is not prioritized by the countries concerned (Bojo and Reddy 2003).

Box 2. The Camdessus Report: Some key findings

- Attainment of the internationally agreed water targets should be the main focus of national and international efforts.
- Financial flows into the water sector from all sources would need to roughly double in order to achieve these targets.
- While mobilizing much larger volumes of finance will be a prerequisite for achieving the targets, fundamental problems in the governance of the sector will also need to be addressed if it is to generate and attract this finance.
- Better cost recovery from users is vital. However, full cost recovery is unlikely to be achieved easily or quickly. The Panel endorsed the concept of "sustainable cost recovery", consisting of improved efforts to raise revenues from users, with residual subsidies applied in a predictable, transparent, and targeted manner.
- National public funding is, and for the foreseeable future will remain, the main source of investment finance for this sector in many countries. National governments should raise the priority of the water sector in their national investment strategies and make their funding of it more reliable.
- National governments should also establish the policy and institutional framework to enable subnational entities, such as municipalities, regional water boards, and water utilities, to generate and attract finance for investment.
- The choice of organizational model for the water sector (for example, public, private, or the various permutations involving both) is a matter for local decision. The key issue is how to establish the conditions for the effective and efficient delivery of water services.
- More could be done to promote local capital and financial markets as sources of finance for investments in the water sector. This would avoid foreign exchange risk which is one of the main deterrents to the use of external finance.
- Donor governments and external agencies should aim to make substantial increases in the share of their total commitments allotted to the water sector, improve the coordination of their activities, and use their funds as catalysts to mobilize other flows. IFIs could provide more support to mitigate the risks of investment in the water sector and take steps to remove obstacles to their lending to sub-sovereign entities.
- Governments, international institutions, and other key players should be held to account for their commitments and performance against the internationally agreed water targets.

Even if water is prioritized in national development strategies, a detailed sectoral plan needs to be developed. Ideally such a plan should identify clear objectives and the means for achieving them; financial, policy, and institutional reform and capacities. Often, sectoral plans prepared by developing and transition economies are unrealistic and fail to establish an achievable set of objectives. In particular, financial issues are not adequately addressed—the costs of achieving goals; how the costs could be minimized; and the challenge of matching costs with projections of the financial resources that are likely to be available.

To try to help bridge this gap, the Danish government and the OECD have developed a decision-support tool that helps identify possible scenarios for financing the achievement of national or regional water infrastructure goals. This tool, the FEASIBLE model,[1] helps to assess the financial affordability of achieving goals, both for national budgets and for households paying user charges. It supports an iterative process that aims to establish a consensus on realistic goals and how they will be financed. Its application in the former Soviet Union and in China has also helped to identify critical policy and institutional reforms that could de-block increased financial flows. It also helps to focus attention on any measures that might be needed to mitigate the impacts of increased tariffs on low-income households.

Figure 1 summarizes some of the results obtained through the development of financing strategies in the countries of the former Soviet Union and China. It shows that user charges in the former Soviet Union account for between 50 and 90 percent of finance for water and wastewater utilities. In Sichaun Province, China, by contrast, public budgets account for about 80 percent of finance for wastewater utilities. In all cases, the contribution from other sources, including donors and IFIs, is very small.

Ideally, the elaboration of financing strategies should not be a one-off exercise; nor is it a purely an analytical exercise. It should be treated as an iterative process, refined and modified in the light of data and experience, enabling decision makers to make more informed trade-offs. By engaging all the main stakeholders, it can become an important tool in consensus building. The participation of economics and finance ministers together with ministers responsible for the water sector helps to establish a close link between policy development and implementation, which is crucially lacking in many countries.

a. Issues in formulation of finance strategies

At a recent OECD meeting,[2] participants identified a number of issues relevant to the formulation of finance strategies for water infrastructure:

Firstly, there is no “magic bullet” to solve the problem of financing water. Although reform and innovation is needed in financial instruments and financial engineering, a paradigm shift is unlikely. All sources of finance will need to be combined carefully to enhance synergies, avoid crowding out other sources, and maximize leverage on the total flows.

1. Access to the FEASIBLE model is available free of charge at www.oecd.org/env/finance. A review of experience with the application of this tool can be found in OECD 2003a.
2. Global Forum on Sustainable Development: Financing Water and Environmental Infrastructure for All, Paris, 18 December 2003. See OECD 2004c for a report of the Global Forum. See also OECD 2004b.

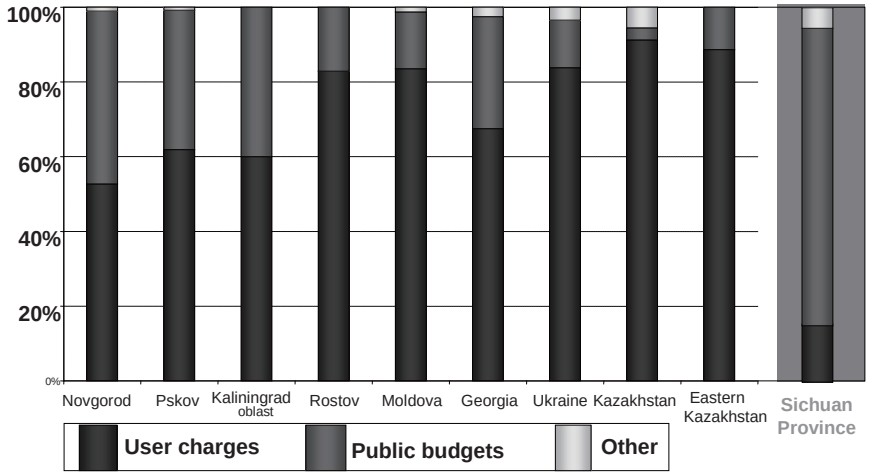


Figure 1. Shares of different sources in financing water and wastewater utilities

Some cities and regions may have to move faster than others. Sequencing of actions is essential, and should start with measures that yield large benefits and/or cash savings with low capital costs. Sophisticated and expensive solutions, especially if they yield small incremental benefits, should be postponed until they are affordable.

Investment targets are often too ambitious and local policymakers should not be pressured by donors or IFIs to accept unrealistic targets for infrastructure development. Even if they can be financed, a high investment rate may place unbearable pressure on weak institutions and outstrip the growth in income necessary to generate revenue for sustainable operation and maintenance.

Capital investments do not always lead to effective provision of services. There are examples in China and Eastern Europe where relatively new facilities, in particular wastewater treatment plants, have not been fully operated, with frequent shutdowns and, in some cases, abandonment. Donors and IFIs sometimes add to the pressures by encouraging and financing capital investments in overly ambitious and expensive technological solutions that local communities are unable to operate and repair.

The gradual increase of user fees to cost-recovery levels is essential for financial sustainability, but the increases should be at a realistic pace. Measures to mitigate the potentially adverse impacts of tariff increases on poor and vulnerable groups, and to ensure their access to water services, should be explicitly identified and costed. Sizeable cash flow can often be generated from users without increasing user fees, for example by increasing collection rates and making billing systems more reliable and user friendly.

Improvements in billing and collection, through metering, for example, should be introduced carefully, especially in utilities that have a high proportion of non-revenue water (for example, in Lesotho 96 percent and in Armenia 80 percent of water entering the system is unaccounted for). In such cases moving from block rates to individual metering of consumption can decrease utility revenues in the short term, although in the longer term it is a necessary incentive to reduce water losses and overall utility costs.

National governments are, and will remain, a major source of finance, particularly for capital investments.

Box 3. Finance strategy for wastewater in Sichuan Province: Implications for water governance

China's rapid urbanization is generating a demand for urban infrastructure that is calling into question existing policy, institutional and financial arrangements. OECD recently concluded a study to develop a strategy to finance wastewater infrastructure in Sichuan Province, including related changes in the governance of the water sector that would need to be implemented. The overall conclusion of the study was that on present trends, wastewater infrastructure development targets would not be met; these targets are broadly comparable to the water-related Millennium Development Goals which aim to halve the proportion of people without access to safe water and sanitation by 2015.

Current financing arrangements in Sichuan Province rely excessively on public budgets, and would be unsustainable in the future. The report analyses various finance options and suggests that both users and taxpayers will need to pay more. At the same time, it identified some regulatory and institutional reforms that would need to accompany efforts to mobilize additional financial resources, including:

- The institutional arrangements for the wastewater sector at the national level do not allow resources to be used in the most efficient manner. They are biased in favor of construction of treatment plants, whereas the greatest need for capital expenditure is for sewage networks.
- The existing tariff system should be reformed. Water tariffs are kept well below cost-recovery levels, ostensibly to protect the poor. However, this is undermining the financial sustainability of the sector and benefiting richer segments of the population as much, if not more than, the poor. Tariff reform, together with more targeted subsidies for the poor would lead to more efficient use of public funds and reduce demand for water resources and related infrastructure.
- The projected financial burdens on taxpayers and users suggest that more will need to be done to spread the increase of user charges over time by greater recourse to debt financing. However, this implies that current legislation prohibiting municipalities from borrowing from commercial banks, issuing bonds or extending guarantees to municipal utilities would have to be reformed. This is turn would involve broad reform of the municipal finance framework to ensure, *inter alia*, that municipalities did not incur excessive debt.
- Relations between municipalities and water utilities should be redefined. Currently, local governments provide implicit, unsanctioned guarantees to utilities to borrow from commercial banks. It is not clear what the level of this "hidden" municipal debt might be. Allowing municipalities to raise debt financing would address this problem.

Box 3—*Continued*

- The status of water utilities should be re-assessed. Property rights to infrastructure should be clarified. Utilities should be given more financial and operational autonomy, and held accountable for it. For wastewater utilities, this would mean granting them authority to collect user charges (they do not have this of present) and to use the revenues to finance their operations. This would also generate more incentives for efficiency. Consideration should also be given to merging water supply and wastewater-utilities, or at least providing for joint billing and collection. This would increase efficiency, better help to address non-payment and help increase the willingness-to-pay of consumers for wastewater services.

Source: OECD 2004a.

Public subsidies from domestic and foreign assistance need to be applied more strategically in order to galvanize more flows from other sources. Public funds would be more effective if they were disbursed on achieved results (output based), used in "smart blending" (that is, in an optimal combination) with other sources, and used in risk-sharing through guarantees and insurance instruments. Care must be taken to avoid potentially adverse effects of soft financing (see box 3).

4. External finance

Except in a few very poor countries, domestic rather than external resources will be the dominant source of finance. Nevertheless, external finance, whether concessional (for example, grants or soft loans) or non-concessional (IFI loans), can play an important catalytic and demonstration role. External finance can support financial and governance reforms in the sector, build capacities, and introduce international disciplines and good practices. On the other hand, care must be taken to avoid crowding out domestic financial sources, inducing subsidy dependence, or removing incentives for essential reforms.

If the internationally agreed water targets are to be achieved, official development assistance (ODA) would need to rise substantially (the Camdessus Report argued that ODA would have to at least double). The need for increased levels of ODA was recognized at the International Conference on Financing for Development held in Monterrey, Mexico, 18–22 March 2002.[3] The "Monterrey Consensus" established a new international partnership for achieving internationally agreed development goals, including the Millennium Development Goals. Essentially, developing countries pledged to promote sound policy reform, good governance, and increased domestic financial resource mobilization in return for increased international financial flows.

Examining ODA flows is instructive in this regard. The OECD Secretariat recently issued a report analyzing aid flows for the water sector.[4] Data were only available until 2002 so it is not yet possible to determine whether the Johannesburg World Summit on Sustainable Development or the Monterrey

3. See the UN Department for Economic and Social Affairs website on Financing for Development: http://www.un.org/esa/ffd.
4. Secretariat to the DAC, "Aid for Water Supply and Sanitation" (paper presented at the Stockholm World Water Week, August 2004).

Conference have had an impact on aid flows to the water sector. The following chart (figure 2) shows trends in aid to water supply and sanitation from 1973 to 2002.

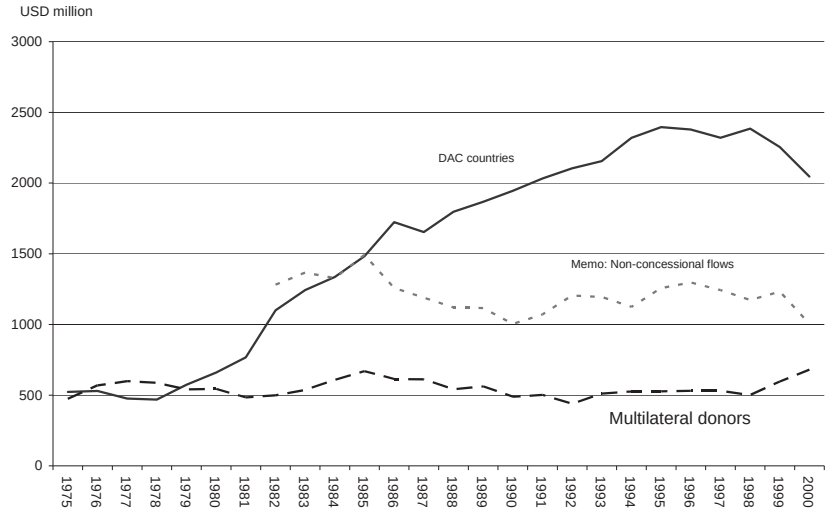


Figure 2. Trends in aid to water supply and sanitation, 1973–2002

Note: Five-year moving averages, constant 2002 prices.
Source: OECD Development Cooperation Directorate (DAC), Creditor Reporting System

Some of the main findings from the OECD Secretariat report can be summarized as follows:

- Concessional aid flows from donors peaked in about 1994, remained roughly constant until 1998, and thereafter declined;
- Non-concessional flows increased during the 1990s, but ended the decade at about the same level as at its start;
- Half of the commitments made to donors were allocated to just 10 countries: China, Palestine, Vietnam, India, Jordan, Egypt, Nepal, Morocco, Bangladesh, and Turkey;
- A very significant proportion of resources was allocated to countries where access to water and sanitation services was already relatively high; however, it is not clear whether or not the resources were used to improve access to services within the country.
- On average, the gap between commitment and disbursement of water-related aid was *eight years*. This suggests that there are important bottlenecks that need to be overcome to implement donor-supported aid projects.

Although some care must be taken in interpreting these data, they do not seem to suggest that, following current trends, ODA will be sufficient to achieve the internationally agreed water targets.

Some more encouraging information was reviewed at a high-level meeting of OECD's Development Assistance Committee, 15–16 April 2004 (OECD 2004d). On the basis of data provided by donors, the committee concluded that the overall level of ODA had increased over the preceding two years by 11

percent. This upward trend reverses a decade of declining budgets. Pledges made by donors following the Monterrey Conference suggest that overall levels of aid could increase by a further 25 percent. While these trends are encouraging, the high-level officials at the meeting recognized that there was no room for complacency and that the additional aid by itself would not be sufficient to meet the internationally agreed water targets. They stressed the need for further policy reform and capacity building in developing countries and reiterated the importance of prioritizing the international targets in the main national development strategies such as Poverty Reduction Strategy Papers. It remains to be seen what these new trends will mean for achieving the international targets.

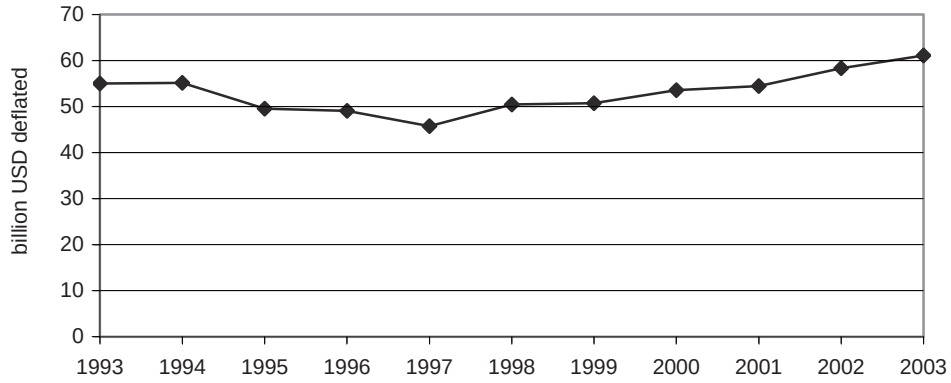


Figure 3. Net ODA from OECD Development Aid Committee countries to developing countries and multilateral organizations, 1993–2003

Note: ODA calculated using 2002 prices and exchange rates. 2003 data are preliminary.
Source: OECD DAC activity databases.

Whatever the level of ODA flow, more could be done to improve its effectiveness and to improve coordination between donors. Some donors are now moving away from financing individual water projects to establishing local, financially sustainable, financing mechanisms. Greater use is also being made of output-based budgeting that focuses on achieving development outcomes, such as a number of increased connections, rather than focusing on inputs such as provision of pipes and pumps. Many donors are also working to strengthen the pro-poor dimension of their activities, amongst other things by finding ways to finance shortfalls in consumers' ability to pay when tariffs are increased.

Non-concessional loans from IFIs are important sources of long-term investment capital for developing countries, and are generally offered on terms that are more favorable than those available on local capital and financial markets; interest rates may be lower and/or the payback period longer. Substantial resources are available from the World Bank and regional development banks for loans to municipalities and water utilities, but there are a number of key bottlenecks that constrain their wider use.

For one thing, there is often a lack of bankable projects—that is projects where the IFI has sufficient confidence that the loan will be repaid. This may be because of a lack of capacity for project preparation or because the risks associated with proposed projects are unacceptably high. Projects may have to be above a threshold as high as US$10 million to justify the transaction costs for the IFI. This obstacle can sometimes be overcome by bundling projects so that the value of the sum exceeds the threshold.

Governments may be unwilling or unable to borrow. Debts have to be repaid, typically either from public budgets or from user charges, and most IFIs require governments to provide a sovereign guarantee that this will indeed happen. Governments may be unwilling or unable to take on this additional obligation. If countries are heavily indebted and receiving support from the International Monetary Fund, the Fund may prohibit the country from taking on any additional debt. Some IFIs such as the European Bank for Reconstruction and Development are authorized to issue loans on the basis of a sub-sovereign guarantee—from a municipality, for example. While this creates more flexibility, the requirements to justify that the loan will be repaid are no less demanding than in the case of sovereign guarantees.

Loans to IFIs have to be repaid in foreign currency such as US dollars. However, the revenues to repay the loan are generated in local currency. When the local currency devalues against the currency in which the loan must be repaid, this can result in a sudden and substantial increase in the schedule for repayments, placing an unforeseen burden on public resources that may be already stretched. Guarantees can help to offset currency risks, but they are not cost free. Following the advice of the Camdessus Report, IFIs have taken a number of measures to enhance the use of guarantee instruments (see Winpenny 2004).

Donors work with IFIs to make loans more accessible to developing countries. Usually this takes the form of providing grant support to help prepare bankable projects, to soften the terms of the loan, or to build capacities that are needed to implement the loan. One mechanism that was established specifically for this purpose is the Project Preparation Committee (PPC), a network of donors and IFIs who work together to accelerate the development and implementation of IFI loans through the provision of grant support.[5]

5. User charges and their social impacts

The preceding discussion suggests that the internationally agreed water targets will not be achieved without increases in user charges; in some cases, substantial increases. Indeed, failure to move in the direction of charging consumers for the costs of providing water services has a number of perverse effects: it inflates demand for water and sanitation services and hence investment needs; it creates vested interests and dependence on the subsidies that governments provide in place of user charges; it undermines efforts to put the sector on a more financially sustainable basis; it results in chronic under-funding of utilities and deterioration of assets; and more generally it impedes reform of the governance of the water sector.

5. See the PPC website: http://www.ppcenvironment.org.

It is sometimes argued that water is a basic right or a "gift of god"—something that people are entitled to and should not have to pay for. However one regards water, it is also true that its provision to urban populations requires pipes, pumps, and other materials as well as labor and institutions to make it all happen. These cost money and someone has to pay, ultimately users and/or taxpayers.

Probably the main obstacle to water pricing has been its perceived social impacts, and their political consequences. In OECD countries, taxpayers rather than consumers have financed the bulk of investments in water infrastructure. Although many OECD countries have achieved full cost recovery there are still some where user charges are below this level. Those countries that have reached full cost recovery have done it over several decades. Hence, full cost recovery is probably a distant objective for most developing countries. Nevertheless, there are opportunities to move progressively in this direction, while ensuring that poor and vulnerable groups have access to water services. Indeed, there is probably no alternative: governments in developing countries may not be able to afford to emulate the policies followed in OECD countries where public finance (taxpayers) was the dominant source of finance.

Box 4. Tariff-setting and affordability in Poznan, Poland

The tariff-setting mechanism in Poland has been established so as to minimize obstacles to raising tariffs for political reasons. Utilities are required to develop rolling, long-term development plans which cover all aspects of their activities. Each year they must submit these plans, together with proposals for tariff adjustments, to the city council via the mayor, at least 70 days before any tariff adjustment is due to take effect. If the council accepts the utility's development plan, and if the mayor determines that the tariff adjustments have been established in accordance with national law and are necessary to achieve the planned results, then the tariff adjustments must be approved. If the council does not approve the proposed tariff adjustments within 45 days, they are approved automatically. If the council considers that there is an affordability problem, it may decide that the tariffs for all or some consumers should be increased by less than proposed. However, the resources to finance the subsidy to the designated consumers must be drawn from the city budget and transferred to the utility. More generally, support for poor households is provided through social services that are financed by the municipality. Recently the utility in Poznan set up a small fund to alleviate difficulties that poor families may encounter because of increased tariffs, which has helped support the political acceptability of tariff increases.

Source: Kayser 2004.

Water services often fail to reach the poor, who bear the main burden of inadequate access, service deficits, poor water quality, unreliable supplies, and unsanitary disposal of wastewater and solid waste. Subsidies are often justified in terms of keeping services affordable to poor households, but there is mounting evidence that they are often not well targeted and not very effective. Instead of benefiting the poor (who are frequently not connected to water distribution and sanitation networks), such subsidies often benefit richer people who are capable of paying the full costs of water services. The effectiveness

of public spending on water infrastructure could be much increased if subsidies were restructured and better targeted.

Water charges are not a significant burden on most households in OECD countries; typically they account for less than 1 percent of household income (OECD 2003b). However, in developing and transition economies they may represent a more significant portion of income (see, for example, OECD Environmental Action Programme Task Force 2003). International financial institutions often use a benchmark of 4–5 percent of household income for water tariffs when they plan water infrastructure investment projects. However, such estimates need to be complemented by more detailed analyses of how projected tariff levels would impact different income groups. For example, projected tariffs may be less than 4 percent of *average* household income, but for the poorest 25 percent of the population they might represent 5–20 percent of income. It would not be feasible to introduce such a tariff policy unless measures were taken to mitigate the impact of the increased user charges on these groups.

In OECD countries, a variety of approaches have been developed to mitigate or offset the impacts of tariff increases on the poorer sections of the community.

- *Income support.* Measures providing income support aim to compensate poor households for tariff increases that are judged to be unacceptably burdensome. The support may be directly linked to water use. For example, support may be provided if the water bill is above a certain percentage of household income, or may be calculated to maintain an absolute level of income after the utility bill is paid. It can be paid either directly by the government to the utility or through a voucher system. This type of support represents a financial burden on the state and reduces incentives to conserve water. Alternatively, the support may not be linked to water consumption, but to income levels. The people receiving the support can choose themselves how to spend it—on water or on other goods and services. In this way, the costs fall on the state budget rather than the utility. If combined with appropriate water charges, it does not encourage over-consumption of water.
- *Tariff-related measures.* The tariff structure can be designed in such a way as to mitigate the potentially adverse impacts of tariff increases on poor households. The approach used in an increasing number of OECD countries involves a “block-tariff” structure. In this approach, the price paid is linked to the amount of water consumed, and the charge levied for each unit or “block” of water used increases with the total amount used. The initial block may be free or charged at a very low rate, assuring that poor households have access to a basic level of water services for free or at low cost. The system needs to be designed to take account of the number of people in each household in order to avoid penalizing larger families. This system can move in the direction of full cost recovery by providing a cross-subsidy from households that use lots of water to those that use little water. It can be implemented by the utility and does not draw on the central government budget. It also provides a very strong incentive to conserve water, and targets those who use little water for the subsidies rather than all water users. But the drawback is the need for metering of water use—which can involve high upfront costs and, sometimes, social opposition.

- *Facilitating payments*: In many countries, householders are not disconnected from the water supply system even if they are unable to afford their water bills. In part this is because water is essential for life and dignity, but also because of the high reconnection costs. In such cases, utilities in many OECD countries work with consumers to make them aware of how to reduce water consumption, to manage their budgets by paying water bills at short intervals, and to provide other forms of advice and assistance to ensure that consumers have access to water services but pay their bills.

Box 5. Chile's voucher system for subsidizing water costs

The approach to target subsidies for water use on the poorest households that has been developed in Chile is often considered as an intelligent balance between efficiency and equity considerations. Municipalities pay utilities directly a subsidy for poor households based on the bill for water consumed. The subsidy covers a fixed portion of the bill, with the household liable for the charge (water consumed) above this level. However, the subsidy is cancelled if the household does not pay its part of the bill. Thus the system provides incentives to conserve water while ensuring the provision of a basic level of service. It also enables the utility to move in the direction of full cost recovery and financial autonomy. The drawback, particularly for developing and transition countries, is that it requires a strong local administrative capacity, coupled with a high government commitment.

Studies that assess consumers' willingness to pay can also provide important information in relation to user charges. Analyses conducted in the countries of the former Soviet Union and elsewhere suggest that consumers are often willing and able to pay more for water services than is frequently thought Detailed studies are also important because they can reveal the upper limit of the proportion of their income that people are ready to spend on water, and therefore help policymakers to establish affordable tariff levels. This suggests that studies of this kind can help design policies that can generate the revenues that are needed to finance water infrastructure while ensuring that poor and vulnerable groups have access to water services.

6. The role of central and local governments

In the mid-1990s, it was estimated that the domestic public sector provided 65–70 percent of capital investments in the water and sanitation sectors. No doubt the public sector will continue to play a major role in this regard for some time to come. At the same time, government has the responsibility to establish the policy and institutional framework needed to mobilize financial resources for the sector and to ensure that water services are delivered to the population efficiently and effectively. Establishing clear responsibilities for institutions and making them accountable is fundamental to this task. In the water sector it is particularly important to clarify responsibilities for policymaking, regulation, and service delivery.

One approach to addressing these issues is set out in the Almaty Guiding Principles for Reform of the Urban Water Supply and Sanitation Sector in the New Independent States, which were adopted by

ministers of economy, finance, and environment from the countries of the former Soviet Union (see OECD 2001). Amongst other things, the Guiding Principles suggest how the roles of central government, local government, and water utilities (*vodokanals)* should be clarified.

One of the key governance issues affecting the financing of water infrastructure is fiscal decentralization (see Shah 2004). This has three main components:

- The ability of local governments to raise revenues to meet their delegated responsibilities,
- The autonomy of local governments to make expenditures, and
- The authority of local governments to incur debt.

Local governments should have the means to raise revenues to carry out the responsibilities that they have been assigned. In principle, revenue raising should be closely linked to expenditure at the local level; this increases the accountability of local officials to the electorate. However, in developing and transition economies, tax and expenditure responsibilities are assigned more to central governments than in OECD countries. This is often because of concerns about the capacity, integrity, and fiscal discipline of local governments. Adequate controls of local government are certainly necessary as a country's fiscal policy and credit rating can be jeopardized by excessive local debt.

The gap between the revenues that local governments are able to raise themselves and what they spend is generally accounted for by inter-governmental transfers. Indeed, intergovernmental transfers are the dominant source of revenues for sub-national governments in most developing and transition economies. The design of these transfer mechanisms can have an important bearing on the efficiency and effectiveness of local service provision. To date there has been little if any analysis of how these transfers might best be structured for the water sector.

Central governments' concerns have also led them to place restrictions on local governments' access to credit. In many developing and transition economies, municipal governments have limited or no access to either domestic or foreign finance. In some cases, this may create a paradox whereby local capital and financial markets are developing but local governments cannot access them to finance water and other municipal infrastructure. In OECD countries, the financing of water infrastructure has been dependent on the possibility that municipalities can incur debt: in Western Europe this was usually through commercial bank lending, and in North America through municipal bonds. The Camdessus Report recommends that more should be done to facilitate access to local capital and financial markets in developing and transition economies to finance water infrastructure (Petersen 2002).

Fiscal decentralization is one of the key governance challenges facing many developing and transition economies. Success in this area could also have an important bearing on the achievement of the internationally agreed water targets. More could be done to help strengthen local governments and to enhance their creditworthiness. This would facilitate their access to local capital and financial markets within a clear, prudent framework established by central government. Support could be provided to improve the quality and transparency of local government budgeting; to develop multiyear (rather than annual) investment plans; to conduct project selection and public procurement fairly and transparently; and to develop the capacity to manage debt.

Box 6. The recommended role of national authorities contained in the Almaty Guiding Principles for Reform of the Urban Water Supply and Sanitation Sector in the New Independent States of the Former Soviet Union

The Role of the National Authorities should be to set the framework for managing urban water supply and sanitation by:

Decentralization:

decentralising responsibility for water supply and sanitation services to the municipal level, avoiding excessive fragmentation.

establishing the legal, regulatory and institutional framework for sound and sustainable municipal finance, including effective planning, supervision and fiscal control systems for municipalities.

clarifying the legal status of vodokanals, their relations with local governments and property rights for infrastructure.

establishing a framework for treating the inherited debts of vodokanals.

Regulatory Oversight:

depending on the particular circumstances in a country, consider establishing an independent, national regulatory agency to ensure that vodokanals do not exploit a monopoly position and/or to protect them from undue political interference. In such cases, the objectives of the regulation should be clearly identified and appropriate means for achieving them provided.

regulating issues that have national or inter-municipal dimension, such as standards for environmental quality, wastewater discharge and drinking water; and establishing the legal framework to facilitate water and sanitation management initiatives undertaken jointly by groups of municipalities.

establishing the legal and regulatory framework for stakeholder involvement, including private sector participation and consumer protection.

establishing a framework for managing the competitive uses of water at the national and regional levels, including principles and rules for the management of different water resources, and policies for integrating municipal water and sanitation systems into coherent programs for water resources management within river basins.

ensuring that an adequate system for monitoring water quality is in place and that the results are available to the public.

Strategy Formulation and Technical Assistance

defining strategic policies and development objectives, including investment strategies and the means for financing them; such policies and investment strategies should strike an appropriate balance between water supply and sanitation objectives.

providing assistance to utilities and local governments in areas such as capacity building, finance, and international assistance co-ordination.

promoting demonstration projects to reform selected vodokanals; disseminating results; publishing performance indicators for vodokanals.

facilitating market creation and promoting competition in the supply of goods and services to vodokanals.

Source: Almaty Guiding Principles for Reform of the Urban Water Supply and Sanitation Sector in the NIS (http://www.oecd.org/dataoecd/16/46/2390168.pdf).

Various efforts have been made to channel credit to local governments through specially established funds. Earlier versions of these effectively monopolized municipal lending, which limited opportunities for other market players. The funds were financed primarily from hard-currency borrowing from international institutions, which introduced currency risk into municipal credit. More recent municipal development funds have sought to correct these problems by raising capital from domestic sources for on-lending and deepening the local credit market. Suitably qualified municipalities are encouraged to borrow directly from banks or to issue municipal bonds, rather than to borrow exclusively from a municipal development fund.

Box 7. Accessing local capital markets in Tamil Nadu

Experience in Tamil Nadu, a state in southern India, illustrates how local capital markets can be accessed to help finance water and sanitation projects in small and medium-sized cities. The pooling of resources helped to overcome the transaction costs and to reduce risks that the cities would have otherwise encountered. Funds were raised through two bond issues and then disbursed to participating municipalities. A trust was established to manage operations, 51 percent owned by private investors, and 49 percent by the state government. The following arrangements were established to service the debt:

- The borrowing municipalities agreed to maintain a sum equivalent to their annual debt service payment in an escrow account 90 days prior the date the debt was due to be paid;
- The state government maintained a separate reserve fund, equivalent to 1.6 times the amount due to bondholders. This mechanism would be triggered if the escrow mechanism failed. The state government is empowered to replenish the reserve fund by intercepting the transfer of state funds to the defaulting municipality;
- If both these mechanisms fail, repayment to bondholders is guaranteed up to 50 percent by a local private sector institution, and up to another 50 percent by the USAID Development Credit Authority.

Establishing this mechanism required extensive negotiations between the stakeholders, but proved to be an attractive investment opportunity for institutional investors. A first bond issue of US$21.3 million was over-subscribed, and established an interest rate at 11.58 percent over a five-year term. A second bond issue set the interest rate at 9.2 percent over a 15-year term.

Source: Planning and Development Collaborative, Inc. 2003.

There will be no single solution for addressing the challenge of municipal finance. Further analysis to identify successful approaches is needed. One source of such analysis is Central and Eastern Europe, where a number of countries have undergone rapid transitions. The Polish experience indicates that it is possible to decrease central government transfers while increasing local government financing for water infrastructure. Figure 4 illustrates some other factors that were critical in the movement toward greater financial sustainability in the Polish water sector; namely, the opportunity to access loans from commercial banks and the utilities' own resources generated by efficiency gains.

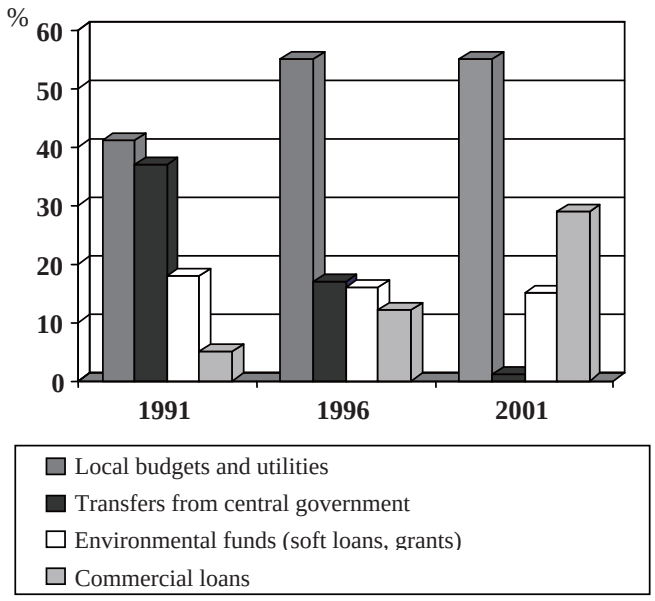


Figure 4. Financial sources for investment in the water sector in Poland

Source: Porawski 2003.

6.1. Defining the roles of local governments and water utilities through performance contracts[6]

The provision of water supply and sanitation are fundamentally local activities and local governments play a critical role in assuring their provision. Compared to central governments, local authorities are, in principle, better attuned to local demand and better placed to identify local solutions and to organize their implementation. As a result, local authorities have generally developed close working relations with utilities. In some countries water utilities are part of local government. However, the close linkages between local authorities and utilities can involve conflicts of interest, blur responsibilities, and impede the effective delivery of water services. For example, local politicians are often reluctant to raise tariffs to levels that would guarantee the financial autonomy of utilities as this might erode their electoral support. Interventions of this type undermine the operational autonomy of utilities and create confusion over the roles that local government and utilities should play.

It is now widely recognized that a fundamental element of a viable water governance system is to clarify the relative roles and responsibilities of central and local governments as well as utilities. More specifically, local governments should be responsible for planning as well as many aspects of policy and regulation, including the involvement of the public. Utilities should have sufficient operational autonomy and resources to deliver agreed services. They should also be held strictly accountable for how they exercise their discretion and for how they have used their resources. In an increasing number

6. This section is based on OECD Environmental Action Programme Task Force 2005.

of countries, the relative roles and responsibilities between local governments and utilities is being clarified through “performance contracts”.

Agreeing a performance contract can be an arduous task, involving a considerable amount of research and negotiation. On the other hand, the benefits in terms of improved service delivery and efficiency gains can be substantial. The content of performance contracts may vary significantly, but for the purpose of this paper, three elements are worth emphasizing: goals, finance, and monitoring performance.

a. Goals

The goals of a performance contract would normally address the level, quality, and scope of service delivery. Once this has been done, responsibilities for achieving the goals can be specified. The clearer the goals, the easier, in principle, it should be to determine responsibilities. The utility will normally assume most of the direct obligations for service delivery. The local authority’s responsibilities will be to assure that the utility has the means (legal, financial, etc.) to achieve the agreed goals. Related to goal definition are issues such as the service area to be covered (often involving considerable uncertainties), the duration of the agreement (from one to potentially many years), and provision for the early termination of the contract.

b. Finance

An essential part of a performance contract concerns the specification of the percentage of utility revenues that should be allocated to cover operation and maintenance and, as appropriate, capital investments. To the extent that tariffs cover operations and maintenance costs, the utility will enjoy a good measure of financial autonomy. Tariff setting is a complicated and politically sensitive issue. Various models exist for tariff regulation, but they tend to be either an independent central regulator or a regulator at the local level, which often is the local authority. Whichever approach is used, tariff setting should be stable and predictable, and flexible, with automatic adjustments for inflation, and provision for adjusting tariffs in light of unforeseen developments. It should also provide incentives for utilities to improve their efficiency.

The final objective presents real challenges for tariff regulators. If tariffs are set too low, they may provide incentives for efficiency but the utility may not be able to earn a reasonable rate of return. If tariffs are set too high, there is less incentive for efficiency and the utility may earn rates of return that are perceived by the public as being excessive. The challenge is exacerbated by the information asymmetry that exists: utilities have much more detailed information about their operations than the regulator, and this tends to strengthen their position in negotiation.

The performance contract should also address issues of tariff collection. Often there are opportunities to increase revenues simply by improving the billing and tariff collection systems. Tariff collection could be carried out by the utility itself or outsourced. In either case, the utility should be empowered to collect tariffs and to impose sanctions in the case of nonpayment.

In many countries, local authorities will have an important if not primary responsibility for capital investments. Accordingly it is important to specify as precisely as possible the local authority’s financial

obligations, including amounts, timeframe, conditions, mechanism of transfer, etc. The financial relationship between the municipality and utility can be quite complex and take various forms. Thus, the municipality may provide financial support in the form of a grant. The resources provided may come from local taxes, fiscal transfers from central governments, or from finance raised from local capital or financial markets. Alternatively, the municipality may act as a guarantor for the utility to raise capital on capital or financial markets.

In a performance contract, it can be important to provide criteria that could help distinguish between operation-and-maintenance and capital-investment costs: it is not always easy to define where maintenance and rehabilitation end and capital investments starts.

c. Monitoring performance

Monitoring the achievement of objectives is an essential element of a performance contract. The purpose is to provide the utility with better incentives, and a better basis, for improving service delivery than existed before the contract came into effect. Progress in achieving objectives can be linked to a set of rewards or sanctions, though care must be taken when using sanctions as these may undermine the utility's ability to meet its objectives. Performance indicators are often established for financial performance, efficiency of operations, operating parameters, and customer service.

A key challenge is to define a suitable number of indicators that are closely linked to the main goals of the performance contract. Care is needed to avoid identifying an excessive number of indicators: this can undermine a sense of priorities, and may be unfeasible and/or highly expensive to monitor.

An important feature of indicators is the opportunity they create for benchmarking performance. If a utility can compare its performance across a range of parameters with utilities in similar situations, it can gain insights into areas where its performance could be achieved and how this could be done. In addition, indicators can be used to reward good performance by water utilities; for example, national programs for allocating financial resources to utilities, or their associated municipalities, can take account of performance indicators. The International Water Association (IWA) has developed a widely recognized set of performance indicators that are now increasingly used by water sector stakeholders (Alegre et al. 2005). These standards have been developed through a process involving all relevant stakeholders, effectively setting a global standard.

7. Private-sector participation in the water sector

Performance contracts can involve either publicly or privately operated utilities. Indeed, one advantage of performance contracts is that they put emphasis on service delivery rather than the frequently sterile debates about public sector vs. private sector. Many performance contracts have been established with private operators. Private-sector participation in the operation of water utilities can take a wide variety of forms. Figure 5 presents some of the options according to the degree of risk involved and the magnitude of the financing involved. The options range from providing advisory services for a fee, through a contract to manage or lease a utility, to the ultimate form of privatization covering both the operations of the utility and its assets.

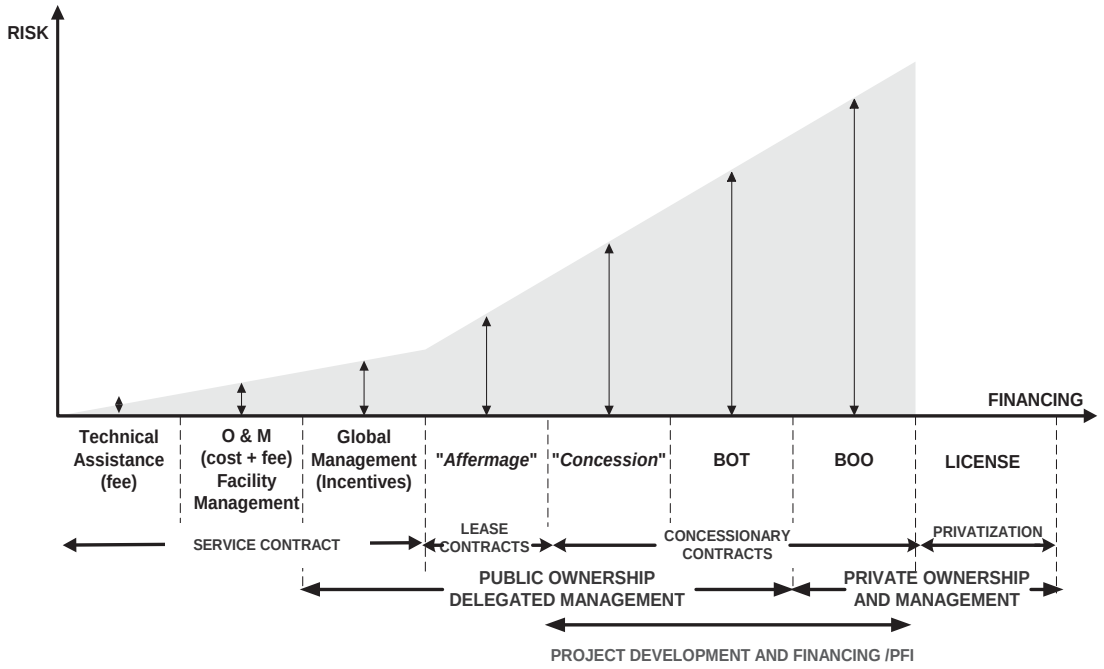


Figure 5. Private-sector participation options (alternative structures)

Source: OECD 2005.

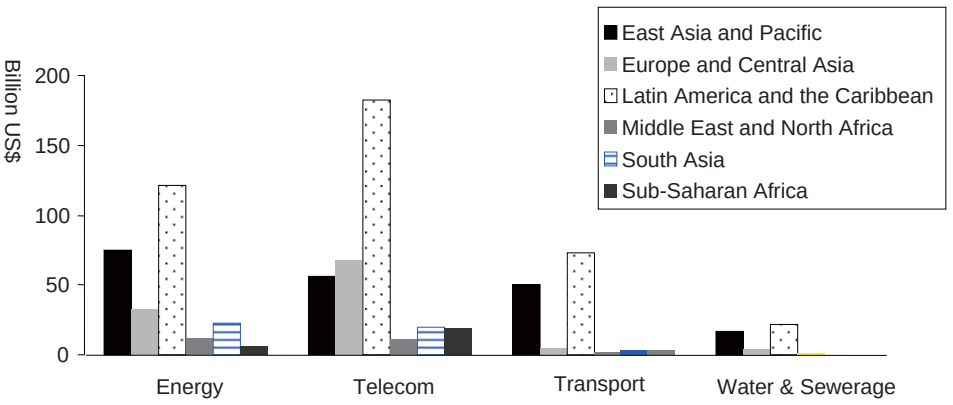


Figure 6. Total (international) private investment in infrastructure in 1990–2002

Source: Saghir 2003.

During the 1990s there was considerable interest in private-sector participation, though such participation has been low in the water sector compared to other forms of infrastructure, as figure 6 illustrates. The private sector promised to bring both managerial and technical know-how to improve the efficiency of utility operations, as well as investment capital. However, the private sector has retrenched,

and its involvement is at a lower level than many commentators had predicted in the 1990s. Some of the main reasons for this identified by the OECD and World Bank (2003) are as set out below.

The private sector has become much more risk averse following some bad experiences. The successive financial crises in Asia and Argentina precipitated the collapse of several public-private partnerships and exerted a powerful chilling effect on international water companies. In some other cases, companies competing for tenders suffered from submitting low-cost bids that proved not to be financially viable.

For the largest international private companies, capitals and major metropolitan cities provide the best opportunities to gain good rates of return. By the beginning of the 2000s, this "low-hanging fruit" had largely been picked. Opportunities in small and medium-sized cities were generally less appealing for these companies.

In some countries where the legal and institutional framework for private-sector participation has been established, and the economic conditions are favorable, grant-based programs have crowded out private-sector involvement. This has happened in some of the countries that recently acceded to the European Union. In other cases, administrative requirements in national or donor-funded programs have been biased against private-sector participation.

Vocal and sometimes physical opposition from anti-globalization and similar social movements has reinforced the risk-averse approach adopted by the private sector.

Often negative perceptions of private-sector participation, fuelled by negative media coverage of cases of PSP failure, and the widespread fears of privatization of a public good in a monopoly situation, have resulted in politicians being skeptical or opposed to this option.

In the current situation, the private sector is generally unwilling to commit its own capital without some form of guarantee or sweetener provided by governments or international financial institutions. Experiences with this type of cooperation have been both positive and negative. In these circumstances it is difficult to see how the positive experiences could be scaled up sufficiently to contribute in a significant way to achieving the water-related international development goals. The strategy adopted by many of the larger private water companies is to enter into arrangements like management contracts that do not involve any commitment of their own capital, but which enable them to gain experience in the market of the particular company or region. Once experience has been gained, the company can assess the opportunities and risks of deepening its engagement in the utility or the country at a later stage.

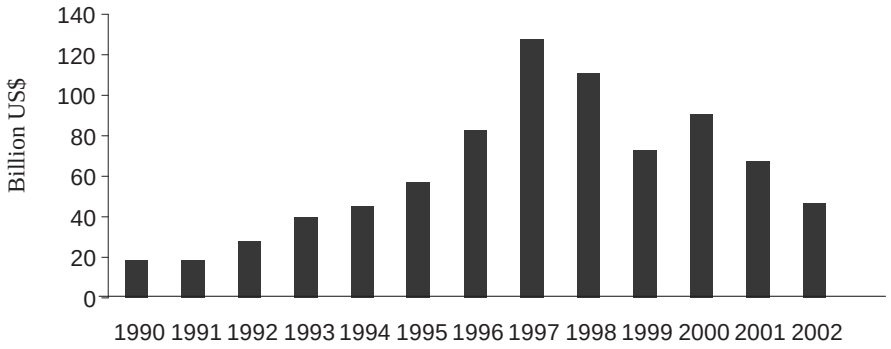


Figure 7. The recent collapse of private investment flows to water infrastructure: Annual private investment in infrastructure, 1990–2002

Source: Saghir 2003

In parallel with this, there has been greater interest shown in the potential role of domestic water companies (see OECD and World Bank 2004). Their local knowledge may mean that they are better placed to deal with the types of risks that can arise in developing and transition economies. A partnership with a large international company can also facilitate the transfer of know-how. Currently in Russia, about 8 percent of urban water is provided by domestic private companies. The figure could rise to 16 percent if the negotiations currently underway are concluded successfully. However, it is not clear at this time whether this development is sustainable.

8. Conclusions

There are a number of paradoxes in financing the water sector. In many respects it is a routine, unglamorous sector, yet it can inflame passionate debate, notably when human health is adversely affected or when the role of the private sector is discussed. The basic requirements for delivering safe water and sanitation are well known, and there is often willingness and ability to pay, yet the problem is far from being solved in many countries throughout the world.

Probably the single most important factor in explaining these paradoxes is failure of water-sector governance, and of governance systems more generally. Some key governance challenges include: low prioritization in government programs; flawed decentralization that does not clarify the roles that central and local governments should play, nor provide local governments with the means they need to carry out their responsibilities; politicized relations between local authorities and utilities; lack of financial autonomy and an appropriate operational framework for utilities; and few opportunities, if any, for the public and consumers to become involved in decision making about the sector.

Addressing these challenges will require vision, political will, determination, and a good base in popular support. Addressing these challenges is necessary in order to mobilize adequate financial resources and to meet the internationally agreed water targets. The primary sources of financing water

infrastructure are relatively clear in general terms. There are no “magic bullets”, and more could be done to leverage the various sources:

- User charges will be essential for ensuring the financial viability of the sector, and in particular to cover operational and maintenance costs. This will be needed to establish water utilities on a sound financial basis and to create the conditions where water systems can be extended to cover the currently non-connected poor.
- Raising user charges to appropriate levels requires the development of appropriate mechanisms for compensating or mitigating the effects of tariff increases on the poorest sections of the population. Managing the potential political and social resistance that such reforms would inevitably generate is going to be key to their success.
- Public budgets will continue to be the major source of finance for capital investments. These resources are scarce and have to compete with other pressing needs. National rather than local budgets are often the main source in transition and developing economies, and appropriate mechanisms are needed to ensure that resources are allocated to top-priority projects, and provide incentives by rewarding good performance by utilities and municipalities
- External finance from donors and IFIs will be a minor source of finance in all but the poorest developing countries. The apparent end of the decline in aid to the water sector, and projections of increases, are welcome, but it seems unlikely that, by themselves, they will make a decisive difference in achieving the internationally agreed water targets. External resources should be used strategically to support demonstration projects; to disseminate and apply the positive lessons learned more widely in the country; to support reform of the governance sector; to introduce international disciplines and good practices into the sector; and, last but not least, to leverage, where this is possible, additional domestic, public, and private funds.
- The private sector is unlikely to be a major source of investment capital for the water sector in the foreseeable future. However, opportunities exist to engage the private sector to help introduce more efficient managerial and technical approaches into the operation of utilities. Donors and IFIs could help in this regard. Over time, such initiatives could lay the basis for the private sector to play a more proactive role in the operation of water utilities than it does at present. However, this would require the development of robust and independent regulatory regimes.
- Finding ways to stretch the large upfront investment costs over time is another key challenge. Accessing local capital and financial markets is probably the most realistic approach for many transition and developing economies. This in turn depends on the emergence of fiscally responsible, creditworthy, and professionally competent local authorities that have clear roles and responsibilities for water service provision vis-á-vis utilities.
- Opportunities exist for developing new financial products and other forms of financial engineering, but they are likely to be limited. Improved mitigation of risks associated with water projects is probably the area with the greatest potential.

References

Alegre, H., W. Hirner, J. M. Baptista, and R. Parena. 2005. *Performance indicators for water supply services.* 2nd edition. London: IWA Publishing.

Bojo, J. and R. C. Reddy. 2003. Status and evolution of environmental priorities in the poverty reduction strategies: An assessment of fifty poverty reduction strategy papers. Paper no. 93, Environment Department Environmental Economics Series. Washington, DC: World Bank.

Hansen, S. and R. Bhatia. 2004. Water and poverty in a macro-economic context. Paper commissioned by the Norwegian Ministry of Environment. http://www.dep.no/filarkiv/203641/Hansen__Bhatia_-_water_and_poverty2.pdf.

Kayser, T. 2004. The path towards improved cost recovery in Poznan, Poland. Paper presented at the Regional Forum on Achieving Full Cost Recovery for Water Utilities in Southeast Asia, Bangkok, Thailand, 13–14 December 2004.

OECD. *See* Organisation for Economic Co-operation and Development.

Organisation for Economic Co-operation and Development. 2001. *Water management and investment in the New Independent States*. Paris: OECD.

———. 2003a. *Financing strategies for water and environmental infrastructure*. Paris: OECD.

———. 2003b. *Social issues in the provision and pricing of water services*. Paris: OECD.

———. 2004a. *Environmental Finance: Financing strategy for urban wastewater collection and treatment in Sichuan Province, China: Terms of reference*. Paris: OECD. http://www.oecd.org/dataoecd/44/23/2408767.pdf.

———. 2004b. *Financing urban water supply and sanitation in Asia*. Proceedings of a workshop, 17–18 September, 2003, Port Dickinson, Malaysia.

———. 2004c. *OECD Global Forum on Sustainable Development: Finacing water and environmental infrastructure for all: Some key issues*. London: OECD. http://www.oecd.org/dataoecd/36/53/30589212.pdf.

———. 2004d. Development cooperation report 2003. *DAC Journal* 5(1).

———. 2005. *Guidelines for performance based contracting in Eastern Europe, Caucasus and Central Asia*. Paris: OECD.

OECD Environmental Action Programme (EAP) Task Force. 2003. *Key issues and recommendations for consumer protection, affordability, social protection and public participation in urban water sector reform in Eastern Europe, Caucasus and Central Asia*. http://www.oecd.org/dataoecd/53/0/14636760.pdf

Organisation for Economic Co-operation and Development and the World Bank. 2003. *Private sector participation in municipal water services in Central and Eastern Europe and Central Asia. Facing a crisis of confidence in private sector participation in the water sector: Measures to overcome obstacles to more effective PSP. Conference proceedings, Vienna, 2–3 July 2003.Washington, DC: World Bank.* http://www.worldbank.org/watsan/pdf/VienaConferenceProceedingsFinalReport.pdf.

———. 2004. OECD-World Bank Conference on Private Sector Participation in Municipal Water Services in Europe and Central Asia, 20–21 September 2004, Moscow. http://www.oecd.org/document/50/0,2340,en_2649_34343_33738290_1_1_1_1 ,00.html.

Porawski, A. 2003. Presentation by Andrzej Porawski (Executive Director of the Association of Polish Cities, Poland) to the OECD Global Forum on Sustainable Development, December 2003.

Petersen, G. 2002. *Banks or bonds? Building a municipal credit market.* Washington, DC: Urban Institute.

Planning and Development Collaborative (PADCO), Inc. 2003. *Innovations and solutions for financing water and sanitation.* With George Petersen, the Urban Institute. Washington, DC: PADCO, Inc. www.oecd.org/dataoecd/16/42/22145238.pdf.

Reisen, H. 2004. *Innovative approaches for funding the Millennium Development Goals.* OECD Development Centre Policy Brief no. 24. Paris: OECD.

Saghir, J. 2003. Financing water and environmental infrastructure for all. Opening speech to the OECD Global Forum on Sustainable Development, Paris, 18 December 2003. http://www.oecd.org/dataoecd/6/29/22286989.ppt.

Shah, A. 2004. *Fiscal decentralization in developing and transition economies: Progress, problems, and the promise*. World Bank Policy Research Working Papers Series no. 3,282. Washington, DC: World Bank. http://econ.worldbank.org/files/35077_wps3282.pdf.

Winpenny, J. 2003. *Report of the World Panel on Financing Water Infrastructure*. Paris: OECD. http://www.oecd.org/dataoecd/60/11/ 21556665.pdf.

Winpenny, J. 2004. Enhancing the impact of financial guarantees. Note for the meeting of Finance for Development Initiative. Sao Paulo, 26–27 October, 2004. http://www.globalclearinghouse.org/wefbrazil/Docs/EnhancingWinpenny.doc.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 477 – 498, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

Waste Management and Recycling in Asia

Atsushi Terazono[a], Yuichi Moriguchi[b], Yuko Sato Yamamoto[c], Shin-ichi Sakai[d], Bulent Inanc[e], Jianxin Yang[f], Stephen Siu[g], Ashok V. Shekdar[h], Dong-Hoon Lee[i], Azni B. Idris[j], Albert A. Magalang[k], Genandrialine L. Peralta[l], Chun-Chao Lin[m], Pireeyutma Vanapruk[n], and Thumrongrut Mungcharoen[o]

This paper provides an overview of solid waste generation and management in Asia, which, with rapid economic growth and urbanization, is becoming a major social and environmental issue. Every country or region within Asia has its own background and characteristics in relation to solid waste management and material-cycle policy, even though they share the same global region. Municipal solid waste (MSW) generation ranges between 0.5 kg and 1.4 kg per capita per day in all countries and regions within Asia (with the exception of China). As gross domestic product (GDP) per capita increases, MSW per capita generation also increases and MSW generation becomes saturated at high GDP. This relationship could be made clearer using detailed data from some countries. Organic matter is the main component of MSW in Asia. Landfill is the most common disposal option used in many Asian countries because it is inexpensive. In most countries and regions in Asia, plastics, glass, papers, and metal are collected by either informal workers or a municipality, and the materials are recycled. Many Asian countries and regions have introduced laws on municipal solid waste recently. However, major concern for waste management in Asian countries/region has addressed to quality control, i.e. environmental protection, compared to quantity control. It is a positive sign that the importance of the waste management hierarchy—that is, reduce, reuse, recycle ("3R"), and disposal—is gradually being recognized; the challenge now is to put it into practice effectively in the many different contexts found in Asia.

Keywords: Waste management, Municipal solid waste, MSW generation, Landfill, Recycling.

a. Senior researcher, National Institute for Environmental Studies, Tsukuba, Japan.
b. Section Head of Sustainable Material Cycles Management Section, National Institute for Environmental Studies, Tsukuba, Japan.
c. Programme Associate, Institute of Advanced Studies, United Nations University.
d. Director of Research Center for Material Cycles and Waste Management, National Institute for Environmental Studies, Tsukuba, Japan.
e. Senior researcher, National Institute for Environmental Studies, Tsukuba, Japan.
f. Associate Research Professor, Research Center for Eco-Environmental Sciences, The Chinese Academy of Sciences, Beijing, China.
g. Environmental Protection Officer, Environmental Protection Department, Hong Kong SAR.
h. Associate Professor, Faculty of Environmental Science and Technology, Okayama University, Okayama, Japan.
i. Professor, Department of Environmental Enginnering, University of Seoul, Seoul, Republic of Korea.
j. Associate Professor, Universiti Putra Malaysia, Selangor, Malaysia.
k. Executive Director, National Solid Waste Management Commission, Quezon City, The Philippines.
l. Associate Professor , College of Engineering, University of the Philippines, Diliman, Quezon City, The Philippines.
m. Associate Researcher, Institute of Environment and Resources, Taipei, Taiwan.
n. President, Development of Environment and Energy Foundation, Bangkok, Thailand.
o. Assistant Professor, Faculty of Engineering, Kasetsart University, Bangkok, Thailand.

1. Introduction

With the rapid economic growth and urbanization that is taking place in Asia, solid waste generation and management is becoming a major social and environmental issue. Complicating the picture, each country and region within Asia has its own background and characteristics in relation to solid waste management and material-cycles policy, even though they share the same global region.

According to the World Bank, the urban areas of Asia produce about 760,000 tons of MSW per day, and it is estimated that this figure will increase to 1.8 million tons of waste per day by 2025 (World Bank 1999). The data on solid waste management are often unreliable. There are only a few comparative studies for Asian countries/regions other than the World Bank survey, while comparative studies of Europe and the USA have been implemented by some researchers (for example, Sakai et al. 1996). Even though the existing data are potentially useful, the definitions or implications of some values are sometimes inconsistent, and this situation should be recognized.

This paper mainly focuses on the MSW, since there are a relatively satisfactory number of data available, compared with industrial waste. We compare and analyze the current status of waste management in Asia, especially MSW generation and disposal. Then we discuss waste management and recycling policy.

2. Current status of waste management in Asia

2.1. Waste generation and disposal

a. Definitions of *waste*

Solid waste is usually categorized into municipal solid waste (MSW) and industrial waste, according to its sources. When countries or regions have laws governing waste management, *solid waste* and *MSW* are usually given specific definitions. Table 1 shows the definitions of solid waste and MSW in selected Asian countries/regions. As can be seen, Indonesia, Malaysia, and Thailand have no laws on waste management, and they thus do not have official definitions of solid waste and MSW. India and Taiwan have definitions of MSW only.

The data in table 1 clearly show that the boundaries of MSW are not yet clear. The term is normally assumed to include all of the wastes generated in a community with the exception of solid wastes from industrial processes and agriculture (Tchobanoglous, Theisen, and Vigil 1983). In previous studies, it has included wastes generated from residences, commerce, institutions, construction, municipal services (Tchobanoglous, Theisen, and Vigil 1983), and sometimes even industrial sources (World Bank 1999). However, the precise definition varies greatly between studies and often only residential waste (or household waste) is included under MSW. From the authors' communication with experts in Asian countries/regions, construction wastes and any hazardous wastes are usually excluded in most countries. There is more complication regarding waste from industrial and institutional sources. In India, Republic of Korea, Turkey, Taiwan, and Japan, MSW includes part of the waste from industrial sources (the business sector), depending on waste types. In Hong Kong, industrial waste is officially included in

MSW. However, there is another notification that responsibility may be attributed to the generators, even though the waste is classified as MSW.

b. Waste generation

Estimated amounts of MSW and household waste generated in selected Asian countries are shown in table 2. It is true that the amount of household waste alone could be suitable for comparison and could avoid the distorting effect of including industrial wastes. However, exclusive household waste data exist for very few countries in Asia (the exclusive household waste data for China and Hong Kong Special Administrative Region are shown here for reference only). The proportion of household waste in MSW varies depending on the country. It is estimated as 60 to 70 percent in mainland China (Gao et al. 2002), 78 percent in Hong Kong (including commercial waste), 48 percent in the Philippines, and 37 percent in Japan (based on data from Osaka). According to the World Bank (1999), in high-income countries, only 25 to 35 percent of the overall waste stream is from residential sources.

Table 1a. Definitions of *solid waste* and *MSW* in each country/region

	China	Hong Kong	India	Indonesia	Republic of Korea	Malaysia
Definition of *solid waste*	Wastes in solid or semi-solid state generated in production, construction, daily life, and other activities, which might pollute the environment. (Law on the Prevention and Control of Solid Waste Pollution to the Environment, 1996).	Any substance or article which is abandoned and includes animal waste, chemical waste, household waste, livestock waste, street waste, and trade waste. (Waste Disposal Ordinance, 1991 amended).	–	–	Useless materials generate from human and business activities, such as refuse, burnable waste, sludge, waste oil, waste acid, waste alkaline, and dead animals. (Waste Management Law, 1991 amended)	–
Types of solid waste included	• MSW; • Industrial solid waste; • Construction and demolition waste; • Hazardous waste.	• MSW; • Construction and demolition waste; • Special waste (hazardous waste).	• MSW; • Hazardous waste; • Bio-medical waste.	• Hazardous and toxic waste.	• Household waste (MSW); • General industrial waste; • Construction and demolition waste; • Hazardous (designated) waste.	• Scheduled waste; • (Hazardous waste).
Definition of *MSW*	Solid wastes generated in the course of urban daily life or activities providing services for urban daily life as well as other solid wastes as stipulated by law and administrative regulations.	Solid waste from household, commercial, and industrial sources.	Commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. (Municipal Solid Waste Regulation (Management and Handling), 2000).	–	Household waste (MSW) includes household waste and household-type industrial waste. Household waste is defined as waste other than industrial waste.	–

Table 1b. Definitions of *solid waste* and *MSW* in each country/region

	Philippines	Taiwan	Thailand	Turkey	Japan
Definition of *solid waste*	All discarded household, commercial wastes, non-hazardous institutional and industrial wastes, street sweepings, construction debris, agricultural wastes, and other non-hazardous/non-toxic solid wastes. (RA 9003 Ecological Solid Waste Management Act, 2001).	–	–	Materials unwanted by their producers, and may cause public nuisance or environmental pollution, and requiring proper disposal together with domestic wastewater treatment plant sludges.	Solid and liquid waste (or unwanted material) with no economic value (Waste Management Law, 1970)
Types of solid waste included.	See above.	• MSW • Industrial waste (Non-MSW).	• MSW; • Industrial waste (hazardous and non-hazardous).	• MSW; • Industrial waste.	• General waste (MSW) • Industrial waste • Specifically controlled general waste (hazardous general waste); Specifically controlled industrial waste. (Hazardous industrial waste).
Definition of *MSW*	–	Garbage, excrement and urine, animal corpses in solid or liquid form, generated by households or other non-industries, which have capacity to pollute the environment. (Waste Disposal Act, amended 2001).	–	Wastes originating from households that do not contain hazardous materials, and those collected from parks and recreational areas. Non-hazardous industrial and commercial wastes are also included.	MSW corresponds to *general waste*, which is defined as waste other than industrial waste. (*Industrial waste* is defined by waste types and sectors.)

Table 2. MSW and household waste generation in each country/region

	China	Hong Kong	India	Indonesia	Republic of Korea	Malaysia	Philippines	Taiwan	Thailand	Turkey	Japan
Year	2000	2003	2002	1995	2002	2002	2000	2002	2002	2001	2001
Population (million)	1,267.4	6.8	1,052.0	194.8	47.6	24.5	76.5	22.6	62.8	68.5	127.3
GDP per capita (current US$)	856	23,800	471	1,038	10,013	3,868	978	12,570	5,430	2,146	32,745
MSW generation (kilotons/year)	130,320	3,440[4]	–	–	18,189[7]	–	10,670[9]	7,970[10]	14,317[11]	25,100[12]	52,100[13]
MSW generation per capita (kg/capita-day)	1.70[1]	1.39	0.2–0.5[5]	0.76[6]	1.05	0.88–1.44[8]	0.5–0.7[9]	0.97	0.62	1.00	1.12
Household waste generation (kilotons/year)	78,192[3]	2,700[4]	–	–	–	–	–	–	–	–	–
Household waste generation per capita (kg/capita-day)	1.02 [3]	1.09	–	–	–	–	–	–	–	0.57	–

Notes and sources: 1. Ministry of Construction, China. 2. For the calculation, an urban population of 209.5 million was assumed. 3. 60 percent of MSW is assumed to be household waste, referring to Yang 2003. 4. Hong Kong Environmental Protection Department 2004. 5. Shekdar 2002a. 6. World Bank 1999. 7. Ministry of Environment.8. Idris, Inanc, and Hassan 2004. 9. World Bank 2001. 10. Lin 2003. 11. Vanapruk 2003. 12. Inanc et al. 2004. 13. Ministry of the Environment, Japan 2004.

MSW generation per capita, or unit generation of MSW, ranges between 0.5 and 1.4 kg/(capita-day) in each country/region except China. MSW generation data in China are hard to understand. According to Fang (1999), in recent times the average MSW generation is about 1.12 to 1.2 kg/(capita-day) in megacities (including the agricultural population living in the surrounding areas). On the other hand, Yang (2003) insists that urban (non-agricultural) population alone should be used for calculating MSW generation per capita. For this study, we derived 1.7 kg/(capita-day) from 130.32 million tons of MSW generation and 209.53 million persons of urban population. This value is higher than that for other Asian countries and depends on what is counted as urban population.

Generally, high-income countries have higher unit generation. In Japan, MSW generation per capita has stabilized at approximately 1.1 kg/(capita-day) since the end of the 1980s. Middle- and low-income countries produce smaller amounts of MSW—between 0.5 and 1.0 kg/(capita-day) in recent years.

Many previous studies indicate that as gross domestic product (GDP) (or gross national product (GNP)) per capita increases, per capita MSW generation also increases, and that MSW generation becomes saturated at high GDP (Bakkes et al. 2004; Nakagawa 2003; Tanaka et al. 2002; World Bank 1999). Bakkes et al. show a curve for MSW generation and give a formula:

MSW generation per capita = -28.2361/ (GDP per capita + 30) + 1.0496; $r^2 = 0.59$

Tanaka et al. (2002) and Yoshizawa et al. (2004) have analyzed data from Organisation for Economic Co-operation and Development (OECD) countries and have further categorized them into three groups according to the rate of MSW generation by per capita GDP: high-generation group (the USA, Australia, etc.), middle-generation group (many EU countries), and low-generation group (Sweden, Japan, etc.).

Nakagawa has analyzed waste generation data for Asian countries/regions and found a similar correlation between MSW generation per capita and GNP per capita. He points out that the curve in most Asian countries is higher than in Japan.

We utilized data for the West from literature (OECD 2002) as well as the above Asian data. A similar curve of MSW generation per capita and GDP per capita was drawn (shown in figure 1). We assumed exponential fitting and obtained the following regression formula:

MSW generation per capita = 0.7184 x GDP per capita exp 0.227; $r^2 = 0.51$

Three implications were drawn from this analysis. The first is the possibility that we could find a more definite relationship between MSW generation and GDP. According to the Japan International Cooperation Agency (1997), per capita MSW generation rates among high-, middle-, and low-income populations in the Philippines are 0.37–0.55, 0.37–0.60, and 0.62–0.90 kg/(capita-day) respectively. As can be seen in this example, MSW generation per capita seems to vary depending on the income level in developing countries. It is true that data availability is quite limited. However, when we used some local data for both MSW generation and GDP, instead of country data for developing Asian countries, a clearer relationship between MSW generation and GDP per capita could be observed.

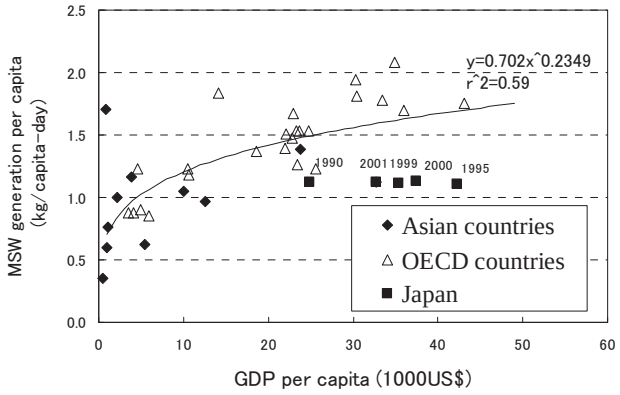


Figure 1. MSW generation and GDP per capita in Asia, OECD countries and Japan

Notes: Asian countries exclude Japan. OECD countries exclude the Republic of Korea, Turkey, and Japan. Data for Japan in 2001 was used for regression analysis together with others.

Sources: Asian countries: See table 2. OECD countries: OECD 2002. Japan: Ministry of the Environment, Japan 2004 and others.

The second implication concerns why MSW generation rises at low GDP levels. It can be easily understood that MSW per capita generation increases in developing countries and regions as GDP rises. However, it should also be noted that not all MSW is counted, due to the activities of the informal sector and self-disposal in developing countries. The informal sector contributes to waste reduction and recycling. However, the fact that the volume of waste collected by the informal sector is not usually counted in official statistics for waste generation is often overlooked. In addition, collection rates are low in developing countries; for example, 72.5 percent in urban areas of India, 70 percent in Malaysia, 70–80 percent in Thailand (Inanc et al. 2004), and 70 percent in urban areas and 40 percent in rural areas of the Philippines (World Bank 2001a). In those countries, it is expected that collection rates and MSW generation will increase in the near future, since municipal collection services will be better organized as the economies grow.

The third implication relates to the MSW generation rates at relatively high GDP levels. When waste generation reaches saturation point at high GDP, it is a flat line and far from the Kuznet's curve that is often postulated for the relationship between economic growth and other environmental issues (Harashima and Shimazaki 2002; Selden and Song 1994). Matsuoka, Matsumoto, and Kochi (1998) suggest that the environmental Kuznet's curve can hardly be observed other than for sulfur oxides emissions. Our study certainly suggests that this curve may not be applied to the case of MSW generation. However, different levels of MSW generation per capita can be found for high-GDP countries, and Japan might provide a successful case for de-coupling economic growth and MSW generation. Japan in 2000 introduced the new concept of a sound-material-cycle society. All high-income countries should make efforts to decrease MSW generation by following the concepts of the sound-material-cycle society or "3R" (reduce, reuse, recycle).

c. Waste composition

Data for composition of MSW cannot easily be obtained at national level, although such data are often collected by some municipalities or by researchers. Organic matter is the main component of MSW in Asia, as shown in figure 2. That proportion ranges 34 percent even to 70 percent, which is higher than the 20–50 percent of most European countries (OECD 2002).

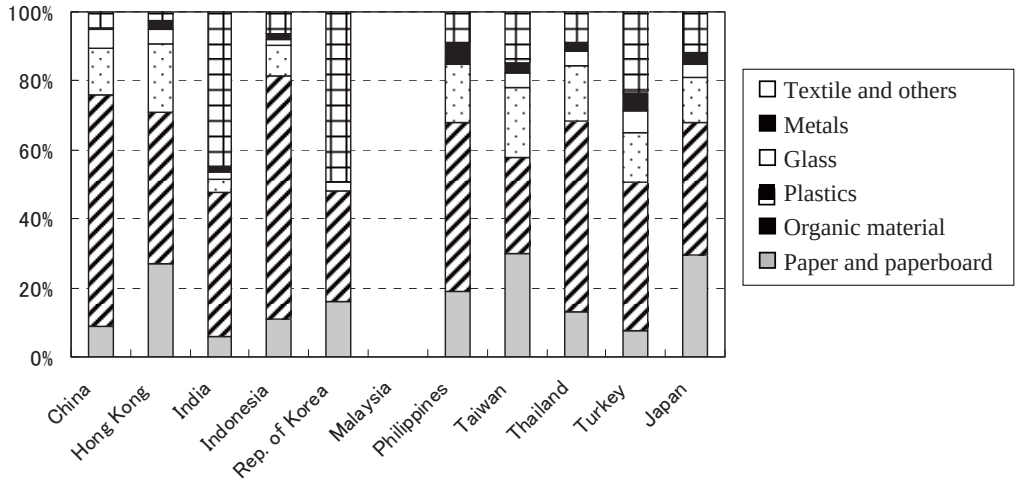


Figure 2. Composition of MSW in Asian countries/regions

Note: China (1998): Data for Shanghai from Zhang and Yang 2002. Hong Kong (2003): Hong Kong Environmental Protection Department 2004. India (1995): TERI 2000—national average data. Indonesia (1993): Data for Surabaya city in rainy season from Ishii and Watanabe 1996. Republic of Korea (2002): Ministry of Environment. Plastics are included in "textile and others". Philippines (1999): World Bank 2001a. Taiwan (2002): Lin 2003. Thailand (2001): Data for Bangkok from Vanapruk 2003. Turkey (2000): Data from Istanbul Greater City Municipality 2000. Japan (2001): Average data for six cities from Japan Environmental Sanitation Center 2001. Malaysia: No data.

In recent times, more and more plastic and paper waste is being generated in every country/region of Asia, reflecting changing lifestyles. In Taiwan and Japan, already as much as 30 percent of total MSW is wastepaper. According to the World Bank (1999), other high-income countries also have a large proportion of paper in their waste.

Some countries have their own peculiarities in composition of MSW. For example, a large amount of ash is generated from domestic coal used for heating in northern cities of China and Turkey.

As described in the previous section, the informal sector plays important roles in collecting recyclable materials in developing countries such as China, India, the Philippines, and Turkey. It is difficult to know the amounts of materials collected and recycled by the informal sector, and how much is thus absent from official waste composition data; it is simply assumed that the overall volumes collected by the informal sector are about 10 to 15 percent in China (Yang 2003) and 15 to 20 percent in India (Shekdar 2002b).

2.2. Waste disposal

Landfilling is the major method of disposal in many Asian countries, as can be seen in figure 3. This is mainly because it is, usually, inexpensive. Especially in China and India, the landfill rate reaches more than 90 percent.

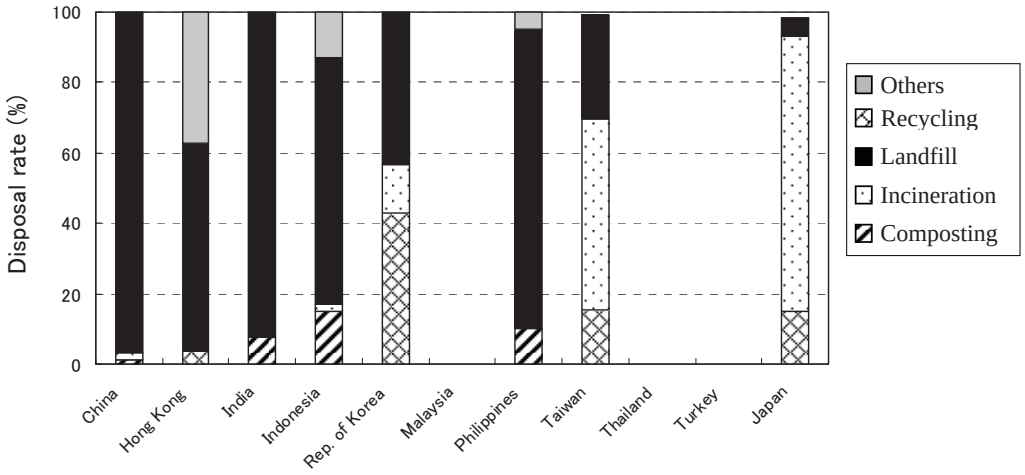


Figure 3. MSW disposal in Asian countries/regions

Note: China (2000): Survey of 138 cities by Gao et al. (2002). Hong Kong (2003): Hong Kong Environmental Protection Department 2004— "others" implies export for recycling. India (1999): Data for Delhi from TERI 2000. Indonesia (1997): World Bank 2001b—data do not include recycling. Republic of Korea (2001): Ministry of Environment—data do not include recycling. Philippines (1997): World Bank 2001a—data do not include recycling. Taiwan (2002): Lin 2003—"recycling" includes composting. Turkey: No data (Turkey has no incinerators for MSW and most landfill sites for MSW were open dumps by 1991, according to Inanc 2003). Japan (2001): Ministry of the Environment, Japan 2004. Malaysia, Thailand: No data.

The concept of landfill quality development in Asia was introduced by Tanaka et al. (2002). They classified landfill into three levels: open dumping, semi-sanitary landfill (which is covered only), and sanitary landfill (which is covered and leachate treated). Tanaka, Tojo, and Matsuto (2003) examined the development of landfill technologies using the case of Japan from 1976 to 1995.

Data for landfill in Asian countries/region are quite limited. However, Inanc et al. (2004) gathered available landfill information from each country/region in Asia in a comparative format, including landfill classification and numbers. Idris, Inanc, and Hassan (2004) provide the example of the detailed landfill classification system used in Malaysia.

Referring the landfill classification by Tanaka et al. (2002) and the database provided by Inanc et al. (2004), we have shown the relationship between GDP and landfill quality levels (figures 4(a) and 4(b)). This shows that sanitary landfill sites are very limited and open dumping can be easily found in developing countries. However, various efforts have been made to improve the quality of landfill sites. For example, many municipalities stopped open dumping in Turkey in 1991 (Inanc 2003), and in India, landfilling is restricted to non-biodegradable, inert waste and other wastes that are not suitable for

recycling. In the Philippines, RA9003 (see table 3(2)) recommended local government units to convert existing open dumps into controlled dumps and further into sanitary landfill (Magalang 2003).

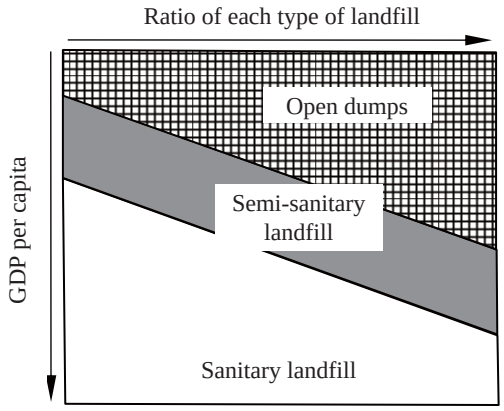


Figure 4a. Development of landfill levels (overall trend)

Incineration involves high costs for construction and operation of facilities. In Japan, incineration has been regarded as important for waste disposal from the point of view of public health. For the last 10 years, the percentage of incinerated waste in the total amount of MSW in Japan has leveled off at 73–78 percent. Besides Japan, the Republic of Korea and Taiwan have been increasingly using incineration since the late 1990s. Incineration is not well accepted in other countries because of its cost. Moreover, the Philippines banned the incineration of MSW, medical waste, and hazardous waste under the Clean Air Act of 1999, RA8749.

Composting can be a major disposal method for organic matter. In India, Indonesia and the Philippines, around 10 percent of generated waste is composted (TERI 2000, World Bank 2001a and 2001b). Manual methods of composting are still used in many towns in India; although mechanical composting plants have been built recently at a number of place in India through private-sector participation, the capital investment and recurring expenditure are high (Shekdar 2002b).

2.3. Recycling

Every country/region recognizes the importance of recycling. In the case of MSW, there are two main recycling flows. In the first flow, recyclable materials are collected at sources by collectors, including those in the informal sector. In the second flow, these materials are separated and recycled by the municipality after MSW collection. As long as the materials have a certain economic value, they are likely to be collected by the informal sector.

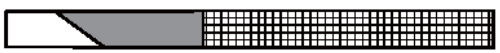
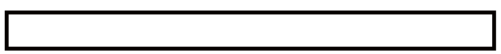
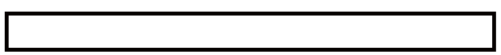
Proportions of open dumps, simple landfill, and sanitary landfill	GDP per capita (current US$)	Country	Remarks
	471	India	All waste disposal sites are open dumps (Damodaran et al. 2003).
	856	China	More than 80% of landfills are simple landfill sites (Tsinghua University 2002).
	978	Philippines	721 open dumps (92%), 65 controlled dumps (that seem to be regarded as semi-sanitary landfills, 8%). Proposed new sites are all controlled dumps or sanitary landfills (Inanc et al. 2004).
	2,146	Turkey	Majority of the disposal sites in small cities and rural areas are open dumps. 12 sanitary landfills accept 33% of total MSW generated nationwide in 2001 (Inanc et al. 2004).
	3,868	Malaysia	60% open dumps, managed poorly.
	12,570	Taiwan	Remediation of 60% of dumps before 2004 is planned. (Inanc et al. 2004).
	23,800	Hong Kong	All sanitary landfill.
	32,745	Japan	All sanitary landfill.

Figure 4b. Development of landfill levels (actual example)

Sources: India: Damodaran et al. 2003. China: Tsinghua Universty 2002. Philippines, Turkey, Taiwan: Inanc et al 2004.

In most countries/regions, plastics, glass, papers, and metals are well collected by either the informal sector or municipalities, and these materials are recycled. Nevertheless, very few countries or regions hold data on recycling rates for each type of material, except for Hong Kong, the Republic of Korea, Turkey, and Japan. The recycling rates for typical materials from MSW in these countries are shown in figure 5.

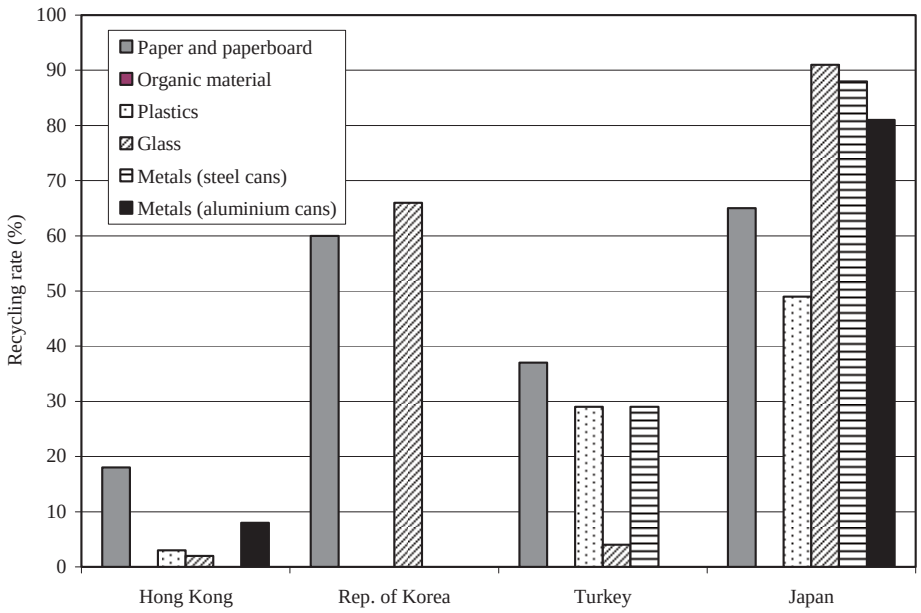


Figure 5. Recycling rate of each materials from MSW in Asian countries/regions

Note: Hong Kong (2003): Hong Kong Environmental Protection Department 2004—only domestic recycling (not export for recycling) is counted. Republic of Korea (2000): Data from OECD 2002. Turkey (2000): Data from Metin et al. 2002. Japan (2003): Data from Clean Japan Center 2002 and others—recovery rate shown for paper and paperboard. "Plastic" means polyethylene terephthalate (PET) bottles here. No data were available for China, India, Indonesia, Malaysia, Philippines, Taiwan, or Thailand.

2.4. Waste management costs

Collection costs generally make up the dominant part of all waste management costs in those countries/regions where landfill is a major disposal method, including the Republic of Korea. In India, nearly 90 percent of total waste management costs go on manpower, mostly in collection. On the other hand, in Japan, a large portion of budget is spent on incineration, and the cost of this doubled between 1987 and 1993.

3. Policy and regulation of waste management and recycling in Asia

Table 3 summarizes legislation and policy on waste management and material cycles in each country/region.

Table 3a. Legislation and policy on waste management and material cycles in Asia

	China	Hong Kong	India	Indonesia	Republic of Korea	Malaysia
Legislation	• Law on the Prevention and Control of Solid Waste Pollution to the Environment (1996). • Temporary Provisions on Some Issues in Implementing Comprehensive Utilization of Resources (1985, 1996 amended). • The tenth Five-year Plan for Renewable Resources Recovery and Reuse (2001).	• Waste Disposal Ordinance (1980, amended 2004).	• Municipal Solid Waste Regulation (Management and Handling) (2000).	• Act no. 23/1997 on Environmental Management.	• Waste Management Law (1986, amended 1999). • Resources Conservation and Recycling Promotion Law (1992, amended 2003). • National Comprehensive Waste Management Plan (1993).	• Environmental Quality Act (1974, amended 2001). • Environmental Quality (Scheduled Wastes) Regulations (1989).
Basic goals or standards	Waste reduction and minimization of solid waste output, and comprehensive utilization of resources.	Unclear.	Minimization of the burden of landfills is addressed in the Regulation.	Indonesian Agenda 21 (management of waste and emissions, including management of hazardous waste, management of solid and liquid waste, and management of radioactive waste).	The goal "firm establishment of a sustainable and resource circulating socio-economic foundation" is given in the National Comprehensive Waste Management Plan.	Waste minimization is prescribed the in Environmental Quality Regulations (only for hazardous waste).

Table 3b. Legislation and policy on waste management and material cycles in Asia

	Philippines	Taiwan	Thailand	Turkey	Japan
Legislation	RA9003 Ecological Solid Waste Management Act (2001)	Waste Disposal Act (1974, amended 2001) Resource Recycling and Reuse Act (2002)	Enhancement and Conservation of National Environmental Quality Act, B.E.2535 (1992)	Solid Waste Control Regulation (1991)	Basic Law for Establishing a Sound Material Cycle Society (2000) Waste Management Law (1970, 2000 amended) Law for the Promotion of Utilization of Recycled Resources (2000 amended)
Basic goals or standards	RA9003 sets targets for solid waste avoidance and volume reduction.	Avoidance or reduction, recycling, and disposal.	MSW generation per capita, non-collection rate, recycling rate, etc. are set as standard for 2005 to 2010.	Preventing damage to the environment during solid waste generation, transportation, and disposal. Waste minimization, proper disposal and more recycling/recovery.	Productivity per resources use, recycling rate, and final disposal volume are main standards under the Basic Plan for a Recycling-based Society. Individual recycling laws each set target recycling rates .

Many Asian countries/regions have already introduced laws on MSW. In China, Japan, the Republic of Korea, and Taiwan, legislation on MSW was promoted relatively early. Indonesia, Malaysia, and Thailand control hazardous waste only under toxic substances regulations, but do not have waste management laws. This may imply that waste management is of higher concern in Asian countries/regions in terms of quality control—that is, environmental protection—compared to quantity control. Appropriate management of solid waste, especially hazardous waste, has high priority in most countries/regions.

The Incineration Ban, based on the Clean Air Act, in the Philippines is also notable, although it targets medical (hazardous) waste as well as MSW.

3.1. Material-cycle control

More and more countries/regions in Asia recognize the need for quantity management due to limitations of space for landfill and treatment capacity. Only a few countries and regions have a concrete index for remaining potential landfill capacity, including Japan and Hong Kong, where the remaining landfill capacity is reported as 12.5 years (from FY2001, Ministry of the Environment, Japan 2004) and 10 years (from 2000, Hong Kong 2001) respectively. However, the importance of the waste management hierarchy—that is, 3R and disposal—is gradually being recognized throughout Asia.

The Republic of Korea and Japan are two active countries that implement measures to support material-cycles policy beyond the framework of mere waste management. In Japan, the Fundamental Law for Establishing a Sound Material Cycle Society was enacted in 2000, and targets were set for material flow in terms of resource productivity, cyclical use rate, and final disposal amount. Material flow analysis at national level in Japan is conducted by Moriguchi (2000) in collaboration with European countries and the United States, and the results are referenced in the national White Paper on the Environment. It shows that a total of about 1,900 million tons of new materials entered the Japanese economy in FY2000 and approximately 1,100 million tons remains in the anthroposphere, adding to stocks (Ministry of the Environment of Japan 2003).

The Republic of Korea explicitly prescribes the “Extended Producer Recycling” (EPR) system under the Resources Conservation and Recycling Promotion Law, amended in 2003. Another remarkable characteristic of the Korean approach is that the new law abolished the deposit system and introduced the “Producer Responsible Recycling” system.

Other countries are now promoting the activities to introduce laws and policies for promoting material cycles. China is preparing the Law for Promoting Circular Economy. In India and the Philippines, laws on the management of MSW have been enacted recently and the importance of material cycles is clearly mentioned in the laws.

3.2. Recycling and management of individual products

As table 4 shows, various regulations on the recycling or management of selected individual products such as packaging waste, E-waste (electrical appliances and personal computers), and End-of-Life Vehicles (ELV), have been enacted or are being prepared in many countries/regions of Asia.

Table 4a. Legislation and polices on various waste products in Asia

	China	Hong Kong	India	Indonesia	Republic of Korea	Malaysia
Packaging waste	–	Unclear.	Governmental ban on thin plastic bags.	–	Use of packaging and disposables is controlled. Four packaging materials (paper packs, metal cans, glass bottles, and plastic) are designated as "obliged recycling items".	–
E-waste (electrical appliances and personal computers)	Small-scale recycling business is eliminated by the e-waste import license system. An Electric Appliances Recycling Regulation was proposed in 2004.	Smuggling of e-waste is strictly controlled.	Batteries (Management and Handling Rules, 2001).	–	Electrical good are designated as "obliged recycling items".	–
ELVs	–	–	–	–	Car tires, lubricants, and batteries are designated as "obliged recycling items".	–

Table 4b. Legislation and polices on various waste products in Asia

	Philippines	Taiwan	Thailand	Turkey	Japan
Packaging	–	Free distribution of plastic bags is prohibited. (2003)	–	Solid Waste Control Regulation concentrates on the quota-deposit system about recovery of packaging waste.	The Packaging Recycling Law came into force in 1996. It contributes to recycling, but the participation of municipalities is limited.
E-waste (electrical appliances and computers)	–	E-waste is prescribed as "due-recycled waste" under the Waste Disposal Act.	–	–	The Home Appliances Recycling Law came into force in 2001. It caused a slight rise in illegal dumping. The way of charging recycling costs to the end-users at the recovery stage is still being. The Law for the Promotion of Utilization of Recycled Resources has been applicable to home and business PCs since 2003.
ELVs	–	ELVs are prescribed as "due-recycled waste" under the Waste Disposal Act.	–	–	The ELV Recycling Law comes into force in 2005. Producers are obliged to recycle ASR, CFCs, and airbags.

While Japan has many recycling laws governing each product, the Republic of Korea seems to cover all items under the one Resources Conservation and Recycling Promotion Law (the Recycling Law) and its EPR system. Also, the Republic of Korea and Taiwan both use strong terms, that is, “obliged recycling items” and “due recycled waste” respectively. They designate packaging waste, E-waste, and others as “wastes to be recycled” from the viewpoint of pollution prevention.

With regard to packaging waste, there are various bans or restrictions on the use of plastic bags in India, the Republic of Korea, and Taiwan. Such strong and direct control is evidence that many countries/regions have a great deal of trouble with disposable packaging in their waste management systems.

As for E-waste, responsibility for recovery and recycling is on producers under the EPR system in the Republic of Korea. In Japan, under the Home Appliances Recycling Law, producers are obliged to recover and recycle their products, and consumers pay the recycling costs.

The ELV Recycling Law of Japan, which comes into force in 2005, prescribes that when automobiles are discarded, the manufacturers are required to accept CFCs, airbags, and Automobile Shredder Residue (ASR) from the disposed automobiles and to recycle them appropriately, and that consumers are obliged to bear the expenses. Other Asian countries/regions have focused on new regulation for E-waste rather than ELV. This might imply that old vehicles are generally valuable and reused again and again in many Asian countries/regions.

ELVs and E-waste both contain hazardous substances like heavy metals. In order to prevent these leaking into the environment at small recyclers in developing countries, and to control the cycles of those materials, Asian countries should share necessary measures.

4. Concluding remarks

Every Asian country/region has a different background and characteristics in relation to material cycles and waste management policy. The data are often unreliable and thus difficult to share and compare. However, most countries/regions have common targets of implementing 3R and some countries are following the new concept of the sound material-cycle society. In addition, accelerating transboundary shipment of secondary materials (Terazono et al. 2004) requires cooperative measures and communication among countries. The tasks ahead of us demand the efficient utilization not only of resources but also of our intelligence in Asia.

Acknowledgments

The National Institute for Environmental Studies (NIES) and the Institute of Advanced Studies at the United Nations University (UNU/IAS) organized the First and Second Workshops on Material Cycles and Waste Management in Asia, held in 2002 and 2003, at Tsukuba, Japan, in order to understand the current status of waste management and material cycles, including import/export of end-of-life products in Asia. In 2004, a NIES workshop was held also, in order to deepen understanding of E-waste issues in Asia. The present work was supported by the participants at the above workshops, including Mr. H. Ma at State Environmental Protection Administration, China, Ms. H. Roosita at Ministry of Environment, Indonesia, Dr. G-J Oh at National Institute for Environmental Research, Republic of Korea, Dr. N. Tanaka at Hokkaido University, and Mr. K. Suzuki at Institute of

Advanced Studies, United Nations University, from China, Hong Kong SAR, India, Indonesia, the Republic of Korea, Malaysia, the Philippines, Taiwan, Thailand, Turkey, and Japan. All their support is greatly appreciated.

References

Bakkes, J., T. Heinrichs, E. Kemp-Benedict, T. Masui, C. Nelleman, J. Potting, A. Rana, P. Raskin, and D. Rothman. 2004. Municipal solid waste. In *The GEO-3 Scenarios 2003–2032: Quantification and analysis of environmental impacts*, edited by J. Potting and J. Bakkes, 113–118. Nairobi: UNEP and Bilthoven: RIVM. http://www.rivm.nl/bibliotheek/rapporten/402001022.pdf.

Clean Japan Center. 2002. Clean Japan Center website. http://www.cjc.or.jp (in Japanese).

Damodaran, N., A. Robinson, E. David, and N. Kalas-Adams. 2003. Urban solid waste generation and management in India. Paper delivered at the Ninth International Waste Management and Landfill Symposium, Cagliari, Italy, 6–10 October 2003.

Fang, L. 1999. Current situation and countermeasures of municipal solid waste in China. *Science Daily*, Dec. 1st.

Gao, X. et al. 2002. *The generation, composition and treatment of municipal solid waste in China*. Internal report, IPCC China Group.

Harashima, Y. and Y. Shimazaki. 2002. Chapter 2: Environment and growth. In *Environment* (annex 3: East Asia long-term economic statistics), 36–44, Tokyo: Keiso Shobo (in Japanese).

Hassan, M. N. 2000. Policies to improve solid waste management in developing countries: some insights in Southeast Asian Countries. In: Proceedings of the 2nd International Conference on Solid Waste Management, 191–207, Taipei: Environmental Protection Administration, Republic of China

Hong Kong Environmental Protection Department. 2004. Monitoring of solid waste in Hong Kong: Waste statistics for 2003. http://www.epd.gov.hk/epd/english/environmentinhk/waste/data/files/msw2003.pdf.

Hong Kong Environmental Protection Department. 2001. Future landfill development in Hong Kong: View-sharing Meeting on 2 March 2001. http://www.epd.gov.hk/epd/ english/environmentinhk/waste/pub_consult/landfill_backgr_r01.html.

Idris, A., B. Inanc, and M. N. Hassan. 2004. Overview of waste disposal and landfills/dumps in Asian countries. *Journal of Material Cycles and Waste Management* 6(2):104–110.

Inanc, B. 2003. Current status of waste management and landfilling practices in Turkey. Paper delivered at the Second Workshop on Material Cycles and Waste Management in Asia, NIES, 2–3 December 2003.

Inanc, B., A. Idris, A. Terazono, and S. Sakai. 2004. Development of a database of landfills and dump sites in Asian Countries. *Journal of Material Cycles and Waste Management* 6(2): 97–103.

Ishii, A. and M. Watanabe. 1996. Data on the waste management service in Indonesia (second edition). *Toshi-to-Haikibutsu* 26(3): 41–55 (in Japanese).

Istanbul Greater City Municipality. 2000. *Solid waste statistics report*, October 2000.

Japan Environmental Sanitation Center. 2001. *Fact book: Waste management and recycling in Japan* 2000. Tokyo: Japan Environmental Sanitation Center (in Japanese).

Japan International Cooperation Agency. 1997. Solid waste management plan for Metro Manila. Tokyo: JICA.

Lin, C-C. 2003. The review of waste management policy and legislation in Taiwan. Paper delivered at the Second Workshop on Material Cycles and Waste Management in Asia, NIES, 2–3 December 2003.

Magalang, A. A. 2003. Waste disposal system in the Philippines. Paper delivered at the Second Workshop on Material Cycles and Waste Management in Asia, NIES, 2–3 December 2003.

Matsuoka, S., R. Matsumoto, and I. Kochi. 1998. Economic growth and environmental problem in developing countries: The environmental Kuznets curve do exist? *Environmental Sciences* 11(4): 349–362 (in Japanese).

Metin, E., A. Eroztruk, C. Neyim, and F. Toksoz. 2002. *Solid waste management practices and review of recovery and recycling operations in Turkey*. Istanbul: ÇEVKO.

Ministry of the Environment, Japan. 2003. *White Paper on sound material-cycles society*. Tokyo: Gyosei (in Japanese).

———. 2004. *Waste management in Japan* 2001. http://www.env.go.jp/recycle/waste/ippan.html. (in Japanese).

Moriguchi. 2000. Material flows: Japan. In *The Weight of Nations*, edited by C. Hutter, Washington, DC: World Resources Institute. 78–91.

Nakagawa, H. 2003. Waste management in Asian countries and the direction of Japanese companies, *JMC Journal* 11:33–37 (in Japanese).

OECD. *See* Organisation for Cooperation and Development.

Organisation for Cooperation and Development (OECD). 2002. *OECD Environmental Data Compendium* 2002: Waste. Paris: OECD.

Sakai, S., S.E. Sawell, A. J, Chandler, T. T. Eighmy, D. S. Kossen, J. Vehlow, H. A. van der Sloot, J. Hartlén, and O. Hjelmar. 1996. World trends in municipal solid waste management. *Waste Management* 16(5/6): 341–350.

Selden, T. M. and D. Song. 1994. Environmental quality and development: Is there a Kuznets curve for air pollution emissions? *Journal of Environmental Economics and Management* 27(2):147–162.

Shekdar, A.V. 2002a. Municipal solid waste management in India: Integrated approach for betterment. Modak Memorial Lecture presented at the 18th National Convention of Environmental Engineers, organized by the Institution of Engineers (India), 19–20 October 2002.

Shekdar, A.V. 2002b. Recycling of solid waste in India. Paper presented in the Internatinoal Symposium on Sustainable Material Cycles, NIES, 5 November 2002.

Tanaka, M., H. Katsube, K. Ishizaka, M. Takagi, and K. Ohkubo. 2002. Estimation and prediction of generation, disposal level and cost of municipal solid waste in the world. *Journal of Japan Waste Management Association* 55:246–242 (in Japanese).

Tanaka, N., Y. Tojo, and T. Matsuto. 2003. History, current state and future of sanitary landfill technology in Japan. Paper delivered at the Second Workshop on Material Cycles and Waste Management in Asia, NIES, 2–3 December 2003.

Tata Energy Research Institute (TERI). 2000. *TERI energy data directory and yearbook* 2000/2001. New Delhi: TERI.

Tchobanoglous, G., H. Theisen, and S. Vigil, S. 1983. *Integrated solid waste management*. New York: McGraw-Hill, 40-44

Terazono, A., A. Yoshida, J. Yang, Y. Moriguchi, and S. Sakai. 2004. Material cycles in Asia: especially the recycling loop between Japan and China. *Journal of Material Cycles and Waste Management* 6(2):82–96.

TERI. *See* Tata Energy Research Institute.

Tsinghua University. 2002. China environment business: Current status and future expectation, Tokyo: Shinko Research. (in Japanese).

Vanapruk, P. 2003. Waste management in Thailand. Paper delivered at the Second Workshop on Material Cycles and Waste Management in Asia, NIES, 2–3 December 2003.

World Bank. 1999. *What a waste: Solid waste management in Asia*. Urban and Local Government Working Paper Series number 1. Washington, DC: World Bank.

———. 2001a. *Philippines environment monitor 2001: Solid waste*. Washington, DC: World Bank.

———. 2001b. *Project appraisal document for the Western Java Environmental Mnagement Project*. Report number 21029-IND. Washington, DC: World Bank.

Yang, J. 2003. Materials and waste flow in China. Paper delivered at the Second Workshop on Material Cycles and Waste Management in Asia, NIES, 2–3 December 2003.

Yoshizawa, S. and M. Tanaka. 2004. Estimation and prediction of generation of solid waste in the world. In *Proceedings of the the Annual Meeting of Japan Society of Waste Management Experts*, 38–40. Takamatsu. (in Japanese).

Zhang, Y. and C. Yang. 2002. Generation and composition of municipal solid waste in Shanghai. *Environmental and Sanitation Engineering* 11(3):104.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 499 – 510, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

Material Flows for a Sustainable City

Frank Ackerman[a]

Materials flow through cities on a daily basis, entering as needed products and leaving as wastes. Management of municipal solid waste provides both sanitation and recovery of valuable materials. At low income levels, market forces lead to recycling with no need for planning. In developing countries today, as in developed countries in the past, the relationship between urban wages and material prices promotes recovery of many materials. However, as wages rise, people become less willing to engage in labor-intensive recycling. At the same time, the waste stream expands and changes in composition; in particular, paper represents a greater fraction of urban waste at higher income levels. Although the market no longer compels recycling, people in high-income countries are willing to pay for municipal recycling programs, and often protest when recycling is cut back or eliminated. There is a need to plan for recycling in a high-income context, particularly for recovery and recycling of paper products, without reliance on the low wages that led to widespread recycling in the past. As Asian cities and countries develop in the twenty-first century, they will need to manage a changing and growing waste stream and plan for new approaches to recycling in order to make their development sustainable.

Keywords: Material flows, Municipal solid waste, Recycling, Waste management, Economic development.

1. Introduction

People everywhere use material goods and discard solid waste on a daily basis. In a city, the material flows in both directions, coming in and going out, greatly exceed the natural capacity of the local ecosystem. Food, fuel, and consumer goods must flow into the city to meet the needs of the urban population. Discarded wastes must flow out to disposal or processing sites, in most cases outside, or on the fringes of, the metropolitan area. The "ecological footprint" of a city is inevitably many times the size of the city itself.

Waste management can be viewed from two distinct perspectives: either in terms of sanitation or of material recovery. In the most obvious sense, prompt collection and disposal of solid waste is required for urban sanitation; wastes must flow outward every day. A subtler role can also be played by the waste management system: it can recover valuable used materials and reduce the need for new materials to flow inward, thereby contributing to the creation of a sustainable city.

The problems of waste management, and the opportunities to promote sustainable material flows, depend on the level of development. A low-income city has a characteristic pattern of waste, and a corresponding waste management system, bearing a partial resemblance to the preindustrial cities of the past. Recovery of valuable materials from urban waste occurs as a result of market forces, with no need

a. Program Director, Global Development and Environment Institute, Tufts University, Medford, MA, USA.

for planning. As incomes rise, the municipal waste stream not only expands, but also changes in composition—and the informal, market-driven system of recovery and recycling of valuable materials is weakened. At higher incomes, the requirements of sanitation and material recovery diverge; each must be addressed separately.

Recycling in today's developed countries is a new process, requiring formal organization and relying on nonmarket as well as market forces. As incomes rise in developing countries, it will be necessary to move quickly from traditional to modern styles of material recovery. This transition, although it involves new planning efforts and new expenditure, is a sign of success: it represents progress both in economic development and in the creation of more sustainable cities.

2. Waste in the preindustrial city

In the centuries before industrialization, most urban wastes were organic rather than manufactured in origin. In the cities of Europe and North America, animal wastes were common due to the widespread use of horses for transportation as well as the practice of raising pigs and other animals for food in low-income neighborhoods. Ashes from burning coal and other fuels made up another important component of the waste stream (Melosi 1981). As Benjamin Miller explains in his detailed history of New York City's waste management, many attempts were made to recover parts of this waste stream for use as fertilizer or other valuable products (Miller 2000). Yet none of these attempts were successful enough to solve the urban waste problem. Growing awareness of the health hazards of uncollected waste eventually led to the introduction of organized municipal waste collection and disposal around 1900.

In preindustrial Japan, the cities also produced a largely organic waste stream, but a different waste management system evolved to handle it. Animal wastes were not important, due to the very limited use of horses and the absence of food animals. Human night soil and ashes, some of the major urban wastes, were collected by farmers who used them to fertilizenearby fields. Rather than being unwanted wastes, these materials were actually commodities with positive prices. Night soil collection simultaneously addressed the sanitation and material recovery goals of waste management, a historically unique coincidence of these two objectives. In the closed economy of the Tokugawa period, the extremely labor-intensive process of manual collection of urban waste not only kept the cities clean, but was also one of the few opportunities for improving agricultural productivity. The practice survived for three centuries, until cheaper and higher-quality imported fertilizers became available in the early twentieth century (Tajima 2005).

Market-driven recovery of materials was not limited to organic waste. Recycling of durable materials and manufactured goods has always occurred, and probably represented a larger share of the supply of materials in the past. Historically, the motivation for recycling everywhere was the same as for night soil recovery in Japan: materials were expensive and labor was cheap. The economic history of medieval England, it has been argued, is a story of continual recycling (Woodward 1985). Winter coats, for example, were repaired and passed on from one generation to the next. Even when textiles became more widely available, in the initial period of industrialization, it was still common to economize on clothing,

with changing fashions reflected in the new decorations and accessories sewn onto old dresses (Fine and Leopold 1990; McKendrick et al. 1982).

The nineteenth-century American housewife, as described by historian Susan Strasser, was engaged in an unending and exhausting process of recovering, repairing, and reusing the household's material goods (Strasser 1999). Even though industrialization had begun to transform the leading sectors of the US economy, earlier modes of material use lived on. Packaging of consumer goods was essentially unknown until the twentieth century. Paper was an expensive product, made from cloth rags, until the development of much cheaper, wood-based papermaking in the second half of the nineteenth century. A textbook for American children written in 1882 still felt the need to provide a definition for "wastepaper basket" and explain its use (Strasser 1999, 67).

This extensive recycling and reuse of materials was not motivated by a commitment to sustainability or a belief in frugality, but rather by economic necessity. Some belief systems made a virtue out of necessity and advocated simplicity in material possessions. But few people of any religion could resist the temptation to consume more, and reuse and recycle less, as their incomes rose.

3. Wages and materials

Throughout the late nineteenth and early twentieth centuries, incomes rose rapidly in the countries that are now described as “developed”. In particular, incomes rose faster than material prices, so that it became possible for the average person to buy more goods. Indeed, this change is fundamental to the meaning of economic development: people become less the slaves, and more the masters, of their material environment. As a consequence, people consume more and discard more. Two examples from the United States illustrate this point.

First, the available historical data confirm that in the long run, the cost of material goods has been dropping when compared to wages. Figure 1 shows the price of cotton fabric and of nails expressed in terms of minutes of work time, at the average worker's wage, required to buy the goods.[1] In the 1830s, when price data are first available, the average unskilled worker had to work for more than an hour to earn enough to buy either a yard (about 91 cm) of cloth or a pound (454 g) of nails. By the 1960s, neither purchase required more than about five minutes' worth of wages (Ackerman 1997, 181).

The decline is almost continuous in both series, with the exception of the surge in prices caused by the Civil War (1861–1865); the extremely high cotton prices of those years are not shown because they would be far above the top of the graph. Both before and after the Civil War, the time required to buy both of these goods was clearly declining.

For the second example, consider the history of the disposable beverage container, one of the most visible and widely discussed forms of urban waste.[2] It is, in historical terms, a surprisingly recent form of trash. Before World War II, beer and soft drinks were sold only in heavy, refillable glass bottles—or more often, sold without any packaging because they were consumed on the premises of a bar or

1. The prices shown in this graph are wholesale prices; retail prices would have been higher.
2. This account is based on chapter 7 of *Why Do We Recycle?* (Ackerman 1997).

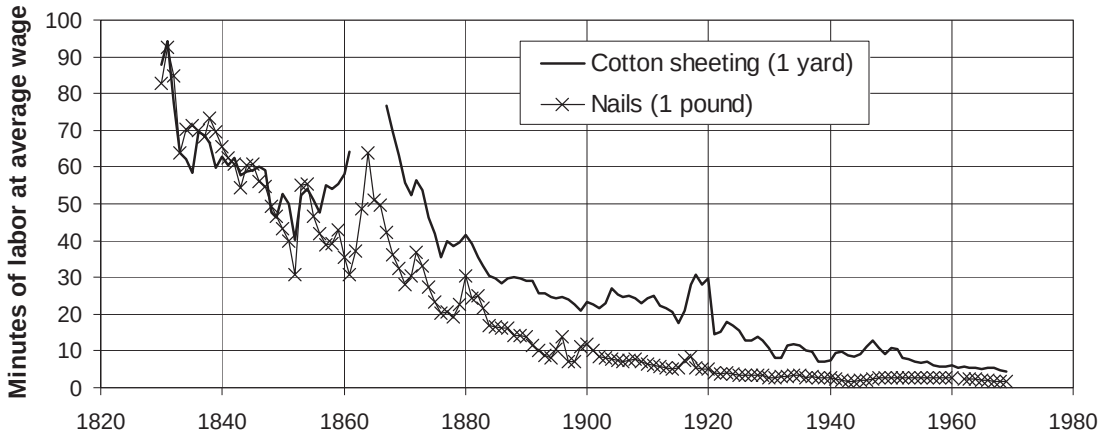


Figure 1. Labor time required to buy materials, 1830–1969

Note: The average wages used are for US urban unskilled labor (1830–1889) and US manufacturing labour (1890–1969).
Source: Ackerman 1997, p. 181.

restaurant. When refillable bottles were used, they were expensive enough so that bottlers charged substantial deposits in order to get the empty bottles returned.

The US beer industry, largely founded by German immigrants, had been accused of pro-German sympathies during World War I. In order to improve its public image during World War II, Anheuser Busch, the leading producer, shipped large quantities of beer in cans to US troops overseas. Even larger quantities of Coca-Cola were shipped to American soldiers during the war; General Eisenhower, the US commander in Europe, believed that Coke was healthier than beer, and persuaded the US government to build new Coca-Cola bottling plants close to the front lines.

Wartime consumption of beer and soft drinks, of course, occurred under circumstances that made it all but impossible to return the empty containers. Thus a generation of young Americans had the first large-scale experience of single-use, nonreturnable beverage containers. This remarkable feat was newly possible in the 1940s; a generation earlier, during World War I, the industry and its technology were far less developed, and shipment of canned or bottled beverages to American soldiers was not an option.

After World War II, traditional refillable glass bottles were initially cheaper than the new cans, but the returning veterans provided a crucial group of consumers who were familiar with, and continued to buy, beverages in cans. By the 1960s, technology had advanced to the point where single-use, nonreturnable bottles and cans became competitive with refillable bottles, and beverage container litter suddenly began to appear on roadsides and in public places. Economic growth created not just more waste, but qualitatively new forms of waste as well.

Beverage container waste, which by now has spread around the world, provides an indirect measure of economic development. Aluminum beverage cans are the most valuable common materials found in

urban waste; their scrap value can be as high as US $0.01 per can. Based on this fact, are aluminum cans unwanted wastes or valuable commodities?

My personal observation—which is only anecdotal information based on a very small sample—is that in Mexico, aluminum cans are never left on the street. Even when other, less valuable, containers are visible as roadside litter, there are no discarded aluminum cans to be seen. Instead, there are occasional storefront businesses that buy aluminum cans from collectors. At Mexican wages, $0.01 appears to be a big enough incentive for market-driven collection of cans.

In the United States, 11 of the 50 states have beverage container deposit/redemption systems, in most cases placing a $0.05 deposit on cans and bottles. Again based on personal observation, there are virtually no aluminum cans left on the street in states with deposits, where collectors receive $0.05 per can. In non-deposit states, however, where collectors would receive only $0.01, discarded aluminum cans do show up in public places. At US wages, therefore, it appears that $0.05 is a big enough incentive to pick up virtually all cans, but $0.01 is not. Note that the relevant wage is that of the urban poor, who engage in can collection, not the average wage. Countries with higher minimum wages and income supports will require bigger incentives to achieve the same level of material recovery through market mechanisms alone.

4. Urban waste in developing countries today

The cities of developing countries today are not repeating the experience of preindustrial Europe or Japan. Human wastes are treated as a sanitary problem, not as a source of fertilizer. Animal wastes are of small and declining importance. Modern manufactured goods are available and enter the waste stream, although in much smaller quantities per capita than in developed countries. Still, there are two great similarities to the waste management system of the preindustrial city: the large organic component of the municipal waste stream, and the availability of low-wage labor for market-driven recycling.

At low income levels, food waste is one of the largest components of urban waste today. As incomes rise, food waste declines in importance while manufactured goods, particularly paper and paperboard products, expand rapidly. This pattern can be observed in the World Bank estimates for solid waste composition by income level, as shown in table 1.

Table 1. Waste composition of low-, middle-, and high-income countries, 1995

	Country income level (%)		
Percentage of waste stream consisting of:	Low-income	Middle-income	High-income
Organics (e.g., food waste) and other (e.g., ash)	88	69	40
Paper and paperboard	5	15	36
Metals, glass, and plastics	7	16	24
Total	100	100	100

Source: Hoornweg with Thomas 1999.

If the low income pattern was expected to persist, then the top priority would be to develop composting programs for food waste (and plans for ash disposal in countries such as China where ash is an important part of the waste stream). Recycling of valuable materials might be expected to take care of itself, in the manner of aluminum can recycling in Mexico. However, this would be an incomplete waste management policy for two reasons: first, some forms of market-driven recycling need to be controlled or eliminated; and second, economic growth leads quickly into new patterns of waste and new challenges for material recovery.

Poverty is a blunt instrument when it comes to promoting recycling. Some of the activities it inspires, such as collecting discarded aluminum cans, may appear environmentally benign, although poorly paid. However, the same economic forces lead to much less desirable occupations, such as landfill scavenging, or manual recycling of electronic waste and other products containing hazardous materials. If labor is cheap and materials are expensive, a purely market-driven recycling process will be designed to capture and conserve valuable materials, not to protect the less valuable human inputs. At the extreme end of the scale, scavengers working—and in many cases, living—on a landfill site can recover many valuable discarded items, but at enormous cost to the scavengers' health.

Surely a sustainable city cannot be based on occupations that are harmful to human health. Thus one priority must be to regulate market-driven recycling, to eliminate the worst practices such as landfill scavenging, and to ensure that hazardous materials are only handled in facilities that provide appropriate protection for workers and the surrounding community.

Despite these concerns, much of the market-driven recycling process is environmentally benign. But it is also unstable. In a country that is rapidly developing, the economic incentives for recycling are rapidly diminishing. As incomes rise from Mexican to American levels, aluminum cans are suddenly left in the streets uncollected, as the can collectors find better paying jobs. The same fate, at varying income thresholds, awaits many other informal recycling processes that a low-income city relies on. A new, planned approach to recycling is needed, at the same time as the composition of the waste stream is changing, as shown in table 1, toward more paper and other manufactured goods.

5. The technical challenge: Paper recycling

In a high-income country, by far the most important material that can be recovered from the waste stream is paper. This conclusion is based above all on the large and growing quantity of paper waste; other materials, particularly metals, may have a higher price per ton.

Metals remain important, but in high-income countries they no longer represent growth industries. Increasingly, technological change is replacing metal (for example, in automobiles) with plastics and composites, which are often less valuable and always less recyclable than metals. Market-driven recycling processes still recover many metal objects; for instance, scrapyards extract metal from discarded automobiles, major appliances, and building materials. (These wastes are often excluded from the waste stream composition figures discussed above.) The cans, small appliances, and other metal

household objects found in the waste stream are worth recycling, but they are not the top priority for material recovery from urban waste.

Paper, in contrast, continues to be a growth industry. The widely discussed technological promise of the paperless computerized office has dramatically failed to come true. At one third or more of the waste stream in high-income countries, paper products represent a majority of the readily recyclable materials. In US recycling programs, more than half of the material collected is paper, whether measured by weight or by market value.[3]

Is paper recycling worthwhile? An academic debate has raged over this question for years, although as we will see in the next section, public opinion has been much less divided. Numerous studies have been done of the relative environmental impacts of recycling versus incineration of paper, with varying results.[4] In terms of energy use, producing paper from wood uses more *total* energy than recycling used paper, but much of the energy used in virgin paper production comes from burning wood waste (parts of the tree that are not made into pulp, and process byproducts); paper recycling uses as much or more *purchased* energy, and hence may entail more fossil fuel consumption. In terms of climate change impacts, studies that ignore forestry impacts often find roughly equal lifecycle greenhouse gas emissions from paper recycling versus incineration. However, if carbon sequestration in forests due to recycling is included in the analysis, recycling is a clear winner.[5] The studies are virtually unanimous in finding that landfilling is the worst option for paper; the only debate from an environmental perspective is between recycling and incineration.

Decisions about paper waste are crucial to the design of the entire waste management system. Since paper represents most of the recyclable material in the high-income urban waste stream, the amount of paper being recycled determines the size of a community's recycling program. Likewise, paper represents more than half of the energy content of the waste stream, so the amount of paper being burned determines the appropriate size, if any, of an incinerator. Profitable operation of an incinerator normally requires that it run continuously at close to full capacity, so it should be no larger than the waste stream that will remain after recycling.

There is a trap lurking here, which some American communities have fallen into: in order to build an incinerator, communities often have to sign long-term contracts to deliver fixed quantities of waste to it, at fixed disposal fees. Frequently the communities are responsible for the fees whether or not they deliver the waste. Once the contracts are signed, it is very expensive for those communities to start recycling more and incinerating less—in effect, they then have to pay both for incineration and for recycling of their paper waste. It is therefore wiser to build a little less incinerator capacity than is needed, rather than a little more. In some cases, the "loss" of paper waste to a recycling program may

3. See the annual reports (through 2001) on “Municipal Solid Waste in the United States” published by the US Environmental Protection Agency, available at http://www.epa.gov/epaoswer/non-hw/muncpl/msw99.htm.
4. For a review of this literature and summaries of some of the leading studies, see the *Journal of Industrial Ecology*, vol. 1 no. 3 (Summer 1997), a special issue on the industrial ecology of paper and wood.
5. When recycling increases and demand for virgin pulp decreases, forest owners cannot adjust their standing stocks of timber immediately, due to the long lags involved in growing trees; thus there is more sequestration in forests. The climate change implications of recycling are explored by the author in an article for *Local Environment* (Ackerman 2000).

make incineration as a whole unprofitable, in which case other disposal options should be explored for the remaining waste.

6. The political challenge: planning for high-income recycling

Parallel to the technical challenges of recycling paper and other valuable materials, there is a political challenge of planning and organizing a recycling program in a high-income community. As incomes rise and the waste stream expands and changes, the traditional market-driven form of recycling becomes less attractive and less reliable. Larger incentives are required to motivate more affluent people if market incentives are still to be the motive force behind recycling.

In fact, it is impossible to rely entirely or primarily on market incentives for material recovery in a high-income context. While it is possible to use deposits to raise the value of aluminum cans from $0.01 to $0.05, it would be impossibly expensive to do this for all wastes. Deposits are normally used only for wastes that would otherwise be a public nuisance, such as beverage containers, or that pose health or environmental hazards if discarded improperly, such as lead-acid automobile batteries.

Even if it were somehow affordable, it might not be desirable to have deposits high enough to bring back market-driven recycling of most recoverable wastes. To do so would once again make materials more valuable relative to average wages; it would bring back the feeling of poverty, of materials being expensive and labor being cheap. The real challenge of high-income recycling is to find cost-effective, sustainable ways of recovering valuable materials without making everyone feel poor.

In the United States, the modern era of recycling began with advocacy and volunteer efforts in the 1970s, followed by the first municipal programs in the 1980s. In the 1990s recycling swept the nation, with more than half of the population served by curbside recycling programs by the end of the decade. Recycling emerged in many other developed countries on similar schedules. In this context, recycling was not a response to market incentives, for materials were cheap and the purely economic incentives for recycling were weak. Rather, it was part of the environmental movement, the upsurge in environmental consciousness and advocacy that began in the 1970s. People wanted to recycle because they wanted to save the earth—and they wanted to find tangible ways to participate in that effort.

Does recycling actually help save the earth? The environmental benefits of recycling include reduced air and water pollution and reduced impacts of extractive industries on surrounding communities and ecosystems due to the reduced demand for virgin raw materials. Other benefits include movement toward sustainable resource use, allowing a richer bequest of natural resources to future generations, and a sense of visible public participation in environmental improvement. Early advocates of recycling, at least in the United States, often confused the public debate by overemphasizing the “need” to reduce waste disposal and solve the so-called landfill crisis. In retrospect it is clear that there was no landfill crisis, and not even a shortage of landfill capacity in most of the country. But that was never really the point; despite the availability of landfill space, recycling remains widespread and popular.[6]

6. These issues are discussed at greater length by Ackerman in *Why Do We Recycle?* (Ackerman 1997).

It is equally mistaken to suggest, as some critics of recycling have done, that existing recycling programs are prohibitively expensive and should be abandoned in order to save money. Some increase in expense should be expected: public support for recycling implies a desire to do more than the market is doing on its own, to push beyond the bounds of what is currently profitable. A well-run municipal recycling program adds a little to total waste management costs—but only a little. In the mid-1990s, under typical American conditions, a curbside recycling program increased the overall cost of waste management by an estimated $21 per household per year (Ackerman 1997, ch. 4).

A conventional cost-benefit analysis would then ask whether the environmental benefits of recycling were worth as much as $21 per household.[7] It is hard to answer this question, since so many of the benefits are difficult or impossible to monetize (Ackerman and Heinzerling 2004). Nonetheless, an ambitious and detailed national study of recycling in Australia found that monetized environmental benefits exceeded net economic costs for every recycling scenario in the study (National Packaging Covenant Council 2001).

As an alternative to the hopeless task of pricing all the environmental benefits of recycling, it is possible to ask people what they are willing to pay—and then see if a recycling program can be run for that amount or less. When researchers have asked Americans how much they are willing to pay for the existence of municipal recycling programs, the answers have generally been above $21 per household per year. Studies in Utah and Tennessee, far from the most environmentally oriented states in the country, find a mean willingness to pay for municipal recycling of $2–7 *per month* (Aadland and Caplan 1999, 2003; Caplan et al. 2002; Tiller et al. 1997). This suggests that communities with recycling programs are getting something they are willing to pay for, consistent with the observed popularity of recycling. Cutbacks in recycling, motivated by municipal budget crises, have provoked grassroots opposition: both New York City and Washington, DC have attempted such cuts, and both cities have ended up restoring recycling in response to popular demand.[8]

A European study cites four estimates of the willingness to pay for participation in recycling programs, ranging from €20 to €290 per household per year (van Beukering 2001). The lower of these figures is comparable to the estimated costs of a typical American recycling program. Although some European recycling programs are reportedly quite expensive, the survey data suggest that Europeans would be willing to cover the costs of American-style recycling.

Enthusiasm for recycling has led to thousands of municipal recycling programs in the United States and Canada. While these programs have emerged within affluent societies, they are still under continual pressure to economize, to minimize the cost of recycling. Yet in contrast to the market-driven recycling of low-income countries, high-income recycling operates in an environment of comparatively expensive labor and cheap materials. Now there is pressure to increase labor productivity through mechanization and program design that maximizes the quantity of material handled per person-hour. In high-income recycling, materials are at times mistreated to save labor; in low-income recycling, the reverse is true.

7. For a thoughtful presentation of this perspective on waste management, see Porter's study (2002).

8. The suspension of recycling in Washington, DC occurred during a crisis of municipal mismanagement that led to severe budget cuts in 1997. In New York, the recycling program was cut back in 2002, and restored in early 2004—in part because the cutbacks saved much less money than the city had anticipated. See Natural Resources Defense Council 2004.

Decentralized experimentation throughout the United States and Canada has led to a range of local innovations that have increased efficiency and lowered costs of recycling; these efforts are far too diverse and numerous to describe here.[9] Those who are interested in lowering the costs of recycling should also study the example of Australia, which appears to have more mechanized and less expensive recycling programs than most of North America.[10]

7. Conclusions

As countries develop and incomes rise, the requirements of sanitation and material recovery diverge. New, valuable materials enter the waste stream—and the materials most worth recovering are among the least likely to pose health or sanitary hazards. Waste management systems need to develop to meet both objectives; this is likely to include the replacement of old, seemingly effortless patterns of material recovery. As a country develops, it should expect to lose much of its informal, market-driven recycling system. Indeed, it should celebrate this loss, for the old style of recycling rested entirely on poverty and sometimes endangered the health of the poor.

Based on the experience of today's developed countries, rising incomes will be accompanied by advocacy and support for new forms of recycling. While market incentives may play a supporting part in encouraging recycling, environmental values and beliefs play the leading role. From the perspective of sustainability, it is encouraging that affluent people, who can afford to discard materials, still want to participate in material recovery. It is a practical step that people are willing to take in response to values rather than prices, a first hint of a social order beyond market necessity.

Yet affluence does not arrive overnight; as a country grows, it remains essential to make recycling as efficient as possible, to keep its costs down and ensure that it remains affordable. The wide range of international experience with recycling provides a good starting point for designing new programs for rapidly developing countries. North American and Australian recycling programs have shown that it is possible to recover significant quantities of materials at very low cost. However, their collection systems have been designed for relatively low-density urban areas. Further innovations may be needed to create appropriate recycling programs for the Asian cities of the twenty-first century.

References

Aadland, D. and A. J. Caplan. 1999. Household valuation of curbside recycling. *Journal of Environmental* Planning *and Management* 42(6) (November 1999): 781–799.

——. 2003. Willingness to pay for curbside recycling with detection and mitigation of hypothetical bias. *American Journal of Agricultural Economics* 85(2) (May 2003): 492–502.

Ackerman, F. 1997. *Why Do We Recycle? Markets, Values, and Public Policy*. Washington, DC: Island Press.

——. 2000. Waste management and climate change. *Local Environment* 5(2):223–229.

9. Information on US and Canadian recycling is available through the National Recycling Coalition (http://www.nrc-recycle.org) and in the magazines *BioCycle* (JG Press, Emmaus PA, USA, http://www.jgpress.com/biocycle.htm) and *Resource Recycling*, (Portland OR, USA, http://www.resource-recycling.com/rr.html) among other sources.

10. Based on the data in the National Packaging Covenant Council's study (2001) and on personal observation.

Ackerman, F. and L. Heinzerling. 2004. *Priceless:On Knowing the Price of Everything and the Value of Nothing.* New York: The New Press.

Caplan, A.J., T.C. Grijalva, and P.M. Jakus, 2002. Waste not or want not? A contingent ranking analysis of curbside waste disposal options. *Ecological Economics* 43(2–3) (December 2002): 185–197.

Fine, B. and E. Leopold. 1990. Consumerism and the industrial revolution. *Social History* 15(1):151–179.

Hoornweg, D. with. L. Thomas. 1999. What a waste: Solid waste management in Asia. World Bank, Urban and Local Government Working Paper 1. Washington, DC: World Bank. http://www.worldbank.org/ html/fpd/urban/publicat/waste.pdf.

Kendrick, N., J. Brewer, and J. H. Plumb, eds. 1982. *The birth of a consumer society: The commercialization of eighteenth-century England*. Bloomington, Indiana: Indiana University Press.

Melosi, M. 1981. *Garbage in the cities: Refuse, reform, and the environment, 1880–1980*. College Station, Texas: Texas A&M University Press.

Miller, B.. 2000. *Fat of the land: Garbage of New York—The last two hundred years.* New York: Four Walls Eight Windows.

National Packaging Covenant Council. 2001. Independent assessment of kerbside recycling in Australia. http://www.packcoun.com.au/NPC-FINAL-01.pdf.

Natural Resources Defense Council. 2004.*Recycling returns: Ten reforms for making New York City's recycling program more cost-effiective.* New York: NRDC. http://www.nrdc.org/cities/recycling/returns/returns.pdf.

Porter, R. 2002. *The economics of waste.* Washington, DC: RFF Press.

Strasser, S. 1999. *Waste and want: A social history of trash.* New York: Metropolitan Books.

Tajima, K. 2005. The marketing of urban human waste in the Edo/Tokyo metropolitan area: 1600–1935. PhD dissertation, Tufts University.

Tiller, K. H., P.M. Jakus, and W.M. Park 1997. Household willingness to pay for dropoff recycling. *Journal of Agricultural and Resource Economics* 22(2) (December 1997): 310–320.

van Beukering, P. 2001. *Recycling, international trade, and the environment: An empirical analysis.* Dordrecht, Netherlands: Kluwer Academic Publishers.

Woodward, D. 1985. Swords into plowshares: Recycling in pre-industrial England. *Economic History Review*, second series 38:175–191.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 511 – 530, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on the Environmentally Sustainable City

The Informal Sector's Role in Urban Environmental Management

A. T. M. Nurul Amin[a]

This paper starts by tracing the origin of the *informal sector* and *urban environmental management* (UEM) paradigms. Their points of intersection in solid waste management and in the provision of water supply and sanitation are investigated based on a large number of published and unpublished studies. In addition to identifying the supply- and demand-side factors, the underlying economic and financial fundamentals and socio-political causes of informal-sector involvement in urban environmental provision are explored. The informal sector's contributions to urban environmental management are highlighted for: the mutually reinforcing roles of the informal sector and UEM, the pioneering role of the informal sector in stimulating private investment in urban environmental infrastructure, the socially crucial transitional function of informal-sector involvement in UEM, and the role of the informal sector in stimulating competition in UEM. The paper proposes two strategies to strengthen the beneficial role of the informal sector in urban environmental management. One strategy seeks to alleviate health hazards associated with the informal sector's involvement in urban environmental service provision. The other seeks to overcome the polarized viewpoints as to suitable institutional options for this provision. A matrix for distribution of responsibility among the competing stakeholders is presented to facilitate finding the optimal role for the informal sector in urban environmental management.

Keywords: Informal sector, Urban environmental management, Waste management, Water supply, Sanitation.

1. Background

In view of the nature of this inquiry, it is worth noting how the *informal sector* and *urban environmental management* paradigms originated in development literature. The literature on the informal sector traces the term to the 1972 International Labour Organization (ILO)-United Nations Development Programme (UNDP) employment mission to Kenya (International Labour Organization 1972), which was undertaken in the middle of a global search for ways and means to create more employment for millions of job seekers in cities of developing countries. Such missions, particularly to the developing countries, were follow-ups to the creation of the World Employment Programme of the ILO in 1969. Since then, the informal sector has been studied from various angles according to respective needs. For example, some authors have found the informal sector to be a helpful analytical mode for studying the nature of segmentation or duality in the urban labor market (Piore 1983; Mazumdar 1983; Amin 1982). Some others have assessed the efficiency of the informal sector as a tool for urban poverty alleviation (for example, Harriss 1989). The sector has also been studied from an urban planning perspective (Amin 1992; Harper 1992, 1996). Recent attention on the informal sector

a. Professor, Urban Environmental Management field of study, School of Environment, Resources and Development, Asian Institute of Technology, Thailand.

has been from the "decent work" perspective (International Labour Organization 1999), which has led to a search for ways and means to bring work in the informal sector up to the standards of decent work (Amin 2002).

The UEM literature is relatively young and has started to grow only in the last decade. Drawing an analogy with the ILO's "discovery" of the informal sector as a possible means of urban absorption of rural migrants, it can be said that the World Bank's urban policy agenda for the 1990s influenced the search for a new paradigm that would move the discourse beyond the *housing and residential infrastructure* paradigm of the 1960s and 1970s and that would emphasize: (i) increasing the productivity of the urban economy and the need to alleviate constraints on productivity; (ii) increasing the productivity of the urban poor by increasing demand for labor and improving access to basic infrastructure and social services; and (iii) reversing the deterioration of the urban environment (World Bank 1991, 3). At this time, problems of water supply, sanitation, congestion, air pollution, and power shortages had started to threaten the leading role played by cities in economic development.

The three policy goals of increasing urban productivity, reducing urban poverty, and improving urban environments contributed to the emergence of the UEM paradigm. Many urban academics and professionals started to pay attention to environmental problems in Third World cities. One of the earliest works in this direction is that of Hardoy, Mitlin, and Satterthwaite (1992). The paradigm of UEM, however, was not yet born. Some planning schools in Asia[1] started to realize that the old paradigms of urban planning and housing alone were no longer adequate to address the problems that were besetting cities in developing countries with huge populations, unabated rural-to-urban migration, vast informal sectors,[2] and rapid economic growth in some cities exacerbating traffic congestion and air pollution (Hardoy, Mitlin, and Satterthwaite 1992). The first explicit use of the UEM paradigm was in two journals: *Regional Development Dialogue* (*RDD*) (vol. 15, no. 2, Autumn 1994) and *Regional Development Studies* (*RDS*) (vol. 1, Winter 1994/95).[3] Four papers (Webster 1994; Shin 1994; Utea 1994; and Lee 1994) together form the UEM sub-theme in that issue of *RDD*. Almost simultaneously, *RDS* published a major paper by Mukoko (1994/5) that traces UEM's origins to "sanitary engineering, environmental health, urban and regional planning, and public administration" (Mukoko 1994/5, 132). Two other distinguished publications on UEM that came out around that time are those of White (1994) and a GTZ publication by Atkinson (Atkinson 1997). Atkinson, jointly with Vorratnchaiphan, also used the UEM paradigm in two journal articles based on research in Thailand (Atkinson and Vorratnchaiphan 1994, 1996).

The credit for first investigating the role of the informal sector in urban environmental management goes to Romanos and Chifos (1996) and Perera and Amin (1996). Romanos and Chifos document a

1. For example, the Asian Institute of Technology (AIT) and the Office of Housing and Urban Program of USAID organized a workshop on "The Role of the City in Environmental Management", 21–24 September 1992, in Bangkok, which culminated in AIT developing a UEM curriculum (Parenteau and Foo 1993) and its presentation to a USAID-AIT Research Triangle Institute workshop, 5–7 May 1993 at AIT, Bangkok. The actual birth of UEM as an academic program, however, did not take place until the Canadian International Development Agency (CIDA) approved the CUC (Canadian Universities Consortium)-AIT proposal for establishing UEM as an academic program in November 1996.
2. In view of the huge presence of the informal sector in the urban economies and environments, Amin (1992) and Perera (1994) stress the need to accommodate the informal sector in urban planning paradigms.
3. Both journals are published by United Nations Centre for Regional Development (UNCRD), Nagoya, Japan.

wide variety of studies that clearly suggest the informal sector contributes in (i) solid waste collection, disposal, and recycling; (ii) water provision; (iii) improving air quality; and (iv) greening through urban agriculture. Perera and Amin report the results of an assessment of the potential of informal enterprises to contribute to UEM. They also identify enterprises with the potential to adversely affect environmental quality, which is intended to help in the design of public policies and actions that mitigate the adverse effects while allowing the enterprises to continue operating. It should, however, be noted that the pollution implications of the informal sector were addressed even in the 1980s (for example, in Sethuraman 1981; Omuta 1986), and this continues (for example, Blackman 2000).

Having set the context, the rest of this paper looks at: definitional issues (section 2); deprivation that creates an association between the informal sector and UEM (section 3); the supply- and demand-side factors that lead to the informal sector's involvement in UEM (section 4), and their underlying causes (section 5); the informal sector's contributions to UEM (section 6); and proposed strategies for enhancing the informal sector's role in UEM (section 7). Some concluding remarks are made in section 8.

2. Informal sector and urban environmental management defined

In view of the problems associated with definitions and lack of consensus not only on the definitions but even on the utility of the *informal sector* and *urban environmental management* paradigms, it is in order to explain briefly the senses in which they are used in this paper.

2.1. Informal sector

Depending on whether the analytical focus is on people, activity, or habitat, the informal sector is distinguished from the formal sector by: (i) certain labor and employment characteristics (such as lack of official protection/recognition, lack of coverage by wage legislation and other social security systems, predominance of own-account work; absence of trade union organization, low income and wages, little job security, and absence of fringe benefits from institutional sources); (ii) enterprise operation characteristics (such as very small-scale operation, unregulated and competitive market, reliance on locally available resources, family ownership, labor-intensive and adapted technology, and absence of access to institutional source of credit and similar support or protection); and/or (iii) land and housing characteristics of settlements (such as unauthorized use of vacant land, illegal subdivisions/renting of land, unauthorized construction, reliance on cheap and locally available scrap construction techniques, lack of application of safety standards and regulations, and non-availability of mortgages or any other financing) (Amin 1996, xvii). Such settlement characteristics sometimes lead to restricted access to basic services, which can also be used as a criterion for distinguishing between informal and formal land and housing settlements. Such lack of access to basic services gives rise to rudimentary service provision by informal labor and enterprises—what Montgomery (1988) calls the informal service sector.

All three of these dimensions for distinguishing the informal sector from the formal sector are, to some degree, relevant for this paper. Enterprise and service provision characteristics certainly are. Labor and employment aspects of the informal sector might, in the first instance, appear to be irrelevant. Their value, however, will be appreciated from section 7, particularly from the strategy proposed for reducing

occupational hazards and improving working condition of informal-sector labor engaged in waste recycling and sanitation services. Thus, all three dimensions of the informal sector noted above are of some relevance for the issues addressed in this paper.

In case readers are confused by the several areas of application and the use of so many characteristics for drawing distinctions between the formal and informal sectors, let me note that despite the diverse composition and varying defining characteristics, the different entities of the informal sector have a basic common denominator: a lack of solid legal or official status that the state machinery and institutions bestow upon formal-sector employment, businesses, and settlements. This lack of solid legal and official status should not, however, be equated with illegality. Also, its transitory nature is a characteristic hallmark of informal-sector employment, enterprises, and housing, although they may exist for considerable periods of time. This transitory nature emanates in part from the aspirations of many of its participants to one day graduate from the informal to the formal sector. It also reflects the attitude of the state, which sometimes seems to wish for the demise of the informal sector. Again, this does not mean that the informal sector will one day disappear; in some places it may, while in others it may not. More importantly, new types of transitory employment, activities, and settlements may appear. Increasing subcontracting and outwork practices in the formal sector, which are giving rise to new forms of informality, are two examples.

2.2. Urban environmental management

Instead of explicitly defining UEM, White, in his book *Urban Environmental Management: Environmental Change and Urban Design* implies that UEM means the study and practice of urban planning and management from an environmental perspective (White 1994, xii). Writing around the same time, Mukoko states that UEM means "the systematic and conscious effort on the part of city or municipal government or any other public institution to influence human activities susceptible of damaging the environment" (Mukoko 1994/95, 132). For this paper, urban environmental management is defined to include a set of concepts, tools, public policies, and actions that allow urban environmental problems to be addressed. These problems include those related to water supply, sanitation, waste, and air pollution.

3. The magnitude of water and sanitation deprivation

Given that improving access to clean water and to sanitation are two key targets in the Millennium Development Goals and that they are also two of the three UEM subsectors that are addressed in this paper, it is worth examining their present status:

- Two billion people have no access to safe water or adequate sanitation (UN-HABITAT 2003).
- More than half the population in most large cities in Sub-Saharan Africa, and many in Asia, still lack water piped to their home and good quality toilets (ibid.).
- Some 100 million urban dwellers worldwide have to defecate in open spaces or into waste paper or plastic bags ("wrap and throw") (ibid.).

Table 1 provides data from UN agencies on lack of water.

Table 2 compares the definitions used for assessing the status of water and sanitation in developing countries with the definition of *adequacy* used for high-income countries. Two points should be noted here. First, no matter which definition is used, the number of people without such basic necessities as water and sanitation is huge. Second, the definitions of both *improved* and *adequate* are very modest compared to what is considered adequate for urban resident in high-income countries. Although in many instances applying different standards according to level of income is wholly justified, on closer examination it would appear that what is seen as adequate for high-income countries should really be the norm for water and sanitation everywhere for all people; these are basic needs for which setting different standards is probably not acceptable because they have implications for health, productivity and income, life expectancy, child mortality, and maternal care.

Table 1. Different estimates of the proportion and number of urban dwellers lacking water and sanitation provision in 2000

Region	Percentage and absolute number of urban dwellers without improved[1] provision of…		Percentage and absolute number of urban dwellers without adequate[2] provision of…	
	water	sanitation	water	sanitation
Asia	7 % 98 million	22 % 297 million	22 % 297 million	35–50 % 100–50 million
Africa	15 % 44 million	16 % 46 million	16 % 46 million	35–50 % 500–700 million
Latin America and Caribbean	7 % 29 million	13 % 51 million	13 % 51 million	20–30 % 80–120 million

Source: World Health Organization and UNICEF data on improved water and sanitation and UN-HABITAT data on adequate access to water and sanitation provided in Environment & Urbanization 2003, p. 6.

1. "Improved" water supply here was defined as access to water through household connection, public standpipe, borehole, protected dug well, protected spring, and/or rainwater collection. Unprotected well, unprotected spring, vendor-provided water, bottled water, and water provided by tanker truck as means of meeting water demands were not considered as improved. Access to "improved" sanitation was defined as meaning being connected to a public sewer, connection to a septic system, a pour-flush latrine, a simple pit latrine, and/or a ventilated improved pit latrine. Service or bucket latrines (where excreta are manually removed), public latrines, and open latrines were not considered improved sanitation.
2. "Adequate" access to water and sanitation, according to the definition used here, requires continuous, good-quality piped water supply into the house or house yard; hygienic, well-maintained, easily accessed toilets that are used by all family members; and safe and convenient disposal of wastewater.

Table 2. Differing definitions for assessing adequate water and sanitation

Term	Water	Sanitation
Adequacy for high-income countries	• Potable water is piped into every home; • This water is distributed by internal plumbing to toilets, bathrooms, and kitchens; and • Piped water is available 24 hours a day.	• At least one water flush toilet in every house or apartment; • Guaranteed supply of water for flushing; • A water basin in the bathroom or close by where hands can be washed; and • Facilities for personal hygiene: hot water and a bath or shower.
Adequate for developing countries	• Continuous and good quality water piped into the house or house yard.	• Hygienic, well-maintained, easily accessed toilets that are used by all family members, and safe and convenient disposal of wastewater.
Improved for developing countries	• At least 20 liters available per person per day; • From a source within 1 kilometer of the person's house: - Household piped water connection, - Public standpipe, - Protected spring and rainwater collection, - Water from standpipes, - Boreholes, and/or - Protected dug wells (no stipulation that this water is safe to drink).	• Shared pit latrine, with no stipulation that they are easy to access or clean; • Connection to a public sewer; • Connection to septic system; • Pour-flush latrine; • Simple pit latrine; and/or • Ventilated improved pit latrine.

The paragraph above should not, however, be understood to imply that a universal standard is being advocated for immediate implementation irrespective of income level of a country, city, or household. The intention is simply to show that the measures used for determining access to water and sanitation are indeed very modest. This means that the above aggregated data do not fully reveal human deprivation in terms of water and sanitation. Only micro-level household survey data can reveal how many people really are able to meet their water and sanitation needs. One household survey (Islam 1998) reveals that on average, a toilet in a Dhaka slum is used by 61.3 people, who wait for about an hour to get a chance to use it. It goes without saying that these toilets are very makeshift arrangements. The same survey also reveals that more than half an hour is required for travel to and from a water hydrant and once again, an hour's queuing is required. This situation is by no means atypical for a low-income country's slum residents.

4. Supply and demand for informal-sector involvement in UEM

In simple terms, the deprivations, noted briefly above, have given rise to the presence of an informal sector in the cities of developing countries, and this has also created new opportunities for UEM in these

cities, particularly with respect to solid waste management, water supply, and sanitation provision. This section of the paper elaborates these new opportunities in a supply-and-demand framework.

4.1. The supply side

The presence of unemployed populations, urban youth, a constant flow of migrants from rural areas, and retrenched workers from the public and private sectors, along with increased participation of women in the labor force, are some of the key factors that have created a huge urban labor pool whose only way to survive in the cities is to create their own jobs. They do this by providing services to urban residents, businesses, and industries. This has led to an expansion of the informal sector to a vast size: 40 to 60 percent of the urban "employed" labor force in developing countries is actually in the informal sector (see Amin 2002, 12–20).

4.2. The demand side

No matter how powerful the supply side and how true the classical dictum that supply creates its own demand, laborers cannot continually create their own jobs indefinitely—no matter how ingenious they are in doing so. There must be enough demand-side development for the supply to make sense. To the traditional demand for cheap labor from business and industry, a new dimension has been added by the huge concentration of wealth, assets, income, purchasing power, and investment in cities, which have been described by McGee (1996) as "theatres of accumulation". In these theatres, demand for labor is diverse. Hawkers, peddlers, rickshaw drivers, construction workers, a variety of people providing services for tourists, and piece-rate workers in slums and low-income settlements in cities of developing countries have been widely familiar for some time. Just as familiar is the work of waste-pickers in the city waste-collection points and dump sites. What are still not so well known are all the different informal-sector activities centering on various phases of waste collection, disposal, recycling, and processing, or, particularly, those in the provision of water and sanitation. Table 3 provides a catalogue of informal services in subsectors of UEM.

5. Underlying causes of informal sector involvement in UEM

The immediate supply- and demand-side factors do not fully reveal the underlying causes of informal-sector involvement in UEM. The interplay of powerful economic, social, and political forces is also shaping the nature of informal-sector involvement in UEM.

5.1. Economic and financial fundamentals

The fundamental reason for the informal sector's involvement in UEM is, simply, the inadequacy of the financial resources available to build and operate urban environmental infrastructure. The huge costs of building a water supply system, drainage and sewerage lines, and wastewater treatment facilities is often an insurmountable barrier for countries at early stages of development with huge urban populations. In an increasingly globalized world with free capital flow, domestic capital shortages can, however, be overcome with capital inflow from abroad. Indeed, foreign direct investment (FDI) flow has increased tremendously, but it is not being invested in the urban environmental infrastructure and services sector (Minh and Amin 2002). Like all capital, FDI opts for profitable sectors. One major

Table 3. A catalogue of informal-sector activities in UEM subsectors

UEM subsector	Informal sector activities
Solid waste management	*In waste collection and separation* • Buying of reusable and recyclable wastes from households by itinerant buyers, which provides incentives for waste separation by household members. • Separation of waste by waste-pickers (also called rag-pickers) at the primary collection points and dump sites. *In waste recycling* • Waste-buying shops around dumpsites, neighborhoods, and commercial centers (buying from waste-pickers and sometimes from municipal waste collectors). *In waste processing* • Informal-sector workshops and factories process or manufacture recovered materials into recycled goods (in all cases there are links with the formal sector too; see Sinha and Amin (1995) and Thepkunhanimitta and Amin (1998). • From simple, outright reuse of recoverable waste to buying and selling to processing and manufacturing (Siddique 1996).
Water supply	• Hawkers selling bottled water in trains, buses, and steamers. • Water vending (Kyessi 2005, 9). • Independent providers. • Truckers with private wells providing quality water when public service companies' water is of doubtful quality (Solo 1999, 122). • From simple water vending or selling of bottled water as hawkers to becoming full-fledged "water entrepreneurs". • On the basis of a review of several francophone African countries, Collignon (1998, 3) notes that a variety of operators, "often in the informal sector, take over various water functions" when public authorities abandon their role of providing water. These are: • The concessionaire (young and college-educated, not craftsmen or tradespeople, obtain concessions as private operators). • The pump operator (with six months' training on required skills: competence as mechanic, plumber, and electrician). • The carter (carters transport small volumes of water—200 to 600 liters—from one supply point to another. This is a well-established profession in Sahel towns). • The standpipe manager (whereas carters are typically below 25 and little educated, and have not much social standing, standpipe managers are typically older, more educated, and more established in the community). • The repair company (including mechanics, plumbers, pump repairers, and others).
Sanitation	• Sweepers who also collect and dispose of night soil; • Sewage-removal services; • Septic-tank emptiers;. • Night-soil carriers;. (Solo 1999, 122; Amin 2004) • Private wastewater treatment plants, such as SIBEAU in Contonou, which charges septic-tank-pumping trucks to receive and treat sullage, dumping the products into the ocean after secondary treatment (Solo 1999, 122). • Moving from traditional ways of collecting night soil to becoming operators for Vacutug machines (which collect sullage through a pump) (Amin 2004).

reason for inadequate capital investment in urban environmental service provision is an enduring sense that these are public services, which are associated with a "culture of non-payment". Economists have even rationalized public ownership, citing the natural monopoly characteristics of these services and their subsidization, and the positive externalities that the services generate.

It should be added that economic argument has not so much been for public ownership as for finding suitable solutions to the problems associated with private monopolies. As long as a private monopoly can be regulated to ensure competitive pricing and quality of services, there is no economic argument against allowing private provision of infrastructure and services. Unfortunately, the pendulum has swung so far that privatization of these infrastructure-based services is now undertaken without consideration of the economic and welfare implications. The irony of all this is that despite built-in cost advantages associated with urban infrastructure and services (arising from economies of scale and agglomeration), there is a large gap between their supply and demand. Why this is the case is difficult to answer. However, it appears that different positions and counter-positions on institutional options for providing these services do not make the task easier. This point is briefly addressed in the next section.

5.2. Unhelpful positions and counter-positions on institutional arrangements

Near-polarized views on suitable institutional and organization arrangements for building and delivery of infrastructure and services also seem to have contributed to the informal sector's involvement in urban environmental service provision. These views are briefly noted below:

- *Government cannot do the job*: In spite of strong economic considerations that favor public-sector provision of basic infrastructure and services, the current political mood around the world is clearly against it. This view has got the upper hand in recent years, partly because of governments' failure to deliver and partly because of the political views of the powerful. There is reason to believe that, in the absence of this powerful backing, non-governmental organizations (NGOs) and even UN agencies would not be so much against government provision.
- *The private sector can do the job*: Organizations like the World Bank and the Asian Development Bank (ADB) advocate private-sector provision of urban environmental services. In a report published by the ADB, Pernia and Alabastro lament that "private enterprises currently account for a smaller share in total capital spending for urban services than that is generally believed to be their maximum potential given appropriate incentives" (Pernia and Alabastro 1997, 24). They firmly believe that: "A move toward privatization and decentralization can improve the current coverage of water and sanitation" (ibid., 35).
- *Community organizations can do the job*: Perhaps because of the failure of the governments and mistrust of the private sector, a strong lobby has emerged globally for community-based organizations (CBOs) to provide basic services. Proponents of this position argue that the economies-of-scale case has been overstressed by economists. Issues of financing and cost recovery do not feature much in this argument. Solo, particularly, argues strongly against the involvement of foreign companies with an interesting "fairy tale" (Solo 1999, 117–118).

- *Small, competitive, private-informal enterprises can do the job*: Citing examples of informal-sector service provision for the poor and by the poor, many people are excited by the idea of relying upon informal-sector-type small, competitive enterprises for urban environmental service provision (see, for example, Solo 1999; Katui-Katua and McGranahan 2002; Collignon 1998).

Each of the above positions has some merit. But they can be counterproductive if together they result in indecision and inaction on the part of the decision-makers and political leaders. In fact, the best option is not one or another of these positions, but a complementary mix of different options. Perhaps there is not a single country or city where urban environmental service provision does not reflect a mix of local government, private sector, and CBO/NGO involvement. In cities of developing countries, the informal sector's contribution is also in this mix.

In summation, it can thus be said that inadequate drives to attract capital investment for urban environmental infrastructure and services, reluctance to adopt user charges for cost recovery, and unhelpful polarization of views on institutional arrangements have all left many urban residents without institutional service provision. The emergence of the informal sector has been defined, at least in part, by these realities in cities of developing countries. In a fundamental sense, this phenomenon also reflects the kind of response expected at low levels, or during early stages, of the development of a country.

6. The informal sector's contributions to UEM

As table 3 briefly catalogues informal-sector activity in the three UEM subsectors and Romanos and Chifos (1996) provide a more detailed documentation of the informal sector's contributions to UEM, this section is limited to highlighting the end results of these contributions, as follows:

- *Mutually reinforcing relationship between the informal sector and UEM*: The increased gap between urban environmental services provided by institutional sources and urban residents' requirements creates opportunities for informal-sector involvement in provision of these services, particularly for the poorer urban residents.
- *Cost-minimization*: Perhaps the single greatest contribution of the informal sector is reducing costs in the provision of urban environmental infrastructure and services, in numerous ways. The best-documented instance is the informal sector's role in waste reduction, reuse, and recycling, which substantially reduces municipal costs for solid waste management. These contributions, particularly in waste separation, facilitate waste recycling and composting of organic wastes, which results in reduction of environmental costs. A growing trend of involvement of informal-sector enterprises in selling water, and the resulting competition, reduce the retail price of water to households in communities without piped water supplies.
- *Paving the way for private-sector investment in urban environmental infrastructure and services:* Those who want to see private-sector investment in urban environmental infrastructure and services and lament its current limited role (for example, the Asian Development Bank, USAID, and the World Bank) may view informal-sector activities as heralding eventual private-sector investment. Indeed, the informal sector serves a testing role, assisting the private sector to reduce the risk of investment. Those who cite limited private-sector investment as evidence that urban

environmental infrastructure and services are unattractive to private enterprise (for example, Budds and McGranahan 2003, 35) may lose some ground if informal enterprises appear to do brisk business in waste, water, and sanitation provision. This vanguard role of the informal sector should be a lesson also for local governments, encouraging them to move in the direction of cost recovery for their municipal services.

- *Socially crucial transitional role*: The vanguard role of the informal sector described above is also transitional in the sense that the informal sector remains active until the formal private sector finds it attractive enough to invest in waste management, water supply, and sanitation provision. But this transitional role holds equally, if not more, for local governments taking over provision of such basic services to all citizens of a country or city, which usually becomes possible at a certain level of economic development and when the local government commands more financial resources and has better management capabilities. In the interim, the informal sector serves a crucial social role, meeting the basic service needs of low-income and poor urban residents.
- *Stimulating competition*: Although this point does not apply only in the context of the informal sector's role in UEM, it is worth noting that informal-sector contributions to UEM have brought a good deal of competition in basic urban environmental service provision, which has traditionally been without it. As noted previously, economists even rationalize monopolies in such service provision as long as public welfare considerations are guaranteed either by public ownership or by regulation of private monopolies.

The above by no means is an exhaustive list of currently prevailing or potential roles of the informal sector in UEM. They are simply some examples based on the author's understanding of the roles and documentation provided by Romanos and Chifos (1996) and Perera and Amin (1996).

7. Strategies to enhance the informal sector's role in UEM

In a market economy with democratic polity and pluralistic values, it would be expected, to an extent, that the informal sector would automatically contribute to UEM, and this is what happens. Because of this, laissez-faireists advocate doing nothing. This is, however, not a healthy strategy. On the one hand, a total non-interventionist approach would entail ignoring the harsh realities faced by informal-sector labor (for example, waste-pickers working in open dumpsites without any protective gear); on the other, total absence of public policy or action may lead to non-optimal outcomes (for example, not rewarding the informal sector's role in waste separation and reduction will mean positive externalities are not internalized, with the theoretical risk that the informal sector's involvement will be less than environmentally and socially desirable). With the above premise, the author suggests adoption of strategies that enhance the informal sector's role in UEM. Since such strategies can never be comprehensive when they come from only one mind, even if they are based on review of many scholars' contributions, I will note two guiding principles that underline the two corresponding strategies proposed in sections 7.1 and 7.2 to enhance the informal sector's role in UEM:

1. Making optimal use of informal-sector labor and enterprises, while paying due care and attention to the basic urban service needs of these people and their enterprises.

2. Adoption of an objective approach in choosing a mix of options in urban environmental service provision.

7.1. Strategy to alleviate health hazards

There are many doubts, concerns, and questions relating to the role of the informal sector in general, not just to its contributions to UEM. Most of these are justified, and many, if not all, can be meaningfully addressed. Again, a few examples only will be presented. One legitimate concern is the health hazards associated with many informal-sector occupations and activities. There are many good examples by now of public action to alleviate these concerns. One example is the work of Waste Concern with waste-pickers in Dhaka, which resulted in their wearing protective gear while working in the waste dump sites or during waste separation. What was a policy recommendation in an academic work (Sinha 1993; Sinha and Amin 1995) was made real by establishing an environmental NGO, Waste Concern. The result drew national and international attention[4]. Many such works in other cities have been documented by the author (Amin 2002, 115–123).

Another concern is that informal-sector enterprises can be polluting. Bartone and Banavides (1997), among others, raise this alarm. Their research reveals that hazardous wastes are generated by some small-scale and cottage industries, and the same is true of informal-sector workshops. Two points should be made here. One, few informal-sector activities linked to environmental service provision appear to be polluting. There is, however, a segment of the informal sector (informal-sector manufacturing enterprises or informal workshops) which does generate industrial waste, some of which can be hazardous (Maldonado and Sethuraman 1992). But Sethuraman (1981) and Omuta (1986) argue that pollution by the informal sector is "actually a manifestation of an unresponsive physical planning system" that does not allow space for informal-sector businesses to operate (Omuta 1986, 183). Perera (1994) has demonstrated, with case studies in Colombo, that accommodation of the informal sector in the urban built environment is a good strategy for urban environmental management.

7.2. Strategy for promoting optimal roles for the informal sector in UEM

As was pointed out in section 5.2, the apparent discord among the international community, donors, national governments, local governments, the private sector, NGOs, and the informal sector as to adoption of institutional mechanisms for urban environmental infrastructure and service provision is unfortunate and counterproductive. Politicians and policymakers are bewildered by conflicting ideas and recommendations coming from many sides. All concerned need to avoid the polarizing tendency in their viewpoints. To this end, table 4 presents a framework to highlight what is probably an optimal distribution of responsibilities in the provision of urban environmental infrastructure and services with respect to solid waste, water supply, and sanitation. The guiding principles here are making the most of the comparative advantages of respective stakeholders and avoiding the tendency to consider one option superior to others in all respects.

4. For this and many other good works on Waste Concern, see the organization's website: www.wasteconcern.org.

Table 4. Toward defining the optimal roles of the informal sector and other stakeholders in key UEM subsectors

Role of …	Solid waste	Water supply	Sanitation
Households	• Separating waste (the informal sector's buying reusable and recyclable of waste serves as an incentive to households). • Composting at least some organic waste for gardening.	• Giving higher priority to the value of water supply for personal hygiene. • Being willing to pay for water. • Not underestimating their own ability to pay. • Taking into account all direct and indirect expenses for obtaining water in estimating individual household ability to pay. • Conserving water and harvesting rainwater.	• Valuing highly sanitation's benefits for health and productivity.
Communities, CBOs, and NGOs	• Organizing environmental awareness campaigns encouraging households to reduce and separate waste (it is crucial that this takes place at household level). • Organizing unemployed youth in a community to collect waste from households (at a charge) and deliver it to the primary collection point. • Assisting informal-sector workers in protecting themselves from health hazards. • Considering the feasibility of undertaking composting at community level.	• Raising households' awareness of the contribution of water to health and safety, and simultaneously of the importance of conserving water. • Undertaking collective initiatives to obtain connections to water supply pipes and making necessary investments for the connections.	• Campaigning to raise households' awareness of the value of sanitation. • Educating children, women, and men on sanitation in general and toilet use and hand washing in particular.
Informal-sector workers and entrepreneurs	• Active involvement in recovery of resources from waste. • Taking advantage of opportunities to buy and sell recyclable wastes. • Organizing to obtain better prices for resources recovered from wastes • Protecting themselves from health hazards.	• Carrying water. • Vending water (buying water from institutional and private sources and then selling to households without access to water supply). • Working with local governments and the private sector to establish a market niche in water supply.	• Acquiring the necessary skills to seize market opportunities in building toilets, cleaning pit latrines, and emptying septic tanks for households in slums and low-income communities. • Setting up shops with labor who have necessary skills for providing sanitation services to households and communities.

Table 4—*continued*

Role of …	Solid waste	Water supply	Sanitation
The private sector	• Taking advantage of market opportunities opened up by informal-sector labor and enterprises in waste collection, transportation, and disposal. • Seeking complementarities with informal-sector workers and enterprises instead of considering them competitors.	• Making use of informal-sector operations to learn about the market. • Seizing market opportunities from residents' increasing demand for water. • Making necessary investment for water supply infrastructure.	• Private-sector enterprises should seize the huge market opportunities of investment in sanitation infrastructure in general and toilet business in particular.
Local governments	• Providing necessary infrastructure for delivering waste to the primary collection points. Safe transportation of waste. • Dumping and disposal of wastes in environmentally sound ways (e.g. sanitary landfills). • Supporting all stages of solid waste management. • Considering subcontracting of some services (e.g., collection and transportation of wastes, billing and collection of payments).	• Being willing to charge for water. • Making use of the informal sector and private sector. • Being ready to extend water supply in a businesslike fashion (i.e., seize opportunities when there is new demand and make sure costs for extending the service are recovered). • Being willing to adopt cross-subsidization principles for reducing the cost burden on the poor while still ensuring cost recovery.	• Allowing informal-sector operators and unemployed youth to build toilets (suitable locations should be determined by environmental assessment, but this should not stifle initiative and enterprise). • So-called unauthorized settlements and informal business locations should not be barred from building sanitation facilities (after all, many of these settlement have stood for a long time and in all likelihood will stand for years more). • Charging user and service fees for use of public toilets and all sanitation services, including drainage and sewerage. • Allowing informal-sector and private operators of toilets to charge their users. • Making use of informal-sector labor and enterprises to build and clean drainage and sewerage lines and to clean public toilets.

Table 4—*continued*

Role of …	Solid waste	Water supply	Sanitation
National governments	• Allowing the initiatives of local governments, CBOs and NGOs, the private sector, and the donor community, and recognizing informal-sector workers' right to work. • Adopting necessary policies to attract FDI in urban environmental infrastructure and services. • Promoting cost recovery measures to encourage capital investment.	• Giving top priority to water. • Investing in water supply systems. • Allowing charging for water. • Legislating cost-recovery provision. • Providing incentives for FDI in water supply systems.	• Taking overall responsibility for ensuring all related agencies and stakeholders prioritize sanitation. • Depending on the situation in the country and city, deciding whether having separate and independent drainage and sewerage authorities is necessary. • Attracting necessary investment, particularly FDI if domestic capital is not enough. • Requiring cost recovery for all sanitation services. • Facilitating cross-subsidization wherever possible, to reflect that societies are made up of different classes with different ability to pay. • Freeing state agencies of responsibility to provide free services. • Promoting a culture of payment for services, especially among the public. This should lead to generation of new revenue that can be invested in operation and maintenance and in new infrastruture.
International development agencies and donors	• Instead of seeking to weaken national governments and their agencies and adopting a we-know-it-all attitude, international development agencies and donors should support good initiatives by CBOs/NGOs, the informal sector, the private sector, and local governments.	• Supporting financially and environmentally sound initiatives by all stakeholders. • Facilitating transfer of financial resources (both official development aid (ODA) and FDI) for investment in water supply systems.	• Instead of seeking to weaken national governments (at least those that are democratically elected and practice democratic polity), encouraging them to give high priority to sanitation and find optimal roles for the private sector, the informal sector, CBOs, and NGOs. • Directing ODA and FDI toward infrastructure for sanitation. • For donor institutions and agencies committed to promoting domestic private-sector investment, recognizing the vanguard role of the informal sector in opening new market opportunities, and supporting and promoting domestic private-sector and informal-sector involvement in providing infrastructure and services for adequate sanitation provision to the urban poor in low-income communities.

Note: This exercise is inspired by Montgomery (1988). Despite focusing on the informal sector as a means of basic urban service provision, Montgomery's article reflects his deep and comprehensive understanding of comparative advantages of national and local governments and the informal sector in different aspects of service provision.

8. Concluding remarks

The informal sector and urban environmental management are two paradigms that have their origins in two different kinds of urban crises that are experienced by developing countries: the informal sector in growing urban unemployment and rural–urban migration, and UEM in the environmental problems that threaten the quality of urban life. It is still surprising that the two have become intertwined in our cities. Documented evidence clearly shows that the relationship between the informal sector and UEM has become one of mutual benefits. Nobody imagined until recently that so many income-earning opportunities would be created for informal-sector labor by urban environmental service provision. Likewise, urban development professionals did not anticipate that the informal sector could be a potential supplier of environmental services required for solid waste management and for the provision of water and sanitation. For those of us urban development professionals who have worked on both areas, the intersection between the informal sector and UEM has been rewarding. Hopefully this has not affected the objectivity of this investigation.

With the above disclaimer, let me note that the piled-up studies and research—by a combination of (i) those who work on the informal sector (International Labour Organization 1972, 1991, 1999; Rakowsky 1994); (ii) those who work on urban environmental management (Hardoy, Mitlin, and Satterthwaite 1992; White 1994); (iii) some who have done work on both areas (Sethuraman 1981; Perera 1994; Amin 2002); and (iv) a few who have worked connecting the two (Omuta 1986; Amin 1991; Romanos and Chifos 1996; Perera and Amin 1996)—show that informal-sector contributions to UEM are substantial and could potentially be even greater. This is due to impetus from market forces that have never been so powerful as they are in contemporary world. As limited scope of planning has made UEM more relevant to urban development professionals, fewer jobs in the public sector and even in the formal private sector have made the informal sector of greater significance from an employment point of view. But this does not mean that planning has become irrelevant for enhancing the quality of life in cities or that secure jobs in the formal sector are not essential for people to be able to afford a decent standard of living.

Having noted these two qualifications, let me end by restating the main points made in this paper. The informal sector's contributions to UEM are substantial, as was noted in section 6. This paper, however, raises two concerns. The first is that when informal-sector workers contribute to UEM, in many instances it is at the cost of their health and often entails sacrificing their children's education. This in turn entrenches intergenerational transfer of poverty. Thus, informal-sector work must be turned into decent work, which requires job security and safety, increased productivity and income, and improved working conditions. For the purposes of this paper, the foremost issues are reducing health hazards and improving working conditions. Public policy and action in this regard are not expensive. Simple awareness campaigns on risks to health and some assistance in obtaining protective gear can make a lot of difference. There are very many good practices in this area, but these are still limited to demonstrations by a few successful NGOs. Local governments must now take these up for citywide implementation.

The second concern is the tendency of stakeholders to take polarized positions on options for institutional arrangements for service provision, which is unnecessary and unhelpful. This paper has given considerable attention to seeking compromise. Table 4 sets out a proposed distribution of responsibilities between the informal sector and other stakeholders.

The two strategies proposed in section 7 to address these concerns are only examples; there could be others. It should also be noted that in actual implementation, these will generate several sub-strategies. The point is that recognizing and supporting the role of the informal sector in urban environmental service provision is essential for ensuring and enhancing the positive impacts of the informal sector's involvement, and for reducing its negative impacts.

Acknowledgements

The author would like to express gratitude to Ms Trinh Thi Bich Thuy and Mr Hoang Duc Vuong's intelligent research assistance and patient and careful word-processing in the preparation of this paper.

References

Amin, A. T. M. N. 1982. *An* analysis of labour force and industrial organization of the informal sector in Dhaka. Ph.D. thesis, Department of Economics, University of Manitoba.

———. 1991. Guidelines for effective utilization of the informal sector in urban waste management. Report prepared for the Division of Industry, Human Settlement and Environment, UN Economic and Social Commission for Asia and the Pacific, Bangkok.

———. 1992. Urban planning in metropolitan areas of Asia: the challenge of accommodating the informal sector. *Southeast Asian Journal of Tropical Medicine and Public Health* 23 (3):119–129.

———. 1996. The informal sector paradigm: Analytical contributions and developmental role, editorial introduction of *Regional Development Dialogue* 17(1) (Spring): vi–xxviii.

———. 2002. *The informal sector in Asia from the decent work perspective*. Working papers on the informal sector economy, no. 4. Geneva: International Labour Office.

———. 2004. *Financing and cost recovery of decentralized wastewater management: Findings from two Vietnam and two Bangladesh cases*. Background paper prepared for DFID-GHK project on Capacity Building for Effective Decentralized Wastewater Management, UEM/AIT, 26p.

Atkinson, A. 1997. *Urban environmental management in South-east Asia: An overview of current practice*. Eschborn, Germany: GTZ.

Atkinson, A., and C. P. Vorratnchaiphan P. 1994. Urban environmental management in a changing development context: The case of Thailand. *Third World Planning* Review 16(2):147–169.

———. 1996. A systematic approach to urban environmental planning and management: Project report from Thailand. Environment and Urbanization 8(1):235–248.

Blackman, A. 2000. Informal sector pollution control: What policy options do we have? *World Development* 28(12):2,067–2,082.

Bartone, C. R., and L. Benavides. 1997. Local management of hazardous waste from small-scale and cottage industries. *Waste Management and Research* 15(1):3–21.

Budds, J., and G. McGranahan. 2003. *Privatization and the provision of urban water and sanitation in Africa, Asia and Latin America*. Human Settlement Discussion Paper Series—Theme: Water 1. London: International Institute for Environment and Development (IIED).

Collignon, B. 1998. Private operators who supply water to small African communities and poor districts in Burkina Faso, Mauritania, Mali, and Senegal. Paper presented at the Community Water Supply and Sanitation Conference, World Bank, Washington, DC, 5–8 May 1998. http://www.wupafrica.org/toolkit/customers/collignon-ssips-africa.html.

Environment & Urbanization. 2003. Water, sanitation and drainage: Ensuring better provision with limited resources. Editorial. *Environment & Urbanization* 15(2):3–10.

Hardoy, J. E., D. Mitlin, and D. Satterthwaite. 1992. *Environmental problems in Third World cities*. London: Earthscan.

Harper, M. 1992. The city as a home for enterprises: Has anything changed for the informal sector?. *Habitat International* 16(2):143–148.

———. 1996. Urban planning and the informal sector. *Regional Development Dialogue* 17(1):97–112.

Harriss, J. C. 1989. Urban poverty and urban poverty alleviation. *Cities* 6(3):186–194.

International Labour Organization. 1972. *Employment incomes and equality: A strategy for increasing productive employment in Kenya*. Geneva: International Labour Office.

———. 1991. The dilemma of the informal sector. Report of the Director-General, presented to the International Labour Conference 78th Session. Geneva: International Labour Office.

———. 1999. *Decent work*. Report of the Director-General of the International Labour Conference, 87th Session. Geneva: International Labour Office.

Islam, M. S. 1998. Improving the work and living environment of urban poor: Focus on the delivery of basic urban services at community level of Dhaka city, Bangladesh. Masters thesis, Asian Institute of Technology, Bangkok.

Katui-Katua, M., and G. McGranahan. 2002. *Public-private partnerships and the poor: Small enterprises and water provision in Kibera, Nairobi*. London: IIED.

Kyessi, A. G. 2005. Community-based urban water management in fringe neighbourhoods: The case of Dar es Salaam, Tanzania. *Habitat International* 29:1–25.

Lee, Y. S. F. 1994. Community-based urban environmental management: Local NGOs as catalysts. *Regional Development Dialogue* 15(2):158–182.

Lipsey, R. G., P. N. Courant, and C. T. S. Ragan. 1998. *Economics*. New York: Addison-Wesley.

Maldonado, C., and S. V. Sethuraman, 1992. *Technological capability in the informal sector: Metal manufacturing in developing countries*. Geneva: International Labour Office.

Mazumdar, D. 1983. Segmented labour markets in LDCs. *American Economic Review* 73(2):254–259.

McGee, T. G. 1996. On the utility of dualism: The informal sector and mega-urbanization in developing countries. *Regional Development Dialogue* 17(1). Nagoya, Japan: UN Centre for Regional Development.

Minh, N. T. B. and A. T. M. N. Amin. 2002. The role of foreign direct investment in urban environmental management: Some evidence from Hanoi, Vietnam. *Environment, Development and Sustainability* 4:279–297.

Montgomery, J. D. 1988. Informal service sector as an administrative resource. In *Urban services in developing countries: Public and private roles in urban development*, ed. D. A. Rondinelli and G. S. Cheema, 89–111. Basingstoke, UK: Macmillan Press.

Mukoko, S. 1994/95. Strengthening urban environmental management capabilities in developing countries. *Regional Development Studies* 1 (Winter): 131–142.

Omuta, G. E. D. 1986. The urban informal sector and environmental sanitation in Nigeria: The needless conflict. *Habitat International* 10(3):179–187.

Parenteau, R. and T. S. Foo. 1993. The proposed UEM program and curriculum. Paper presented at the USAID-RIT-AIT workshop for discussing establishment of the UEM program and curriculum, May 1993, AIT, Bangkok.

Perera, L. A. S. R. 1994. Accommodating informal sector enterprises in the urban built-environment. HSD monograph no. 36. Bangkok: AIT.

Perera, L. A. S. R. and A. T. M. N. Amin. 1996. Accommodating the informal sector: A strategy for urban environmental management. *Journal of Environmental Management* 46:3–15.

Pernia, E. M. and S. L. F. Alabastro. 1997. *Aspects of urban water and sanitation in the context of rapid urbanization in developing Asia.* Economic staff paper no. 56. Manila, ADB.

Piore, M. 1983. Labour market segmentation: To what paradigm does it belong? *American Economic Review* 73(2):249–253.

Rakowski, C. A. 1994. *Contrapunto: The informal sector debate in Latin America*. New York: State University of New York Press.

Romanos, M. and C. Chifos. 1996. Contributions of the urban informal sector to environmental management. *Regional Development Dialogue* 17(1):122–155.

Sethuraman. S. V. 1981. *The urban informal sector in developing countries: Employment, poverty and environment.* Geneva: International Labour Office.

Shin, E. 1994. Economic analysis and valuation of urban environmental problems. *Regional Development Dialogue* 15(2):129–145.

Siddique, F. 1996. A planning study of the Dolaikhal area for its improvement as an informal enterprise industrial district in Dhaka. Masters thesis, Asian Institute of Technology, Bangkok.

Sinha, A. H. M. M. 1993. The formal and informal sector linkages in waste recycling: A case of solid waste management in Dhaka City. Masters thesis, Asian Institute of Technology, Bangkok.

Sinha, A. H. M. M. and A. T. M. N. Amin. 1995. Dhaka's waste recycling economy: Focus on informal sector labour groups and industrial districts. *Regional Development Dialogue* 16(2):173–197.

Solo, T. M. 1999. Small-scale entrepreneurs in the urban water and sanitation market. *Environment and Urbanization* 11(1):117–131. http://www.ingentaselect.com/09562478/v11n1/.

Thepkunhanimitta, P., and A. T. M. N. Amin. 1998. Formal and informal sector linkages in waste recycling: A case study at Prawate District in Bangkok, Thailand. Masters thesis, Asian Institute of Technology, Bangkok.

UN-HABITAT. 2003. *Water and sanitation in the world's cities: Local action for global goals.* London: Earthscan.

Utea, K. 1994. The role of local government in urban environmental management. *Regional Development Dialogue* 15(2):146–157.

Webster, D. 1994. Integrated approach to urban environmental management: The ASEAN case. *Regional Development Dialogue* 15(2):115–128.

White, R. R. 1994. *Urban environmental management: Environmental change and urban design*. London: John Wiley & Sons.

World Bank. 1991. *Urban policy and economic development.* Washington, DC: World Bank.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 531 – 540, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Special Feature on Environmentally Sustainable City

Inter-city Environmental Cooperation: The Case of the Kitakyushu Initiative for a Clean Environment

Mushtaq Ahmed Memon,[a] Christine Pearson,[b] and Hidefumi Imura[c]

Despite major investments in rural development, urbanization is an irreversible trend. In the wake of rapid urbanization, international cooperation has become increasingly important to support the building of local capacity to address environmental concerns. Inter-city cooperation is a recent trend in this regard. This paper discusses the major concepts that form the basis for inter-city cooperation to facilitate local capacity building, with reference to the Kitakyushu Initiative for a Clean Environment. The paper also briefly outlines selected inter-city cooperation programs, highlighting the new approaches of international cooperation in urban environmental management.

Keywords: Capacity building, Urban environmental management, Inter-city cooperation.

1. Introduction

Rapid urbanization is an irreversible phenomenon. Today, most of the world's urban population lives in Asian cities. The United Nations Department of Economic and Social Affairs (UNDESA) Population Division report on World Urbanization Prospects (UNDESA 2003) indicates that in Asia-Pacific, the urban population will increase from approximately 1.4 billion in the year 2000 to about 1.8 billion by 2010, and will reach almost 2.3 billion by 2020. In 1975, there were only two megacities with populations over 10 million, Tokyo and Shanghai, in Asia-Pacific (UN HABITAT 2003, 25); currently, this region is host to 11 megacities out of a total of 19 megacities worldwide. Major cities also form the backbone of economic growth in most of the countries of this region.

However, urbanization and economic activities have an enormous impact on the environment due to water, air, noise, and soil pollution. This has adverse health and socio-economic consequences that go beyond cities, countries, and regions. To reverse this trend, urban environmental infrastructure and services must be enhanced. There have been various strategies developed to improve urban infrastructure and services; however, their sustainable management and operation has been difficult due to lack of local capacity (Fukuda-Parr 2002).

The next section briefly highlights the major environmental issues and gaps facing local governments. The third section reviews the current strategy of international cooperation to support local capacity building through inter-city cooperation. The fourth section discusses the Kitakyushu Initiative for a

a. Senior Policy Researcher, Urban Environmental Management Project, IGES, Japan.
b. Project Officer, Urban Environmental Management Project, IGES, Japan.
c. Professor, Nagoya University and Project Leader, Urban Environmental Management Project, IGES, Japan.

Clean Environment and briefly introduces other inter-city cooperation programs. The fifth section concludes the paper by providing suggestions to improve inter-city cooperation in order to broaden its coverage and impact.

2. Urban environmental challenges

There is an ever-widening gap between demand for urban environmental infrastructure and services—for water supply and sanitation, wastewater treatment, solid waste management, public transport, and pollution control measures—and available supply. Beyond the geographical borders of cities, pollution is resulting in loss of various environmental resources, through, for example, surface and ground water pollution, deforestation, loss of biodiversity, and degradation of air and soil quality. Moving beyond country borders, acid rain and haze are becoming major concerns in the region. At the global level, greenhouse gas emissions are causing marked changes in climate patterns. Nevertheless, due to the immediate impact on the community, the most important challenges for local policymakers include the improvement of access to water supply and sanitation, management of solid waste and wastewater, and control of local air pollution from different sources (Hardoy, Mitlin, and Satterthwaite 2001; Leitmann 1999). International focus has also shifted to local issues, as outlined in the Millennium Development Goals, adopted by UN member states in 2000 (see http://www.un.org/millenniumgoals).

To improve urban environmental capacity, national and international agencies have started to focus on the importance of decentralization to the local government level, coupled with local capacity building and stakeholder participation (Shah 1998). Local capacity that is needed includes: planning capacity for environmental infrastructure and pollution management, regulatory capacity to introduce regulations for local situations where national regulations are not available, institutional capacity to implement regulations and provide environmental services and infrastructure through various partnerships, financial capacity to support institutions and various measures, technical capacity to monitor pollution levels, and capacity to involve local stakeholders in decision making and implementation of various measures (Memon, Imura, and Hitsumoto 2003). These could be broadly grouped into “assessment” and “response” capacities. Assessment capacity covers primarily capacity to carry out DPSER[1] for various urban environmental challenges. For effective and efficient urban environmental management, it is critical to carry out a detailed assessment of the environmental challenges, identify the sources and the immediate and underlying causes of pollution, analyze the impact of the pollution at various levels, and chalk out possible responses or interventions to control the pollution and mitigate its impact. Response capacity covers the ability to implement those responses or interventions (regulations, financial mechanisms, stakeholder participation, and appropriate technological interventions). However, many cities do not have even the basic capacity to monitor environmental changes, and this can lead to difficulties in identifying and implementing appropriate responses.

1. The DPSER (driving force, pressure, state, effect response) model has been widely used to assess the level of environmental change, its sources and underlying causes, and to identify possible strategies for bringing improvements (Imura et al. 1999). This model is also applicable to assess the level of capacity for environmental management (Japan International Cooperation Assistance 2003).

3. Conceptual development of inter-city cooperation

From the early 1970s to the late 1980s, international cooperation focused on providing consultancy services and monitoring equipment, as well as support for high-tech and capital-intensive projects and services. This assistance failed to enhance local environmental management capacity and had little impact on environmentally sustainable development. Fukuda-Parr (2002) highlights important reasons for the failure of international cooperation as a whole, which are relevant for inconsistencies in environmental cooperation as well. The major reason cited for this failure is donor-driven and supply-oriented imported models and foreign expertise; asymmetric donor-recipient relationships were characteristic of such international cooperation and a fixation on physical/visible projects was the norm.

During the 1980s and 1990s, various international agencies and individuals undertook a critical review of international cooperation, covering both general cooperation issues and international environmental cooperation more specifically (Cassen and Associates 1985; Rix 1990; OECD 1991; OECD 1992; Koppel and Orr 1993; Berg and United Nations Development Programme 1993; OECD 1995; Matsuoka 1996; United Nations Development Programme 2001; Fukuda-Parr, Lopes, and Malik 2002). These analyses suggest that most general international cooperation, and international environmental cooperation in particular, might be more effective if emphasis were placed on developing local capacity, rather than solely on the promotion of high-profile and expensive infrastructure projects. Furthermore, a lack of locally appropriate capacity for project identification and implementation led to distorted priorities, while local objectives and wishes were ignored, resulted in a lack of a sense of ownership and participation by the local stakeholders. Donors also understood that the cities, while coping with current levels of urbanization and economic growth, required an appropriate social and institutional culture to sustain an environment in which individual expertise could perform optimally.

These reviews also recommended that capacity building should supplement local knowledge and existing capacity by incorporating appropriate international knowledge. This required an analysis of international experiences with reference to transferability in accordance to local conditions. Stiglitz (2002) promotes the concept of “scan globally and reinvent locally” to make knowledge transfer and acquisition a success. Hence, the process of capacity development should be based on the transformation of local knowledge and existing capacity rather than its displacement by introducing foreign knowledge. Fukuda-Parr (2002) sums up these new directions of international cooperation as: recipient driven and demand driven, improving local knowledge and involving local expertise, promoting partnerships and ownership of local stakeholders, and focusing on institutional strengthening and societal capacity development.

Since the first Earth Summit in Rio de Janerio, Brazil, in 1992 (the World Summit on Sustainable Development), various global and regional inter-city initiatives have been launched focusing on local capacity building in one specific environmental area (for example, solid waste management) or on overall urban environmental management. Some initiatives also take a focus beyond environmental concerns, as they see environment as only one of the major aspects in the creation of a “sustainable city”.

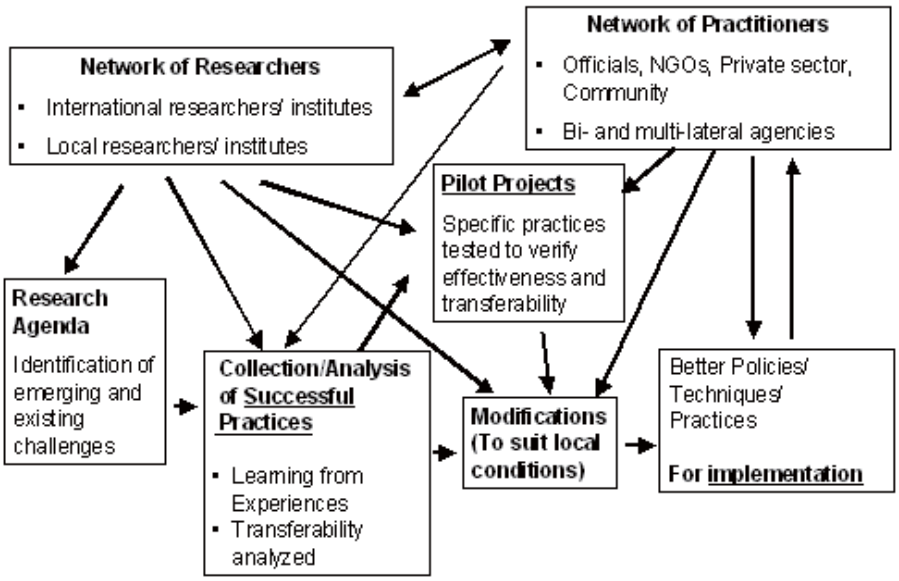


Figure 1. Conceptual model of an inter-city cooperation initiative

Reflecting this new direction, various inter-city programs, with the expertise of both international and local experts, have started to focus on North-South and South-South cooperation to scan and modify the experiences of different cities in order to streamline that information in accordance with local conditions. This approach helps cities to formulate local action plans and policies for sustainable environmental improvement. Figure 1 sets out the conceptual model behind a typical inter-city cooperation initiative.

The focus and process of each inter-city initiative differs slightly, depending on the host institution and objectives. Although most of the initiatives are quite new, a comprehensive review may lead to the identification of suggestions to make these initiatives more effective and efficient.

4. Inter-city cooperation initiatives

4.1. Kitakyushu Initiative for a Clean Environment

The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) organizes a Ministerial Conference on Environment and Development in Asia and the Pacific (MCED) every five years to discuss the *State of Environment* report (*SOE*) and to draw up appropriate action plans with consensus among its member states. During MCED 2000, held in Kitakyushu, Japan, an initiative was launched to bring improvements in the urban environment. This initiative, the Kitakyushu Initiative for a Clean Environment, had a particular focus on the area of environmental quality and human health and was based on *SOE 2000* (United Nations Economic and Social Commission for Asia and the Pacific and Asian Development Bank 2000). The Kitakyushu Initiative was endorsed as a "type-I initiative" in the Plan of Implementation adopted during the second Earth Summit in Johannesburg, South Africa in 2002. The initiative is sponsored by UNESCAP, with active support from the

Government of Japan and the City of Kitakyushu. The Institute for Global Environmental Strategies (IGES), as the host organization, provides administrative, technical, and financial support. With the objective of achieving tangible environmental improvements, the main focus of the Kitakyushu Initiative is to build urban environmental management capacity by sharing and transferring environmental knowledge and experiences in the formulation, implementation, and monitoring of local plans.

The three major components of the Kitakyushu Initiative—collection and dissemination of successful practices, support for the implementation of pilot projects, and development of the network—are illustrated in figure 2. With close links to national governments, the donor community, NGOs, and experts in the field of urban environment, this initiative is active in 60 cities among 18 countries in the Asia-Pacific region (as of August 2004) and promotes close ties with other international networks and initiatives that focus on urban environmental management issues. Major activities include conducting thematic seminars to identify local governments' requirements for capacity building and to share cities' successful and unsuccessful experiences; national seminars to create an intimate understanding for all stakeholders within a specific country context; periodic network meetings to assess the progress of activities and re-focus priorities and methodologies; and an active website to share relevant information and facilitate prompt feedback (http://www.iges.or.jp/kitakyushu).

The Kitakyushu Initiative recognizes that the experiences of cities cannot be transferred to other cities as is; the necessary elements for success must be identified and concrete methods and points of reference for other cities should be indicated. To this end, a portfolio of successful practices is being maintained with a focus on community-based solid waste management, partnerships for water supply and sanitation services, stakeholder involvement in air pollution control and greenhouse gas mitigation, and integration of urban planning with environmental management strategies. To review the transfer and promotion of these successful urban environmental management policies and target setting, pilot activities are conducted and experiences from them are shared with other cities within and outside the city and/or country. Activities that qualify as pilot activities essentially involve actions at ground level aiming towards tangible improvement in environmental quality and human health, along with other co-benefits; quantitative monitoring of progress using indicators; enhanced participation by local stakeholders; and encouragement of a replication approach.

Pilot activities conducted under this initiative differ from traditional donor-supported activities, which are mostly discontinued once aid is exhausted: after a clear and feasible pilot activity proposal is submitted by a local government, appropriate financial and technical support is provided by UNESCAP, IGES, or other relevant institutions, which serves to enhance the substantive in-kind contribution of the local government itself. A case in point is a pilot activity conducted by the administration of Nonthaburi Municipality in Thailand aimed at accelerating the rate of recycling and reducing the volume of final solid waste through community participation. After successful implementation, the outcomes of this pilot activity have been analyzed to determine areas of necessary modification to facilitate transfer to other communities within the city, as well as other cities in the region. Other cities, such as Cebu in the

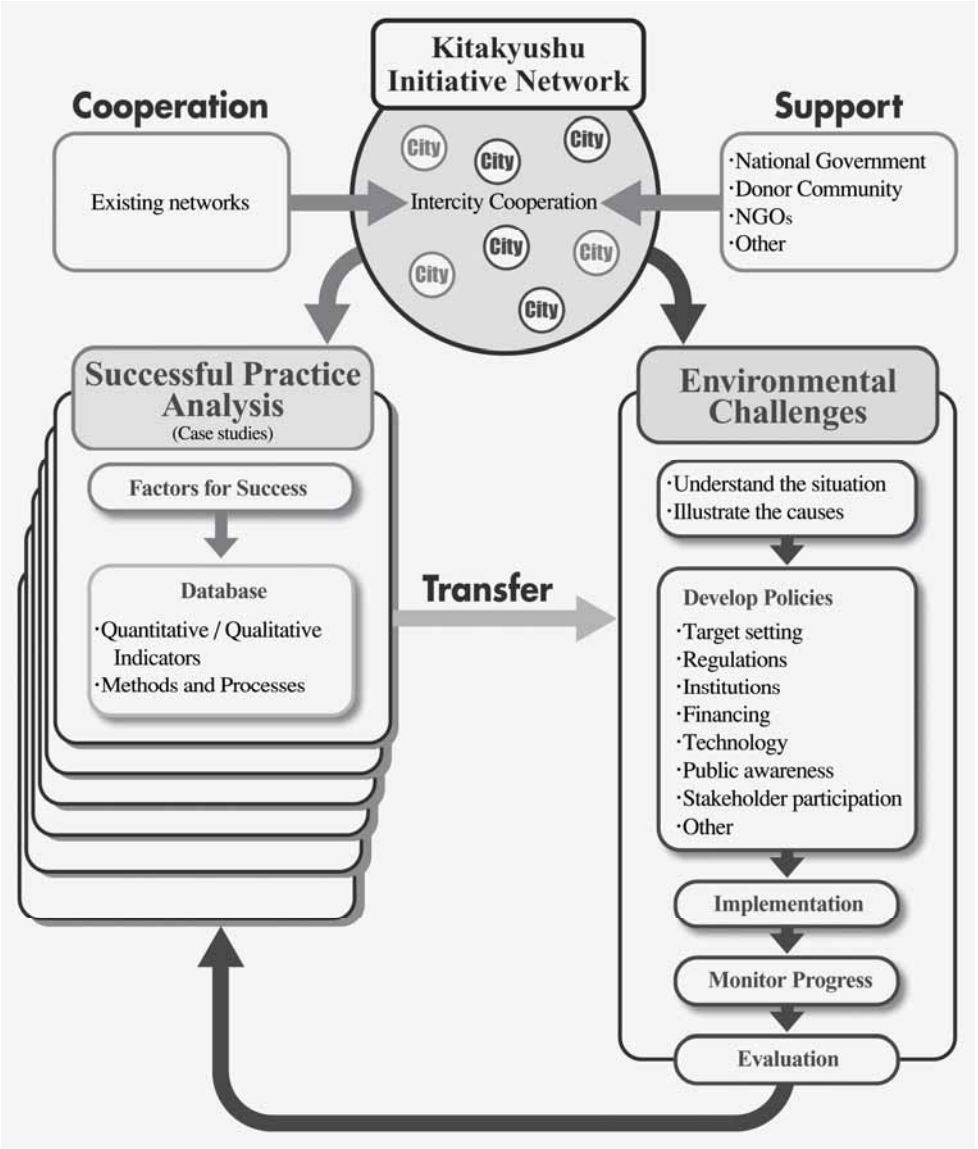


Figure 2. Flowchart for Kitakyushu Initiative for a Clean Environment

Source: http://www.iges.or.jp/kitakyushu.

Philippines, have expressed an interest in replicating these experiences; Nonthaburi itself is now taking this initiative to full scale. Other examples of potential transferability and modification of experiences can be seen in the field of industrial relocation: following successful collaboration between Kitakyushu in Japan and Dalian in China, both recipients of the Global 500 Award, concrete cooperation has started between Dalian and Ho Chi Minh in Vietnam. This type of shift from North-South cooperation to South-South cooperation and the necessary modifications to transfer such practices must be investigated in depth.

The main strength of the Kitakyushu Initiative lies in its networking and interactive communications among cities, national governments, experts, and the donor community. Its other strength is its support for the implementation of pilot activities, where multi-stakeholder involvement and local resources buck the trend to turn piloting into long-term full-scale activities. However, the priorities of cities in the network in relation to urban environmental management are diverse and the limited availability of human and financial resources makes it difficult to address all the priorities identified by the cities. Hence there is a need to balance the selection of focus areas with the availability of resources. This is also a reason for shallow analysis of various environmental challenges in the cities. To ensure in-depth analysis of the environmental challenges and capacity gaps, it would be more beneficial to narrow the focus to selected areas and fewer cities, and to collect/analyze appropriate experiences (successful practices) accordingly. Because the scale of many pilot activities is too small to have a real impact on the local environment, the development, implementation, and/or outcomes of these activities may be intertwined with other activities that are supported by other initiatives or donors. For example, in Cebu, the pilot activity under this initiative is acting as a support mechanism for community awareness as part of a larger pilot activity for river clean-up and solid waste management, which is supported by the local government and other donors. Another option would be to improve financial support on a larger scale, by diverting funds from other donors into one basket.

While the initiative has been evaluated by its stakeholders during the first phase of implementation (2000–2005), a third-party evaluation is essential to incorporate changes to improve effectiveness and efficiency. A detailed cost-benefit analysis of various activities is also critical in order to determine the priorities of the initiative. To date, the focus of internal evaluation has been placed on the cost-effectiveness of collection and sharing of information, as well as scaling-up of pilot activities on a sustainable basis.

4.2. Other initiatives

CITYNET (http://www.citynet-ap.org): In 1987, CITYNET (the Regional Network of Local Authorities for the Management of Human Settlements) was established in Yokohama, Japan. It is a network of local authorities that promotes sustainable urban improvement initiatives in the Asia-Pacific region. To date, 63 cities and 40 local organizations are counted among its members. Its focus, based on priorities set by members, is on urban environment and health, urban poverty alleviation, urban infrastructure and services, urban governance, municipal finance, and urban social infrastructure. In 2002, CITYNET's endeavors were recognized by UN-HABITAT in its “Scroll of Honour” for facilitating city-to-city cooperation and networking among local governments and other urban stakeholders. With respect to urban environmental management, the initiative focuses on solid waste management, water and sanitation, land-use planning, and transport systems. Its major activities include international seminars and training, and publications. Its strength lies in its support from international donors, including the Government of Japan and several UN agencies. Shortcomings include a rather broad focus and emphasis on brainstorming activities (seminars, trainings, and publications) rather than working on focused areas with targeted cities and stakeholders, which could facilitate tangible environmental change.

ICLEI (http://www.iclei.org): Local Governments for Sustainability was founded in 1990 by local governments at the United Nations Headquarters in New York as the International Council for Local Environmental Initiatives (ICLEI). ICLEI is a democratically governed membership association of cities, towns, counties, metropolitan governments, and local government associations. Its headquarters are located in Toronto, Canada. It offers membership to local governments and their national and regional associations. Currently, it is host to 458 members from all over the world. Major activities include: the Local Agenda 21 Campaign, the Cities for Climate Protection Campaign, and the Water Campaign. Its strength lies in the assistance it provides to cities in developed countries enabling them to be more environmentally conscious during the development of various policies and action plans; however, support for cities in developing countries is comparatively low, as financial and technological support from developed countries/cities is normally expected by the developing countries/cities.

IULA (http://www.iula.org): United Cities and Local Governments is a network of local governments, large and small, rural and urban, in over 100 countries across five continents. It supports international cooperation between cities and their associations, and facilitates programs, networks, and partnerships to build the capacity of local governments. It promotes the role of women in local decision making, acts as a gateway to relevant information on local governments around the world, and is committed to capacity building of associations. Its strengths lie in its Information Library, with a wide range of case studies, articles, reports, and studies; its Partnership Gateway, with information on partnerships between local government associations across the world; an online toolkit on the work of local government associations, including case studies and interviews with members of the IULA network; and its publications and newsletters.

CAI-Asia (http://www.cleanairnet.org/caiasia): The Clean Air Initiative for Asian Cities (CAI-Asia) is based in Manila, Philippines, and is supported by the World Bank and the Asian Development Bank. This initiative promotes and demonstrates innovative ways to improve the air quality of Asian cities through partnerships and sharing of experiences. It aims to share knowledge and experiences on air quality management, improve policy and regulatory frameworks at the regional level, implement pilot projects to encourage innovation, and assist cities in implementing integrated air quality strategies. To date, it comprises members from 26 cities, 20 national and state agencies, and a number of NGOs and academic institutes, international agencies, and the private sector. Its strengths are in the active coordination among all levels of stakeholders, and its annual conference, Better Air Quality, which has become established as a key meeting for the region. However, a major shortcoming is that it focuses on coordination only, rather than working intensively with local stakeholders to transform concepts and action plans into reality. Moreover, this program addresses air pollution only, and focuses less on the immediate local impacts of pollution, having instead a broader focus on global impacts.

Other relevant initiatives and programs include WHO's Healthy Cities Programme and Network (http://www.who.org); the Sustainable Communities Network (http://www.sustainable.org); the Urban Environment Forum of UN-HABITAT (http://www.unchs.org); the Asia Urbs Programme of Europe AID (http://203.155.220.242/environment); Southeast Asia Urban Environmental Management Applications, supported by the Canadian International Development Agency and the Asian Institute of Technology (http://www.serd.ait.ac.th/uem/sea-uema.htm); and Environmentally Sustainable Cities in

ASEAN, which is facilitated by the National Environmental Agency of Singapore (http://app.nea.gov.sg/cms/htdocs/article.asp?pid=2264).

5. Conclusion

Rapid urbanization coupled with lack of environmental management capacity is a major challenge for developing countries. Acknowledging this challenge and recognizing that the traditional focus of international cooperation is ill suited to meet it, the donor community is incorporating local capacity building into its policies and programs. Inter-city cooperation is an important way to assist cities to strengthen their capacity to manage urban environmental challenges.

There are differences between various initiatives and programs focusing on inter-city cooperation. These differences are due to variations in philosophy, policy, scope, and geographical coverage of the donors or host organizations. To optimize the impact of these initiatives and programs, the strengths of one initiative could be used to complement the shortcomings of another initiative, rather than just competing. This could be applied in terms of balancing regional coverage, environmental coverage (water, waste, air, etc.), scope of activities (seminars, trainings, best practice portfolios, pilot activities, publications, etc.), and human and financial resources. The individual initiatives and programs must also conduct intensive evaluations by stakeholders and third parties to adjust their objectives according to their resources and strengths. Comprehensive cost-benefit analysis would also be helpful in prioritizing the activities according to their efficiency and effectiveness. Nevertheless, inter-city cooperation is facilitating the move towards South-South and South-North learning and sharing of experiences, in addition to traditional North-South exchange, which is vital in bringing to the fore experiences and technology that can best fit local conditions.

References

Berg, E., and United Nations Development Programme (UNDP). 1993. *Rethinking technical cooperation: Reforms for capacity building in Africa.* New York: UNDP.

Cassen, R., and Associates. 1985. *Does aid work: Report to an intergovernmental task force*, 2nd edition. London: Oxford University Press.

Fukuda-Parr, S., C. Lopes, and K. Malik. 2002. *Capacity for development: New solutions to old problems.* New York: Earthscan/UNDP.

Hardoy, J. E., D. Mitlin, and D. Satterthwaite. 2001. *Environmental problems in an urbanizing world*. London: Earthscan.

Imura, H, J. Chen, S. Kaneko, and T. Matsumoto. 1999. Analysis of industrialization, urbanization and land-use change in East Asia according to the DPSER framework. In *Proceedings of NIES Workshop on Information Bases and Modeling for Land-use and Land-cover Changes in East Asia, 25–27 January 1999,* ed. K. Otsubo, 227–234. Onogawa, Japan: Center for Global Environmental Research, National Institute for Environmental Studies. http://www-cger.nies.go.jp/lugec/Proceedings/pcdscontents.htm.

Japan International Cooperation Assistance (JICA). 2003. Development and social capacity for environmental management in developing countries and Japan's environmental cooperation. Tokyo: JICA,Evaluation Team on Environmental Cooperation.

Koppel, B. and R. Orr. 1993. *Japan's foreign aid: Power and policy in a new era*. Boulder, CO: Westview Press.

Leitmann, J. 1999. *Sustaining cities: Environmental planning and management in urban design*. New York: McGraw-Hill.

Matsuoka, S. 1996. Japan's ODA and environmental cooperation in Southeast Asia. *Journal of International Development Studies* 2(1):35–57.

Memon, M.A., H. Imura, and R. Hitsumoto. 2003. Urban environmental management: Local capacity building through international cooperation. *Environmental Systems* 31:245–256.

OECD. *See* Organisation for Cooperation and Development.

Organisation for Cooperation and Development (OECD). 1991. *Principles for new orientations in technical co-operation*. Paris: OECD.

———. 1992. *Principles for effective aid: Development assistance manual*. Paris: OECD.

———. 1995. *Development cooperation report* 1994. Paris: OECD.

Rix, A. 1990. *Japan's aid program: A new global agenda.* Sydney: Australian International Development Assistance Bureau.

Shah, A. 1998. *Balance, accountability, and responsiveness; Lessons about decentralization.* Washington, DC: World Bank.

Stiglitz, J. E.. 2002. New strategies for development. In *Capacity for development: New solutions to old problems*, ed. S. Fukuda-Parr, C. Lopes, and K. Malik, 271–278. New York: Earthscan/UNDP.

United Nations Department of Economic and Social Affairs. 2003. *World urbanization prospects: The 2003 revision.* New York: UNDESA. http://www.un.org/esa/population /publications/wup2003/2003WUP.htm.

United Nations Development Programme (UNDP). 2001. *Development effectiveness: Review of evaluative evidence.* New York: UNDP.

United Nations Human Settlements Programme (UN-HABITAT). 2003. *The challenge of slums: Global report on human settlements* 2003. London: Earthscan.

United Nations Economic and Social Commission for Asia and the Pacific and Asian Development Bank (ADB). 2000. *State of the environment in Asia and the Pacific*. New York: United Nations.

International Review for Environmental Strategies
Vol. 5, No. 2, pp. 541 – 564, 2005
© 2005 by the Institute for Global Environmental Strategies. All rights reserved

Report from Asia

Executive Summary of the APFED Final Report: Paradigm Shift Towards Sustainability for Asia and the Pacific—Turning Challenges into Opportunities[1]

Asia-Pacific Forum for Environment and Development (APFED) [a]

Asia-Pacific Forum for Environment and Development (APFED) was established in 2001 by the Environment Congress for Asia and the Pacific (ECO ASIA), as a forum to address critical issues facing the Asia-Pacific region and to propose a model of equitable and sustainable development for the region. The 26 members of APFED were nominated by countries in the region and international organisations, but participated in the forum in their individual capacity. Therefore, the recommendations of APFED are not bound by official positions of particular governments and international organisations. The APFED Final Report was formulated through a series of meetings involving some of the region's leading figures in the field of environment and development. The Report consists of an overview of the Asia-Pacific region, APFED's future vision for the Asia-Pacific, APFED recommendations, and the APFED action platform.

Keywords: APFED, Asia and the Pacific, Sustainable Development.

Introduction

Rapid economic growth in Asia and the Pacific during the last four decades has posed a formidable challenge to the region—that of achieving continued economic progress without compromising social and environmental sustainability. Rapid development has led to industrial pollution, degradation of natural resources, increasing levels of poverty, and inequitable income distribution.

The Earth's natural resources are finite. Therefore, to be sustainable, the sum of human activities has to be within the regenerative capacities of the Earth, a fact most often conveniently ignored. Asia and the Pacific will soon be the most dynamic economic centre of the world. However, the region's economic expansion and its huge population are likely to increase the pressure on natural resources. A sustainable world is simply not conceivable if the Asia-Pacific region fails to become sustainable.

Members of the Asia-Pacific Forum for Environment and Development (APFED) believe that the challenges that confront this region can be dealt with, but only if all stakeholders make a conscious effort to live in accordance with sustainability principles. Strong political will and sensible policies

1. Adopted at the Asia-Pacific Forum for Environment and Development, Sixth Substantive Meeting, 2–3 December 2004, Tokyo, Japan.

a. The author information is listed in Appenix.

are required to keep the region peaceful, promote democracy, sustain economic growth, and strengthen social cohesion—without which sustainability cannot happen. Nothing less than a paradigm shift—to turn challenges into opportunities—is needed for the region to move towards sustainable development.

APFED was established upon ministerial deliberation during the Environment Congress for Asia and the Pacific (ECO ASIA) 2001 to: (i) identify critical environment and development issues, (ii) propose a new development framework that will lead to greater equitability and sustainable growth in the region, and (iii) recommend necessary actions to be taken by the relevant stakeholders in the region. APFED members envision a world that allows a new paradigm to emerge. The new paradigm entails a shift in the way we view economy, society and the environment, where the quality of life and people's aspirations, not just economic growth and material wealth, will be the prime concerns for all. In such a world, basic human rights are respected and human activities are conducted in harmony with the natural environment.

Paradigm shifts are not possible by edict but must grow from extensive dialogue throughout the region. Discussions that are more open-minded are needed to understand what must be done for long-term sustainability in the region. Policy interventions by the region's governments to create the enabling environment for this paradigm shift include i) promoting/facilitating participation by all stakeholders concerned in formulating basic policies on sustainable development, ii) integration of environmental and development concerns into sectoral policies and area planning, and iii) development of institutional capacity and finance for enforcement of environmental regulations.

The APFED Report, which consists of an overview of the Asia-Pacific region, APFED's future vision for the Asia-Pacific, APFED recommendations, and APFED action platform was formulated through a series of meetings involving some of the region's leading figures in the field of the environment and development. These high-level deliberations were supplemented by a number of sectoral and subregional expert meetings as well as multi-stakeholder discussions to reflect varying viewpoints regarding the diverse nature of the region, and the complexity of environmental and development implications.

APFED is only a small initiative in the region, but it is a participatory and open regional forum. Its messages are not intended to be imposed upon governments, international organisations, or any other stakeholders in the region. Rather, APFED in its second stage intends to be, as agreed upon at the ECO ASIA 2004 held in Yonago, Japan, a "*knowledge management*" and "*innovation facilitation*" centre of the region. The significance of APFED recommendations is contained in the belief that continuous dialogue among stakeholders, sharing of experiences, and the proposal of challenging new ideas will increase the long-term sustainability of the region. In this respect, APFED continues to advocate a sustainable Asia-Pacific, seeking the thorough implementation of its Action Platform in collaboration with like-minded stakeholders in the region.

Part I: Overview of the Asia-Pacific region

I. State and perspectives of social and economic factors for change

APFED has identified several key social and economic factors upon which future directions of sustainable development of the region depend. These factors include:

A. Population and urbanisation: Although the population growth rate is decelerating in the region, the actual population itself continues to increase. In addition to rural-urban migration, international migration from developing countries to high-growth industrialised countries is significant. Population increase will intensify land use and land use changes, both in urban and rural areas, thereby generating further pressure on natural resources. According to United Nations estimation, by 2015, 15 cities in the region will become mega-cities with a total population of at least 10 million. In particular, South Asia has mega-cities like Dhaka, Karachi, Kolkata, and Mumbai that are expected to experience sharp population increases due to migration as well as natural growth. Increase in urban population has far outpaced the development of essential urban infrastructure and responsible environmental management. It has also resulted in inequitable distribution of income and productive assets. By 2030, approximately 60 % of the total population of the region will live in urban areas. Prospects for sustainable development, therefore, will depend on the development of sustainable cities.

B. Economic development: Economic output in the Asia-Pacific region has quadrupled during the past two decades. Globalisation, in particular, has enabled the region to achieve such high economic gains. On the other hand, expansion of economic activities has brought about accelerated exploitation of natural resources through expanded production and consumption, as well as the increasing volume of solid waste and pollution. Deepening income inequality among different groups is also a worrying trend for sustainable social development. The economic structure of the region has changed remarkably over the past 30 years—showing the decline of the agriculture sector and the growth of the industrial and service sectors—leading to further intensification of the rural-urban gap.

C. Major social concerns: Poverty is the biggest social challenge in the region, although significant efforts have been made towards its alleviation. Poverty levels actually fell in the region between 1990 and 1999. In 1990, about 32 % of the people were living on less than a $1 a day. This figure fell to 22 % by 2000. Nevertheless, slightly less than 1 billion people in the region still live in poverty. In addition to income poverty, particular attention should be given to the differences in the state of poverty between different groups of people, including urban-rural and subregional. Inequitable distribution of assets within a country and within the region underpins social conflicts, which are often resolved violently.

Nutrition and health, education, and gender discrimination are additional social factors that have significant implications for the sustainable development of the region. Since most poor people, especially in urban areas, are unemployed or underemployed, nutrition levels are low and housing is poor, thus making poor families vulnerable to unsanitary conditions and prone to disease. Poor families also tend to have lower levels of education, with boys having preference over girls for better educational opportunities and access to nutrition. The Asia-Pacific region is home to just under two-

thirds of the developing world's undernourished people. More than 500 million people—10 times the population of Republic of Korea—still do not have enough food to meet basic nutritional requirements.

Social cohesion can be described as the glue that bonds society together, promoting harmony, a sense of community, and a degree of commitment to common values. Beyond the social relations that bridge ethnic and religious groups, vertical linkages relating state and market institutions with communities and peoples can further cement the cohesiveness of a society, if they are inclusive, transparent and accountable. Weak social cohesion increases the risk of social disorganisation, and has the potential to end in violent conflict. The emergence and growth of civil society is central to a nation's capacity to manage social and economic transformation and to mediate conflict.

Corruption impedes sustainable development by debasing fair and efficient economic transactions, undermining governmental legitimacy, threatening political stability, and jeopardising socio-economic development in many countries. According to the corruption perception index (CPI), some countries in the region are high on the global list.

D. Technological development: Technological innovations have caught on in Asia and the Pacific and are transforming everyday lifestyles, production and consumption, work, and communication. Current technology innovation typically features information and communications technologies (ICTs), biotechnology, and new energy technologies. Technological change underpins the transformation of the world economy into a knowledge-based one. Heavy and resource-intensive industries, once the powerhouse of economic growth, are also being replaced. These new technologies can be positive in terms of natural resource use and their impact upon the environment, and thus provide new opportunities for environmentally sound development in the region, especially in developing countries. It is unlikely, however, that new technologies alone will result in sustainable development. Increased appreciation and promotion of traditional and indigenous technologies that play an important role in sustainable development should also be a critical component of an appropriate technology strategy.

II. Signs of environment stress

The expansion of the economy and population over the last 40 years, based mainly on the exploitation of cheap labour and extensive natural resources, has degraded the environment—now the most serious obstacle to continued economic and social development in the region. While these threats are significant at local and national levels, trans-boundary environmental problems constitute a major challenge in the region. Such problems include the "haze" problem in Southeast Asia; acid deposition, and dust and sand storms (DSS) in Northeast Asia; "atmospheric brown clouds," pollution and environmental deterioration in the regional seas and international rivers; and trans-boundary movements of hazardous wastes.

Areas exhibiting signs of significant environmental stress:

- Freshwater resources,
- Marine and coastal environment,

- Air pollution,
- Climate change,
- Natural disasters,
- Land degradation,
- Forest and biodiversity, and
- Hazardous substances and waste.

III. Responses to sustainable development challenges

To promote sustainable development in the Asia-Pacific region, a wide array of actions have been taken at local, national, subregional and regional levels. Although the national governments still play a leading role, various stakeholders including local governments, communities, non-governmental organisations (NGOs), and the private sector have become increasingly involved in national and local planning and in the implementation of sustainable development. Political decentralisation, being promoted in many countries in the region, has been a driving force. Besides this, regional and subregional mechanisms and initiatives have been strengthened to support national-level efforts.

Regional cooperation has become an important means of promoting environmentally sound development in the region. The regional consultation process for preparation of the World Summit on Sustainable Development (WSSD) provided a comprehensive framework to thoroughly review the region's efforts to achieve sustainable development. Assessing the remaining challenges to be addressed by the region, the process concluded the Phnom Penh Regional Platform, proposing seven new initiatives for the region's sustainable development. The five-yearly Ministerial Conference on Environment and Development in Asia and the Pacific (MCED) has also contributed to periodical review of the state of the environment in the region, as well as adoption of the region's action agenda on environmentally-sound development for the subsequent five-year period. Such intergovernmental mechanisms have been complemented by informal forums such as ECO ASIA.

Intergovernmental initiatives adopted in the different subregions include the South Asia Cooperative Environment Programme (SACEP), South Pacific Regional Environment Programme (SPREP), the ASEAN Senior Officials on Environment Meetings (ASOEN), and the North-East Asian Subregional Programme of Environmental Cooperation (NEASPEC).

Local, national, and regional initiatives need to be further strengthened to meet the Millennium Development Goals (MDGs), particularly Goal 1, which is to halve poverty levels by 2015. Since the Asia-Pacific region has some of the worst poverty levels, integrated policies have to be adopted that take economic and social, as well as ecological dimensions into consideration. Policies aimed only at income poverty alleviation may work in the short term, but in the long term, these policies need to be complemented by social development that improves access of the poor to facilities such as health, education, and life's basic amenities. Social development policies promoting greater participation in economic and social activities, especially of the poor, are needed to ensure that the benefits of economic development are shared by all.

Environmental Impact Assessment (EIA) is now a legal requirement in most countries, enabling rational decision-making by integrating environmental concerns into project planning. Most environmental regulations are based on the command-and-control approach; however, market-based instruments have been progressively introduced to provide incentives and flexibility in environmental management, to increase transparency in implementation of legal requirements, and to improve the efficiency of law enforcement.

The industry in the region has exhibited a positive response to ISO 14001 by introducing consistent environmental management systems, demonstrated by a substantial shift from end-of-pipe pollution control to cleaner production engendered by prevention of adverse environmental inputs. Industries in several countries have also started to adopt voluntary business charters for sustainable development.

Part II: APFED future vision for the Asia-Pacific region

I. Scenarios

The Final Report examined the four scenarios developed under the Global Environment Outlook (GEO) 3 conducted by the United Nations Environment Programme (UNEP). These four scenarios are:

Market First Scenario - this envisages a world in which market-driven development converges on values and expectations that prevail in the industrialised countries;

Policy First Scenario - strong actions are undertaken by governments in an attempt to reach specific social and environmental goals;

Security First Scenario- assumes a world of great disparities where inequality and conflict prevail, brought about by socio-economic and environmental stress;

Sustainability First Scenario- a world in which a new development paradigm emerges in response to the challenge of sustainability supported by new, more equitable values and institutions.

II. APFED future vision

Path to sustainable societies

According to the scenario analysis, the unfolding future is most likely to be a mixture of elements contained in each scenario.

Unless the security situation deteriorates rapidly, the region as a whole will, in the short run, continue to move along the lines assumed under the Market First Scenario. Economic development under this scenario will certainly deal with poverty and the needs of growing populations. However, market forces tend to weaken social cohesion, and promote unsustainable lifestyle patterns. Environmental quality will continue to deteriorate and pressures on natural resources will remain severe. Poverty will remain unsolved despite some improvements. These negative outcomes make this scenario unsustainable in the long run.

Gradually, more of the measures contained in the Policy First Scenario would be introduced in proactive countries, to seek a balance among economic, social, and environmental concerns. Consequently, small, patchy improvements could be achieved in the areas of environmental improvement and poverty alleviation, but the overall trend of unsustainable production and consumption would prevail.

Eventually, a shift towards Sustainability First societies would take place, where fundamental changes in lifestyle would mitigate against environmental pressures. To ensure long-term sustainability for the region in the face of further population expansion and economic growth, a sufficient number of people will recognise that it is not enough to simply follow the traditional pattern of economic development characterised by mass production and mass consumption. Popular pressure will demand that the region employs a new development paradigm by fully integrating social and environmental concerns into economic development.

Principles for building sustainable societies

To achieve sustainable development, an innovative development path designed around principles such as those advocated by the Earth Charter should be articulated for the region. Sustainable development is a vision that places equal importance on economic, social, and ecological well-being, i.e., a holistic and integrated approach to development.

Since peace and stability underpin sustainable development, violent conflict must be avoided by addressing root causes, such as religious and ethnic differences, and disputes over resources and inequities. In this light, it is essential to strengthen democratic institutions at all levels of decision-making. Participation by civil society and individuals in decision-making should be promoted, and maximum transparency and accountability of governance should be provided. The empowerment of the individual through education, poverty eradication, gender equality, and elimination of all forms of discrimination should become the basis for sustainable societies. Encouragement through consultation and leadership particularly at the grassroots level will go a long way in achieving sustainability in the region.

Basic human needs such as drinking water, clean air, food, security, shelter, and sanitation must be met, and care must be taken to create societies that protect the disabled and the vulnerable. Governments in the region should fulfil their obligations in the short run according to the MDGs (Millennium Development Goals) set, and promote policies along sustainability principles in the long run. Ultimately, sustainable societies will only be realised if the earth's ecosystems and natural processes that sustain life are fully protected. Human activities should not exceed the regenerative capacity of natural systems or threaten the environment by the introduction of non-native organisms.

Regional perspectives

The Asia-Pacific region is characterised by economic growth, is the most densely populated region in the world, and is the most diverse in natural and socio-cultural conditions. Challenges facing the region remain as daunting as ever, but these challenges could be turned into opportunities by building on the region's strengths. Respect for the rich human resources, traditional values, and enormous

diversity treasured in the region should be the basis for the design of future sustainable societies. Clear vision, strong political will, and flexible social partnerships will enable the region to move along a truly sustainable path as the world leader in the 21st Century.

The sustainable societies that APFED envisages for the future will be diverse, and will take various forms, reflecting the socio-cultural and natural differences found in this region. Sustainable societies will be economically dynamic, and yet modest in their use of natural resources. They will be democratic, equitable, and peaceful. To realize sustainable futures of this kind, the societies should be truly participatory, encouraging mutual leaning, and promoting innovation, while ensuring local diversities for future generations of the region. The ultimate aim should be achieving a less materials-intensive society, and a more service and knowledge-based society and economy. The entire society and the market need to shift their focus of production and consumption patterns to one which is more knowledge-based and which has more local value, from one currently based on mass exploitation of non-renewable as well as renewable resources.

Part III: APFED recommendations

To promote the shift to sustainable societies, APFED has put together the following recommendations, organised into three groups. (I) *Recommendations for an Integrated Approach to Sustainable Development* primarily addresses cross-sectoral issues essential for integration of the environment into decision-making, implementation, enforcement, and monitoring of environmental and natural resource management policies, as the key element of sustainable development. (II) *Recommendations for Empowerment of Multi-Stakeholder Partnerships* addresses measures to promote synergistic participation of the three major stakeholders: civil society, private business, and the public sector. The third group is (III) *Sectoral Recommendations* to facilitate the application of the sustainability principles in the five major sectors selected, namely freshwater, marine and coastal environment, energy and clean air, land use management, and chemical issues.

I. Recommendations for integrated approaches to sustainable development

To promote environmental conservation in the context of sustainable development, the first priority is the integration of environmental concerns into basic policies of economic and social development. Recommendations for an integrated approach to sustainable development focus on measures to promote consistent and efficient development and implementation across key development sectors. The recommendations aim at strengthening the environmental foundations of the region, upon which various sectoral policies would then be formulated and implemented. Reflecting the features of new environmental policies, recommendations are centred on i) provision of incentives, ii) the promotion of stakeholders' participation, and iii) an intensified focus on trans-boundary issues.

Recommendations for integrated approaches to sustainable development:

- Institutions for environmental democracy
- Systems development for partnership

- Capacity drive for sustainable development
- Innovative financing and market mechanisms for sustainability
- International trade for sustainable development
- Innovative technologies for sustainable development.

A. Institutions for environmental democracy

An encouraging evolution in recent years has been a shift from highly centralised and compartmentalised bureaucratic structures to decentralised and participatory governance in most countries of the region. This has resulted in promotion of grassroots community participation, decentralisation of administration, integration of national and local decision-making processes, and involvement of NGOs and the private sector in policy making. Also important are the increasing number of environmental organisations and programmes that have been initiated at the subregional and regional level.

To reinforce this trend, three layers of regional institutions are recommended to strengthen environmental democracy in the Asia-Pacific region in a manner compatible with the emergence of new environmental actors and initiatives at the national, subnational and regional levels. An open forum entitled the *Asia-Pacific Open Forum for Sustainable Development* could be built on a strengthened regional network of national committees on sustainable development. Its main function would be to set the priority agenda for sustainable development in the region, through open discussions among key stakeholders. For governments in the region, the *Asia-Pacific Environment Round (APER)* has been proposed to strengthen regional environmental governance by complementing existing intergovernmental forums, and to enhance common environmental policies. At the technical level, an *Asia-Pacific Knowledge Centre for Sustainable Development (KCSD)* is proposed. The centre will systematically accommodate in its database, knowledge and information essential for promoting sustainable development for the region.

B. Systems development for partnership

Several new activities are proposed in accordance with the three layers of regional institutions mentioned above. What is common to these proposals is the partnership among different stakeholders.

The *Asia-Pacific Voluntary Commitment Initiative* would be connected to the Open Forum for Sustainable Development. It would encourage action towards sustainable development by registering specific commitments by stakeholders, monitoring the implementation of these commitments, and providing small incentives for commendable actions. APER could take a lead in ensuring that any new regional conventions always include two common features—participation and result-orientation. The initiative for *Participatory Environmental Agreements* will address this concern. KCSD will be instrumental in networking various databases including those assembling good practices in terms of policies, technologies, and practices. *Good Practice Databases* could provide useful lessons learned from various initiatives introduced in the region. The value of such databases lies in their constantly updated, good-quality information.

C. Capacity drive for sustainable development

Education and capacity development is key to sustainable development and active promotion of the United Nations Decade of Education for Sustainable Development is crucial for the Asia-Pacific Region. The four main aspects for enhancing capacity for sustainable development in the Asia-Pacific region are i) education, ii) training, iii) public awareness-raising via formal and informal channels, and iv) cross-sectoral approaches.

i) Education

Integrated and Empirical Education attempts to give schoolchildren direct experience of the importance of the environment and should be further promoted by facilitating the development of teaching materials and modules, student exchange programmes, and networking of practitioners. In view of the important role of higher education institutions in promoting sustainable development education, the *Inter-University Accreditation System* could be expanded among the universities engaged in sustainable development courses and programmes in the different countries in the region, thus strengthening the multidisciplinary characteristics of the programmes.

ii) Training

Increased training is needed for all leaders, drawing upon past and ongoing initiatives, such as the Network for Environmental Training at Tertiary Level in the Asia-Pacific (NETTLAP).

iii) Awareness raising

The need for greater public awareness of sustainable development cannot be over-emphasised. All means of awareness raising, including public campaigns, exhibitions at museums, television (TV) and radio broadcasting should be extensively used. An *Asia-Pacific Environmental TV Channel*, which could engage the technology of web-based TV, would provide a variety of services and opportunities for the media, and encourage them to produce quality films for sustainable development of the region in collaboration with existing programmes, such as the National Geographic and Discovery Channels. Collaboration with existing media needs to be strengthened in parallel to or as a first step toward launching the regional environmental TV channel.

iv) Cross-sectoral approaches

The cross-sectoral recommendations emphasise the inter-linkages between different sectors. *Local Partnership for Education for Sustainable Development* is recommended to promote locally based, integrated, and holistic approaches in various endeavours of sustainable development education. An innovative mechanism for enhancing local-level communication, coordination and networking may be considered. This recommendation calls for strengthening of communication and coordination at all levels of formal and non-formal education. *Distance learning based on information and communication technologies* (ICTs) is a good way to promote learning on sustainable development.

D. Innovative financing and market mechanisms for sustainability

Despite an increase in overall capital inflow to the region over the last decade, the environment has not been the main beneficiary of such financing. Although global mechanisms for environmental

project funding, such as the Global Environment Facility (GEF), have been initiated and have brought some additional funding, necessary financing has not been provided for a range of subregional and regional environmental problems such as acid rain. At the national level, environmental spending has remained inadequate, with further reductions and general budget restructuring in the aftermath of the Asian financial crisis. While micro-credit and community-based finance have been commonly viewed as the only form of capital available to the majority of poor people on a sustainable basis, local finance remains under-developed in terms of both volume and sophistication.

To address this gap, a series of financial initiatives at the regional and local scale is recommended. The *Regional Environment Fund for Asia and the Pacific (REFAP)* is proposed as a new financial mechanism funded primarily by governments, to support actions to address trans-boundary environmental problems at regional and subregional levels. Local finance initiatives are also recommended. *Eco-Currencies* are known to effectively stimulate voluntary environmental activities without any external funding, usually at the community level, but a similar system could be applied in the context of multilateral enterprises with offices and factories in several countries in the region.

E. International trade for sustainable development

Trade liberalisation under an increasing number of free trade agreements (FTAs) and other bilateral trade agreements is expected to bring greater prosperity and dynamism to the region. However, economic growth propelled by international trade will increase the pressure on the environment through greater exploitation of natural resources and increased polluting activities. According to a 2004 report ("Fair Globalisation: Creating Opportunities for All") launched by the 26-member independent World Commission on the Social Dimensions of Globalisation sponsored by the International Labour Organisation, FTAs have to be designed in such a way as to be equitable, ensuring that the weaker countries benefit and do not lose out. Therefore, in negotiating trade agreements in the region, maximising the benefits, specifically of economic prosperity, while minimising the environmental costs must be addressed. Despite the fact that the implementation of Multilateral Environmental Agreements (MEAs) sometimes have the potential to conflict with existing or newly negotiated trade rules, MEAs must be implemented if the region's sustainability is to be ensured for future generations. It is worthwhile to reiterate that Paragraph 98 of the Johannesburg Plan of Implementation (JPOI) called for the "mutual supportiveness" of the two regimes.

It is recommended that the region should take a lead in setting a sound precedent for integrating environmental considerations into trade agreements. This could be achieved by providing *Better Environmental Guidance to FTAs and Other Trade Agreements*.

Further promotion of *Region-wide Recycling* could facilitate sustainable development in the region, not only by minimising the total volume of waste that requires final disposal, but also by contributing to economic development and employment opportunities. The *Fair Trade Initiative* is intended to promote a promising instrument that could provide people at the grassroots level, low-income people, and small businesses in developing countries and countries with economies in transition with fair fruits from the global trading system, by, for example, trading organic agricultural products.

F. Innovative technologies for sustainable development

Conventional technological development has been characterised by factors such as mass production, high speed, economic efficiency, central control, and standardisation. Sustainable development may necessitate a paradigm shift in technology development. The new paradigm will be characterised instead by durability, environmental friendliness, reusability, easy maintenance, decentralised control, and diversity. Nowadays, technologies based upon the new paradigm such as renewable energy technology and green chemistry are increasingly available.

Making the best use of these technologies and ensuring access to them are keys to building sustainable societies in the region. ICT is the most important technological development in the last decade. It has changed the way people work and communicate. It also has a few positive implications for the environment by way of raising environmental awareness and strengthening advocacy powers of NGOs. Though fast spreading, there is a big gap in accessibility to ICTs amongst the developed and less developed countries (LDCs). This digital divide can be overcome by providing accessibility to all. *Community Internet Kiosks* are already being promoted in the region in countries such as India and Thailand. An *Asia-Pacific Alternative Technologies Development Partnership* is proposed to catalyse internal technology development capabilities through enhanced interactions among technical institutes in the region, by joint research, and provision of research funds for promising proposals. Establishment of *Technology Transfer Consortiums* (TTCs) is proposed as one way to address the financial barriers associated with technology transfer. TTCs would channel necessary funds in the form of soft loans, leasing, and other affordable financial devices. TTCs would also provide tailor-made consulting services to meet the needs of individual users, by networking with local technical institutions as well as with international technology information clearinghouses.

II. Recommendations for multi-stakeholder partnerships

Highly centralised political systems are often identified as a characteristic of governance in Asia and the Pacific. However, this style of government has been gradually changing in response to recent socio-economic trends such as globalisation and decentralisation. Decentralised local governments have become more autonomous and the role of central governments has been gradually shifting from “implementation” to “facilitation” in promoting the sustainability agenda. At the same time, the private sector is increasingly regarded as a major driving force behind the promotion of a sustainable society in the region; civil society organisations (CSOs) have been playing an increasingly important role in setting the agenda and implementing projects for sustainability.

As opportunities for participation by all stakeholders are expanded, the form that this participation will take must be designed to take full account of factors such as culture, history, social structure, nature of the decisions in question, and the characteristics of decision-making systems. All stakeholders should participate in actions for sustainable development with a good understanding of their respective roles. Recommendations outlined below primarily aim at promoting actions of the primary actors, specifically grass roots, civil society, and the private and public sectors.

Three Primary Actors for Multi-Stakeholder Partnership:

- Empowerment of civil society organizations,
- Eco-drive for the private sector,
- Public sector to catalyse multi-stakeholder partnerships.

G. Empowerment of civil society organisations

CSOs have become an essential actor in building a sustainable society in Asia and the Pacific. Increased involvement of CSOs in environmental decision-making and their enhanced capacity are considered vital in achieving sustainability. The ability of CSOs to create trans-boundary ties between stakeholders has become important in recent times due to increased linkages between trans-boundary issues concerning sustainable development. At the same time, grassroots activities of CSOs could also act as a safeguard for traditional values, lifestyles and cultures, which tend to be neglected in this age of globalisation.

To strengthen CSOs in the region, various initiatives are recommended such as the creation of a sound environment through institutional arrangements for promoting CSO activities, development of the capacities of CSOs, mainly through intensified interaction and modest financial assistance, and reinforced regional or subregional networking amongst various types of CSOs such as women's groups. The establishment of an *Asia-Pacific CSO Centre* could act as a regional attempt to catalyse further interaction and collaboration among CSOs working on sustainable development in the region. At the same time, the *Asia-Pacific Grassroots Initiative for Sustainable Societies* may be initiated to demonstrate the potential of grassroots social movements in Asia and the Pacific, based mostly upon traditional values such as modesty, simplicity, self-help, value of family, and respect for all other life forms. This would develop excellent examples for practitioners in other regions to learn to promote truly sustainable societies.

H. Eco-drive for the private sector

With globalisation, the private sector is a critical player in sustainable development. This trend is becoming increasingly clear with the recent progress in trade liberalisation dialogues. The private sector is realising the importance of streamlining their production processes and products, which, in turn, results in a reduction of adverse ecological impacts. Thus, eco-efficiency helps not only the private sector; it also represents a benefit for both the business sector and society

The private sector has made tremendous efforts towards environmental improvement due largely to regulatory compliance, market pressure, leadership by the Chief Executive Officer, and policies for social responsibility; yet more innovative measures by the private sector will be needed. Domains for emerging efforts include the application of environmentally sound technologies, adoption of voluntary corporate initiatives, i.e., *Voluntary Environment Agreement Initiative*, introduction of environmental management systems (especially along supply chains), eco-efficiency, and environmental reporting.

There are also signs of a positive response to the growing interest of consumers in sustainable development and health consciousness, demonstrated by increasing demand for eco-products, recycled materials, and other products with less environmental impact over their life-cycle, as well as

non-toxic detergents and organic vegetables. These shifts in consumer demand open up new business opportunities for the private sector in the region, i.e., *promotion of eco-industry*.

The informal sector provides essential services such as transportation, retailing, and waste disposal, in major cities of many developing countries. Their operations are often environmentally unsound and unsafe, but are constrained by a lack of funds and appropriate knowledge. The proposed *Renovation of Informal Sector* would address this issue by capitalising on synergistic opportunities that exist between the informal sector and local environmental action. Examples include introduction of electric three wheelers (e.g., in Kathmandu, Nepal), and organised recycling and composting of solid wastes.

With consumers becoming more environmentally conscious, strengthened networking among *Environmental Consumers Cooperatives* established in various parts of the region is proposed to promote the purchase of environmentally friendly goods and services. To overcome the uncertainty caused by a proliferation of environmental labelling schemes, an *Asia-Pacific Green Labelling* system is proposed, which would convey accurate and reliable product information and would appeal to consumers. This system could be set up to combine existing schemes in the region. It would also remove barriers to environmentally sound production processes associated with separate national labelling schemes.

I. Public sector to catalyse multi-stakeholder partnership

As globalisation, democratisation, and decentralisation progress worldwide, the roles of CSOs and the private sector have significantly expanded, along with a change in the traditional highly centralised political systems in the region.

Yet, the public sector—local and national governments and international organisations—continues to play a primary role in policy planning and coordination. Central governments set the overall framework of action, coordinating and facilitating implementation at the national level, while local governments play an increasing role in environmental enforcement and monitoring, in collaboration with other stakeholders at the local level. However, the long history of centralisation means that local governments may lack human, institutional, and financial capacities, and experience difficulties in carrying out their expected roles. International and regional organisations are playing central roles in setting the international agenda, particularly in the development of MEAs. Support channelled through international and regional organisations is essential in promoting the sustainable policy agenda at national and local levels in developing countries.

With the above in mind, recommendations for local governments are intended to strengthen their capacities through networking, multi-stakeholder involvement, training, and the empowerment of communities. Community empowerment could be attained through *Supporting Community-based Activities for Sustainable Development*, in which local governments would provide support, in combination with various policy tools, to individual citizens, CSOs, businesses, and social groups for their voluntary actions, through day-to-day communication, campaigns, and information dissemination.

The recommendations for central governments highlight their catalytic role in providing the framework, within which other actors, such as CSOs, businesses, and local governments could operate under their own initiatives. This can only be achieved by promoting *Transparency of the Political System and Stakeholder Participation*, including information disclosure, periodic release of national environment performance reviews, application of Green GNP and sustainable development indicators, and promotion of the full involvement of stakeholders in the environmental policy cycle.

III. Major sectoral recommendations

APFED has formulated sectoral recommendations for facilitating the application of the cross-sectoral recommendations in five sectors, namely freshwater, marine and coastal resources, energy and clean air, land use management, and chemical issues. These sectors have been selected through APFED consultative meetings as key areas for action to achieve environmentally sound sustainable development in Asia and the Pacific. These recommendations aim at a dematerialising and self-sufficient society.

Priority Sectors Addressed by APFED:

- Freshwater Resources
- Marine and Coastal Resources
- Energy and Clean Air
- Land Use Management – Urbanisation, Rural Development, and Forest Conservation
- Chemical Issues

J. Freshwater resources

Increased water demand has occurred in line with economic and population growth, leading to intensified water use by the agricultural, industrial, and domestic sectors. Increased demand for water often leads to overexploitation of water resources, which, in turn, results in water shortages, land degradation, and destruction of natural ecosystems such as wetlands and estuaries. Improperly treated wastewater leads to deterioration in water quality and thereby a decrease in the total volume of available water resources. Inadequate water supply and sanitation systems hinder the health and safety of the people in the region, in particular the poor. Such critical water issues cast a shadow on sustainable development in the region, creating a need for more rational and effective management of water resources.

Integration and harmonisation of national policies in different sectors should be undertaken alongside capacity enhancement of government officials in relevant institutions at national and local levels. Participation by key stakeholders, particularly local communities, is also considered essential. For this purpose, awareness raising, creation of incentives, and strengthening of stakeholders' capacity are key elements to be addressed. Dissemination of adequate information and technology transfer are also important driving forces behind improved water management.

Mobilising financial resources from the private sector should be promoted with appropriate attention to the poor and marginalised. In this respect, community participation in the process of

developing water supply and sanitation systems is considered essential. Thus, the *Strengthening Community Participation in Public-Private Partnership for Water Supply and Sanitation* is proposed.

A *System to facilitate water transfer* is proposed to help resolve disparities in water availability and to promote rational use of water resources. A system for establishing rights to access water, if properly established, would facilitate the transfer of water from areas with surpluses to those facing shortages.

Technology plays a vital role in appropriate management of water resources, therefore, development of *Technology for New Sources of Water* should be strengthened to deal with the increasing demand for water, with particular focus on the creation of non-conventional water resources, such as rainwater harvesting and seawater desalination combined with renewable energy sources.

K. Marine and coastal resources

The livelihoods of people in many countries of the region are closely related to coastal and marine resources, both living and non-living. On the other hand, marine and coastal resources have been under threat from expansion of non-compatible human activities. Major pressures on coastal and marine ecosystems include the overexploitation of fishery resources; land-based pollution such as industrial and agricultural water discharge and inadequate waste disposal; and sea-based pollution such as oil spills. Coastal erosion, resulting from increased land subsidence from groundwater extraction and offshore mining of sand and dredging are other notable problems.

The sectoral recommendations are provided, primarily, to establish Integrated Coastal Area Management (ICAM) to enhance stakeholder coordination and participation among governments, scientists, experts, the public sector, and NGOs and to strengthen regional cooperation on marine and coastal resources.

Water Body-Based Strategic Action Programmes, which have already been established in some water bodies, need to be developed for other water bodies of the region. Priority issues on environmental and resource use in each specific water body need to be addressed in a cost-effective and cooperative manner. This formation of the strategic action programmes will enable subregional coordination based on scientific assessments.

There is also a need to strengthen participation and awareness of the general public, which would require a region-wide expansion of existing programmes. For this purpose, the *Asia-Pacific "Save Our Sea" (SOS) Campaign* should be the immediate initial step.

L. Energy and clean air

Energy has fundamental implications for sustainable development. Industrial development in the 20th century depended on high-energy consumption, with fossil fuels as the main source of energy. Energy demand and consumption have increased as economic development in the region has progressed. Heavy dependence on fossil fuels and the high-energy consumption patterns in modern societies have resulted in serious environmental problems, including air pollution, global warming,

and potential climate change, and hindered sound socio-economic development. Increases in levels of carbon dioxide (CO_2) have put many island-states in the Asia-Pacific region at great risk from potential climate change and associated sea-level rise. In addition, the disparity of access to electricity has been of serious concern in the region. For a sustainable future, energy use must be made more environmentally benign. Renewable energy sources such as solar, wind, biomass, micro-hydro, and geothermal have great potential, both in terms of access to energy and environmental conservation.

Quantitative targets for renewables determined according to different natural and socio-economic situations of each country would be a useful tool not only in putting into operation various programmes to reduce greenhouse gases and emissions of air pollutants, but also in developing and implementing clean energy strategies that link the available energy resources and technology development programmes with national security and sustainable development scenarios.

Other recommendations are provided, primarily, to:

- strengthen policy and regulatory reforms to provide the necessary price signals and stronger government commitment through clear policy objectives. Sustainable engagement of the private sector is needed in the renewable energy sector;
- secure funds from private financial institutions, consumer financing schemes, and private entrepreneurship, and;
- encourage the development of indigenous technological capacities; or facilitate the acquisition/transfer of technology.

For enhanced air quality management, *Integrated Transportation Planning* should be advocated to promote environmentally sustainable transportation. Approaches, such as integrating land use planning, telecommuting, public transportation, hybrid electric vehicles, non-motorised transportation, transport awareness raising initiatives, traffic demand management, conventional emission standards, and inspection/maintenance could be considered according to local situations. In the longer term, the use of hydrogen gas for fuel cell technology as well as the possibility of using this energy for future internal combustion engines could be conceivable.

M. Land use management—urbanisation, rural development and forest conservation

The Asia-Pacific region is the most densely populated region in the world, thus making land a scarce resource. Continued population increase and economic growth in the region will make land even more precious, both in rural and urban areas. Urban areas continue to expand rapidly, causing an alienation of valuable agricultural areas. Even the expansion of agricultural areas will soon reach its limit, pushing more and more farmers into marginal forest areas. Forest areas will continue to shrink, and infertile areas will increase, causing desertification and land degradation. In addition, as forests and other natural ecosystems continue to diminish, deteriorated water resources and decreasing biodiversity are emerging as even more urgent issues.

To holistically address these environmental and sustainable development problems, policies and strategies interlinking conservation efforts and environmental services in different areas are becoming important. An integrated approach to national land use planning needs to be promoted through the

establishment of a *Mechanism for Participatory Integrated Land Use Planning*, by which planning committees with multi-stakeholder representation are set up at national, provincial, and local/ grassroots levels.

The region's protected areas system needs to be strengthened for biodiversity conservation, protection of ecosystem services, and other reasons. Establishment of the *Asia-Pacific Nature Corridor* offers a practical model and a bridge between protected areas and sustainable production landscape, i.e., forestry and agricultural areas.

To alleviate pressure on already overcrowded and overburdened urban areas, and develop rural areas, promotion of *Rural-Based Industry with Support from Urban Community* should be undertaken. This would not only decrease pressure on urban areas but also act as a means to revitalise rural communities, while conserving the maximum levels of energy, water and other natural resources. It would also help to establish a material cycle that effectively combines urban and neighbouring rural areas; and to create new partnerships between urban and rural residents.

There should be expanded research and dissemination of sustainable agriculture techniques and a programme to improve and transfer these techniques.

N. Chemical issues

The production and use of chemicals in the Asia-Pacific region has been substantial, resulting in the accumulation of stockpiles and contamination of the environment with attendant risks to human and animal health. Of particular regional concern is the extensive contamination of water, land, and air with a wide range of inorganic and organic compounds released into the environment from household, industrial, and agricultural activities. While the compounds causing greatest concern, particularly in the global context, are persistent organic pollutants (POPs), a variety of other compounds are known, or suspected, to adversely affect humans and animals in the region.

To improve management of chemical hazards, long-term national policies on hazardous chemicals must be introduced by establishing a system that would enable a *"Cradle-to-Cradle" Management System of Chemicals* in each country. A regional collaborative effort needs to be made as the first step in developing a set of model guidelines to address key issues in promoting the safe use, transport, storage, and disposal as well as reuse and recycling of chemicals under the "cradle-to-cradle" principle, thereby strengthening regional mechanisms for efficient and safe chemical management.

Better management of chemicals would require promotion of "Green Chemistry" for which the R&D capacity needs to be strengthened as a first step. The initiative to promote *Green Chemistry Research and Development* would enable regional research institutes to form a branch of the World Green Chemistry Network. Under such a network, a regional R&D initiative could be effective in promoting the development of more environmentally benign technologies for the manufacture, use and disposal of chemicals, using renewable biological resources to the greatest extent possible.

APFED action platform

Although modest, APFED is an important, participatory and open regional forum. Its messages cannot be imposed upon governments, international organisations, or any other stakeholders in the region, but is intended to recommend a paradigm shift in the Asia-Pacific region through the integration of economic, social, and environmental initiatives. In its second stage, APFED intends to be, as agreed upon at the ECO ASIA 2004, a "knowledge management" and "innovation facilitation" centre of the region. The significance of APFED recommendations is based on the belief that continuing dialogue among stakeholders, sharing experiences and wisdom with others, and proposing challenging new ideas will increase the long-run sustainability of the region. Productive ideas will develop a life of their own. In this respect, APFED continues to advocate a sustainable Asia-Pacific, seeking the thorough implementation of its Action Platform in collaboration with like-minded stakeholders.

The recommendations presented in the Final Report suggest broad directions in which the Asia-Pacific region as a whole should move to attain sustainable societies. These are to be realised over the long term at the regional, subregional, national, and local levels, taking into account potential future political, economic, social, and environmental conditions. The APFED Action Platform is put forward to initiate the first step to turn the recommendations into reality.

It highlights an action framework, within which follow-up actions to the recommendations contained in the APFED Final Report could be undertaken to facilitate and nurture sustainability initiatives in the region. A second stage of APFED (APFED II) is proposed to mobilise this region towards sustainable development, acting on the Final Report recommendations. APFED II will (i) intensify efforts to collect information on successes and failures of policies and projects for sustainable development of the region, (ii) take a lead in promoting joint research on strategic policies to promote sustainable development for the region, and (iii) play a catalytic role in sharing knowledge and experiences for sustainable development with key stakeholders in the region.

The Action Platform consists of the three broad mechanisms, each of which complements the others:

Multi-stakeholder interactive channels: The Multi-Stakeholder Interactive Channels consist of a variety of consultation processes involving concerned stakeholders, that are held to discuss and, whenever possible, to develop concrete ways and means to address priority issues in realising a sustainable future for the region.

Sustainable development knowledge initiative: Lessons and experiences will be accumulated from innovative actions already implemented to promote sustainable societies in the region, wisdom will be extracted from these lessons and experiences, and this wisdom will be shared with all stakeholders concerned. The APFED Sustainable Development Knowledge Initiative is the "brain" for accumulating knowledge for a sustainable future. It will develop a network of databases that contain extensive examples of good practices for sustainable development, create mechanisms that

enable lessons to be learnt from past and current actions, and organise workshops and other knowledge-sharing activities.

Innovation showcases for sustainable development: Opportunities will be provided for various actors in the region to showcase innovative policies, technologies, and practices. Innovative ideas will be put into practice on an experimental basis to verify whether the proposed ideas are congruent with the prevailing political, economic, social, and natural conditions. The Innovation Showcases for Sustainable Development are intended to aid the formulation of various innovations considered appropriate for the region, and facilitate their widespread application.

Example of selected initiatives proposed under The Three Mechanisms:

- Multi-Stakeholder Interactive Channels:

  i) Asia-Pacific Environmental Finance Roundtable

- Sustainable Development Knowledge Initiative:

  i) Joint Research on Integrated Environmental Policy Design in an Economically Integrated Asia

  ii) Asia-Pacific Water Development Report (APWDR)

- Innovation Showcases for Sustainable Development:

  i) Clean Energy Islands.

Next steps to be taken by APFED will be as follows. APFED is an ongoing initiative, and some of the activities contained in the three mechanisms proposed above are already in operation. In particular, the three activities under the Sustainable Development Knowledge Initiative (i.e., (iii) the Good Practices Database for Sustainable Development, (ii) Strategic Policy Research, and (iii) the APFED Lessons Learned Partnership) are basically enlarged extensions of the three APFED Commitments to WSSD, i.e., best policy practices (BPPs), capacity building programmes (CBPs), and networks of researchers and research institutes (NetRes). Therefore, these three activities are the ones APFED II will address first in terms of time sequence. Then, efforts will be made to set up and initiate the Multi-Stakeholders Dialogue and the Policymakers Conference. These forums will be built on, as much as possible, existing mechanisms such as the current APFED forum. These two APFED forums will provide, among other things, overall directions and basic guidance regarding the Innovation Showcases for Sustainable Development, based upon which innovative policies, technologies, and practices contained in the APFED Final Report will be piloted in various countries of the region.

APFED is an important advocate for sustainability in Asia and the Pacific. Its messages are meaningful only when other stakeholders in the region join forces with APFED. In this respect, APFED continues to seek dialogues and collaboration with other stakeholders in the region. It believes that hope for the future exists in small initiatives already undertaken in many parts of the region. What matters is having sensible ways to detect them, and effective mechanisms to nurture them. It is hoped APFED II will be successful in building on successes in the past, and using them to facilitate truly sustainable societies for the future.

Closing comments

Though efforts are being made in the region, it is thus far clear that current development patterns constitute an important threat to environmental security, which is in itself a threat to global security. The challenges the region is confronted with can be dealt with, but only if all stakeholders make a conscious effort to live in accordance with the sustainability principles. Strong political will and sensible policies are required to keep the region peaceful, to promote democracy, to sustain economic growth, and to strengthen social cohesion, without which sustainability cannot flourish. Challenges being faced by the region need to be turned into opportunities. An essential change in the way we view economy, society, and the environment—where the quality of life and people's aspirations, not just economic growth and material wealth, will be the prime concerns for all—is required.

Recommendations put forward by the APFED members are designed to move the region onto a sustainable path. For some ideas, uncertainty associated with them could be the barrier to their introduction. In other cases, potential losses to be imposed upon certain stakeholders may create tacit resistance to the recommendations. Still it is obvious that countries in the region have to accommodate innovations not only in technologies but also in policies and social practices to promote sustainability. Indeed, the question is not whether innovations are necessary for the region, but how soon such innovative ideas can be introduced.

Appendix: List of APFED Members (as of December 2004)

Vinya S. Ariyaratne	Executive Director, Sarvodaya Shramadana Movement, Sri Lanka (successor to A.T. Ariyaratne, from APFED 3, January 2003)
James Cecil Cocker	Minister of the Environment, Tonga
Enkhbayar Nambaryn	Prime Minister, Mongolia
Cielito F. Habito	Professor and Director, Ateneo Center for Economic Research & Development, Philippines
Barbara R. Hardy	Former Commissioner of the Australian Heritage Commission, Australia
Ryutaro Hashimoto	Former Prime Minister, Japan
Parvez Hassan	Former Chairman of the World Conservation Union (IUCN) Law Commission, Pakistan
Yolanda Kakabadse	President, World Conservation Union (IUCN)
Martin Khor	Director, Third World Network, Malaysia
Kim Myung-Ja	Former Minister of Environment, Republic of Korea (successor to Kim Jin-Hyun, from APFED 4, August 2003)
Reza Maknoon	Advisor to the Vice-President and the Head of the Department of the Environment, Deputy Chairman, National Committee on Sustainable Development, Islamic Republic of Iran
Akio Morishima	Chair of the Board of Directors, Institute for Global Environmental Strategies, Japan
Nakamura Kuniwo	Former President, Palau
Wadan Narsey	Director, Employment and Labour Market Studies, Pacific Institute of Advanced Studies in Development and Governance, The University of the South Pacific, Fiji Islands
Neth Barom	Vice-Rector, Royal University of Phnom Penh, Cambodia
Olga Ponizova	Executive Director, Eco-Accord Centre on Environment & Development, Russian Federation
Qu Geping	Former Chairman of Commission for Environment Protection and Resource Conservation, National People's Congress, China
Emil Salim	Chairman of Association for Community Empowerment, Indonesia
Maurice F. Strong	Chairman of Earth Council, Rector of United Nations University of Peace
Simon SC Tay	Chairman of the Singapore Institute of International Affairs, Singapore (successor to Tommy Koh, from APFED 3, January 2003)

Tongroj Onchan	President, Mekong Environment and Resource Institute, Thailand (successor to Phaichitr Uathavikul, from December 2001)
Tadao Chino	President, Asian Development Bank
Hans van Ginkel	Rector, United Nations University
Bulat Yessekin	Executive Director, Regional Environmental Centre for Central Asia
Klaus Töpfer	Executive Director, United Nations Environment Programme
Kim Hak-Su	Executive Secretary, Economic and Social Commission for Asia and the Pacific

- Observers -

Yoriko Kawaguchi	Special Assistant to the Prime Minister of Japan
Aitkul Samakova	Minister of the Environmental Protection, Kazakhstan

Subscription Order Form of
International Review for Environmental Strategies (IRES)

To order, please fill in this form and send/fax to:

The Secretariat

Institute for Global Environmental Strategies (IGES), attn: IRES

2108-11 Kamiyamaguchi, Hayama

Kanagawa 240-0115 Japan

Tel: +81-46-855-3730, Fax: +81-46-855-3739

E-mail: IRESinquiry@iges.or.jp

Also order available from, https://www.iges.or.jp/en/pub/ires/subform.html

We accept credit cards and bank transfer. No checks money orders, bank draft please.

Please enter my subscription for (please mark ❒, if applicable):

❒ **Volume 5, Number 2 Issue** (Special theme: Environmentally Sustainable City)
1 issue **JPY 2,200 (US$ 20)**

❒ **Volume 5, Number 1 Issue** (Special theme: The Kyoto Protocol; Its implication, development and the future)
1 issue **JPY 2,200 (US$ 20)**

❒ **Volume 4, Number 2 Issue**
1 issue **JPY 2,200 (US$ 20)**

Back issues

❒ **Volume 4, Number 1 (2003) Issue** (Special theme: Environmental Education for Sustainable Development)
1 issue **JPY 2,200 (US$ 20)**

❒ **Winter 2002 Issue** (Special theme: Sustainable Freshwater Resource Management)
Volume 3, Number 2 **1 issue** **JPY 2,200 (US$ 20)**

❒ **Summer 2002 Issue** (Special theme: Globalization and Sustainable Development)
Volume 3, Number 1 **1 issue** **JPY 2,200 (US$ 20)**

❒ **Winter 2001 Issue** (Special theme: Towards the Earth Summit 2002)
Volume 2, Number 2 **1 issue** **JPY 2,200 (US$ 20)**

❒ **Summer 2001 Issue**
Volume 2, Number 1 **1 issue** **JPY 2,200 (US$ 20)**

Payment

Charge my credit card:

❒ Visa ❒ Mastercard ❒ American Express ❒ JCB

Card Number: _____ Expiration Date: _____

Signature: _____

Name: _____

Position: Department:

Organization: _____

Address: _____

_____

_____

Tel: _____ Fax: _____

E-mail: _____

Send notices of change of address to the IGES Secretariat 6 to 8 weeks in advance. Please include both the old and new addresses.

Thank you very much for your subscription order.

To help us improve the quality of our journal, please answer the following questions:

Q1. Please rate IRES according to your level of interest:

❒ Very interesting ❒ Moderately interesting ❒ Somewhat interesting ❒ Not interesting

Q2. How did you find about IRES?

❒ Library ❒ Web site ❒ Friend ❒ Direct Mail ❒ Others ( )

Q3. If you subscribe to other environmental journals, please list them:

_____

Q4. If there are any specific subjects you would like to see addressed in IRES, please send your comments to the IGES secretariat by E-mail, at IRESsubmission@iges.or.jp

International Review for Environmental Strategies (IRES)

Instructions to Authors

1. **Contents:** Submitted manuscripts should make new or substantial contributions to the development of effective environmental strategies. The potential readers are expected to be persons not only in research institutions, academic societies and universities, but also in governmental organizations, business corporations and non-governmental organizations.

2. **Types of submissions:** Manuscripts are solicited in five categories:
   (a) **Article:** Original papers on analytical or synthetic research and studies. 10,000 words maximum.
   (b) **Research Note:** Papers concisely stating and analyzing interim findings of studies and research surveys. 6,000 words maximum.
   (c) **Current Development:** Papers reporting the latest developments in environmental strategies, practices, policies and laws. 3,000 words maximum.
   (d) **Essay:** Papers discussing critical environmental and related issues or discussing the state and directions of environmental policy-oriented research and studies. 3,000 words maximum.
   (e) **Book Review:** Reviews of recent books on environment-related policy and related issues, preferably written in languages other than English. 800 words maximum.

3. **Submission guidelines:**
   (a) **Hardcopy submissions:** One original, single-sided manuscript should be submitted along with 4 single-sided copies. Rejected manuscripts will not normally be returned. The submission of electronic files on diskettes is encouraged, and electronic files should be in MS Word 6.0 or higher. The hard copy and the electronic files must match exactly. Manuscripts should be sent to:

   IRES / IGES Secretariat
   Institute for Global Environmental Strategies (IGES)
   2108-11 Kamiyamaguchi, Hayama, Kanagawa 240-0115, Japan
   Tel: +81-46-855-3730 / Fax: +81-46-855-3739

   (b) **Electronic submissions:** IGES welcomes electronic submissions. To submit a paper electronically, please submit your paper in MS Word 6.0 or higher as an attachment to:

   IRESsubmit@iges.or.jp

   Upon acceptance for publication, a hard copy of the paper will be required.

4. **Technical guidelines:** Manuscripts must be written in English and should be type-written on one side of A4 paper, and double-spaced with 3-cm margins. All pages should be numbered consecutively. Titles and subtitles should be short.

5. **Manuscript structure:** Manuscripts should be structured as follows: Title page, Abstract, Introduction, Main Text, Conclusion, Acknowledgements, References, Tables and Figures. Long papers may require subheadings.

   The title page of the manuscript should include:
   - ❒ the title,
   - ❒ the first and last name of the authors and their affiliations,
   - ❒ sources of support in the form of funding or grants,
   - ❒ a short (up to 30 characters, including spaces) title for running heads (the title presented at the top of each page),
   - ❒ keywords (up to 5 key word phrases),
   - ❒ the name and address of the author responsible for correspondence, including telephone and fax numbers and e-mail address (if available).

All papers should include an abstract of no more than 250 words.

6. **Formulas:** Important formulas should appear on separate lines and should be numbered consecutively throughout the manuscript as (1), (2), etc. on the right-hand side of the page.

7. **Footnotes:** Footnotes are encouraged to be kept to a minimum (under five sentences) and numbered consecutively and placed at the bottom of each page.

8. **References:** Authors should attempt to reference every authority used in their papers. When directly quoting other materials, page numbers for the quotes should also be provided.

9. **Citation style:** References should be listed alphabetically by last name or by name of the institutional author at the end of the paper, and should follow the 15th edition of the Chicago Manual of Style. In the text, author(s) and year of publication should be given in parenthesis, e.g., (Brown 1957). When a citation has more than three authors, the first named author should be given followed by "et al.", e.g., (Brown et al. 1957). However, all authors should be listed in the References section, even if there are more than three authors. The conventions (Brown 1957a) and (Brown 1957b) should be used where more than one paper by the same author(s) has appeared in the same year.

For periodicals:
Consecutively numbered journals:
(1) Names and first initials of all authors. (2) Year of publication. (3) Full title of cited paper. (4) *Journal title in full* (5) volume number:(6) first and last page numbers.

For example:
Daly, H. E. 1990. Towards some operational principles of sustainable development. *Ecological Economics* 2:1-6.
Miyamoto, K. 1976. Problems of the environment impact statement system (in Japanese). *Kogai kenkyu* (*Pollution studies*) 6:121-27.

Non-consecutively numbered journals:
(1) Names and first initials of all authors. (2) Year of publication. (3) Full title of cited paper. (4) *Journal title in full* (5) volume number, no. issue number:(6) first and last page numbers.

For example:
Edmonds, J. 1999. Towards a technology greenhouse strategy. *Consequences* 5, no. 1:17-28.

For books: (1) Names and first initials of all authors. (2) Year of publication. (3) *Full title of book.* (4) City of publication: (5) Publisher.

For example:
Ostrom, E. 1997. *Governing the commons—The evolution of institution for collective action.* Cambridge: Cambridge University Press.

For chapters in books: (1) Names and initials of all authors. (2) Year of publication. (3) Full title of chapter. In (4) *Full title of book*, edited by (5) Initials and names of all editors, (6) first through last page numbers for the chapter. (7) City of publication: (7) Publisher.

For example:
Inoue, M. 2000. Participatory forest management. In *Rainforest ecosystems of East Kalimantan: El Niño, drought, fire and human impacts*, edited by E. Guhardja, M. Fatawi, M. Sutisna, T. Mori and S. Ohta, 299-307. Berlin: Springer-Verlag.

If the list is incomplete, or not in the correct form, it may be returned to the author for amendment, and publication of the paper may be delayed. For more information, please refer to

the Chicago Manual of Style, or see further examples on our web site (http://www.iges.or.jp).

10. **Figures:** Figures should be titled and numbered consecutively in Arabic numerals and placed on separate sheets at the end of the manuscript. Their positions should be indicated in the text. All figures should be copy-ready for reproduction. For line drawings, good-quality glossy prints in the desired final size are preferred. Computer printouts are acceptable, provided they are legible and reproducible. For charts, both X and Y axes should be clearly labeled, and units (if applicable) for the axes should be presented. Black and white images, as opposed to color images, are preferred. If data from other sources are presented, those sources should be referenced and page numbers where the data appear should be provided.

11. **Tables:** Tables should be titled and numbered separately from figures. Row and column labels should clearly describe the content of the rows and columns, and units should always be included. Accompanying electronic copies are preferred. If data from other sources are presented, those sources should be referenced and page numbers where the data appear should be provided.

12. **Units:** If applicable, metric units should be used. For currency, if a unit is ambiguous (e.g., "dollars"), the currency's country should be specified (e.g., "U.S. dollars").

13. **Abbreviations:** The use of abbreviations should be consistent throughout the paper. Standard abbreviations are preferred. If an abbreviation is nonstandard, the full term for which the abbreviation stands should precede its first use in the text, and the abbreviation should be placed in parentheses immediately following the term.

14. **Proofs:** One set of proofs will be sent to the author(s). Corrections should be limited to printer's errors, because the costs involved in making any other alterations are substantial and may be charged to the author.

15. **Copies:** Three copies of the journal and twenty offprints will be supplied free of charge.

16. **Copyrights:** When quoting from someone else's work or when reproducing an illustration or table from a book or journal article, the author should make sure that he/she is not infringing a copyright. In general an author may quote from other published works. However, he/she should try to obtain permission from the holders of the copyright if he/she wishes to make substantial extracts (500 words or more) or to reproduce tables, plates, or other illustrations.

    Authors must transfer the copyright of their papers to IGES with the IRES copyright transfer form when papers are accepted for publication. The copyright covers the exclusive rights to reproduce and distribute an article in any form of reproduction (printing, electronic media, or any other form); it also covers translation rights for all languages and countries.

    Exclusive copyrights of papers in IRES belong to IGES. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from IGES.

17. **Disclaimer:** IGES makes no representations or warranties of any kind, express or implied, as to the information, content, materials, data, tables, opinions, arguments, or other information included and contained in IRES. Opinions expressed in IRES do not necessarily represent the views of IGES, and authors will assume full responsibility and liability for all statements of fact or opinions contained in their papers.

Back Issues of
International Review for Environmental Strategies (IRES)

Back issues are available for sale. To place an order, please contact: IRESinquiry@iges.or.jp or visit our web: https://www.iges.or.jp/en/pub/ires/subform.html

➢ *Volume 5 Number 1 issue (2,200 Japanese yen)*

➢ *Volume 4 Number 2 issue (2,200 Japanese yen)*

➢ *Volume 4 Number 1 issue (2,200 Japanese yen)*

➢ *The Winter 2002 issue (Volume 3 Number 2: 2,200 Japanese yen)*

➢ *The Summer 2002 issue (Volume 3 Number 1: 2,200 Japanese yen)*

➢ *The Winter 2001 issue (Volume 2 Number 2: 2,200 Japanese yen)*

➢ *The Summer 2001 issue (Volume 2 Number 1: 2,200 Japanese yen)*

➢ *The Summer 2000 issue (Volume 1 Number 1: Inaugural Issue)*

CONTENTS

Volume 5 Number 2 2005

Institute for Global Environmental Strategies
2108-11 Kamiyamaguchi, Hayama, Kanagawa, 240-0115 Japan
Tel: +81-46-855-3730, Fax: +81-46-855-3739
Web site: http://www.iges.or.jp

Printed on recycled paper