Good Practices for Urban Greening

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Preface

Given that almost three-quarters of the people of Latin America and the Caribbean live in cities, improvements in urban living conditions are essential to raise the overall quality of life. The Inter-American Development Bank has long been active in lending to ameliorate urban pollution and resolve water-related problems. Although financing for so-called Agreen@ urban projects has been limited, the few instances in which it was undertaken proved quite positive. As a result, and in light of the many benefits of establishing and managing green areas, the Bank=s Environment Division carried out a study of the management of green urban areas in the region.

This first-of-its-kind study found that municipalities are aware of the numerous benefits that accrue from the management of green areas. However, the availability of financing for these types of projects is severely restricted. In addition, there is a scarcity of trained professionals and workers in the field, a distinct lack of regional exchanges of existing information, and little technology transfer from other parts of the world.

Consequently, the IDB stepped in to fill this gap by organizing a regional meeting in cooperation with the state of Mexico and Mexico City municipal authorities, who are currently undertaking a multimillion dollar environmental conservation program with partial financing from the Bank. The seminar provided an immediate opportunity to consult regional decisionmakers on the study and solicit their input and recommendations for improvement. Seminar participants also recommended that the Bank take a proactive role in promoting green environmental management in all urban development projects proposed for financing. In this regard, the Bank=s goal should be to assist borrowing countries in raising the current level of 3.5 square meters of green open space per city dweller to the international standard of 9 square meters.

This report provides a basis for planning, executing and further discussing urban green investments, and should contribute to improving the quality of urban development projects.

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Executive Summary

The increasing concentration of human populations in cities presents urban planners with enormous challenges in meeting the demand for infrastructure. Population growth and high human densities can exact a heavy toll on a city=s fragile natural and environmental resources, particularly in developing countries where squatter communities are prevalent and resources are scarce. Nevertheless, the preservation of a system of vegetated areas, or green spaces, can improve the quality of life by providing people with natural settings for leisure and recreation, and *by safeguarding the quality of precious life-giving resources* such as air and water. Green areas also have the potential for affording citizens the opportunity to get direct economic benefits through urban agriculture or forestry. Yet none of these amenities occurs accidentally.

Careful planning and forethought are the keys to ensuring that a city will have healthy natural resources for both today and tomorrow. *Local governments, however, cannot undertake the planning and preparation alone*. Because green spaces are ultimately for the enjoyment and benefit of citizens, city planners need to involve local communities in the decision-making process. This means soliciting *input from the public* on topics ranging from siting and designing green spaces, to establishing a priority ranking of desired environmental benefits, and developing workable upkeep strategies. Cooperation also includes involvement of the private sector, as well as community groups, nongovernmental organizations (NGOs), and even the international community. It is the local community, however, that is to benefit most directly from a greening project, and on whom the ultimate success of the project depends.

This report seeks to provide the reader with a strong background on the benefits, challenges, and approaches to the development of a sustainable urban greening program. It is intended to be applicable to a broad readership, ranging from government officials and city planners to local business owners, concerned community members, and the staff of organizations such as the Inter-American Development Bank. While the objective is not to be exhaustive on any one part of the topic, the goal is to cover the major elements necessary in project initiation. Included are a variety of examples from *case studies* throughout Latin America and the world to illustrate real life problems and solutions. The examples and ideas in the report draw on the expertise and acumen of more than 300 professionals from 23 countries; people who work in all reaches of the private and public sector, with insights on the political, administrative, technical, financial and social aspects of urban greening. Many of these people came together to share their experience and knowledge at the 1996 Mexico City Seminar on Urban Greening sponsored by the Bank, where they also participated in workshops specifically designed to review an earlier draft of this publication. This final report

represents the culmination of the efforts of these professionals and the staff of the IDB.

The first section of this report introduces the phenomenon of *rapid urban growth*, the form it takes (i.e., what it looks like and where it occurs), and why an urban greening effort is particularly necessary. Illustrations of *environmental neglect* demonstrate how the quality of urban life can be jeopardized by air and water pollution, development in fragile ecosystems, and loss of water catchment and floodplain surface areas. The development of *a design plan* is the first step for creating an integrated citywide green system. City planners need to *prioritize projects, establish criteria and set quantitative targets* to evaluate progress and judge the degree of success. The general target, established by the World Health Organization, is the availability of a minimum of 9 square meters of green space per city dweller. Currently, only 3.5 square meters of green area per inhabitant are available in Latin American cities. The paper also outlines the *function of the IDB* in urban greening, describing both the part it has played in the past, and the leadership role it could take in the future. The Bank sponsored the first regional forum for the exchange of ideas and experiences, and helped create a hemisphere-wide information and resource network on urban greening. The IDB will continue to finance greening investments.

This report=s second section describes the many environmental, material, and social benefits associated with urban greening efforts. The third section addresses the biggest *challenges confronting urban greening projects.* Foremost among them is getting people to place an appropriate monetary value on benefits such as clean air and a stroll through the park**C**benefits that are typically thought of as unquantifiable. Without some economic estimation of these benefits, investors cannot accurately *compare the value of greening projects* to other more quantifiable, but perhaps less-needed uses of the land.

Municipalities face great challenges in implementing greening projects under rapid urban growth conditions, where the ability to provide technical, legal and institutional support may be in question. Another difficulty is making sure that investors continue their support throughout the life of the project and *provide for monitoring and maintenance expenses.* Covering these expenses is rarely possible without local investment which, in turn, hinges on the perception of being a legitimate stakeholder and having *land tenure security* for their homes and green areas**C**an illusive concept in many developing countries. Ecological factors also constrain greening efforts since problems like soil compaction and air pollution may limit the types of plants and species that will be able to survive in an area. Outdated laws and customs thwart successful environmental improvements when, for example, dumping of industrial effluent into a river is accepted, whether or not it is legal. Finally, planners and city officials need to incorporate the input of women when designing projects, since women are responsible for a large share of a family=s interaction with the natural environment whether through gardening, firewood collection, or taking children to the park.

The fourth section delineates *the basic frameworks***C***social, political, financial,*

etc.**C**that need to be in place for an urban greening program to be successful. *Four basic types* work particularly well for greening investment projects: stand-alone projects for specific cities; components of other urban development projects, such as infrastructure improvements; Aglobal@ projects that share resources and strategies for a number of smaller urban centers; and projects whose goal is only to provide technical assistance and training. Solid *social and political support* is paramount to the success of a project and requires the *involvement at the national, regional and local levels*. Technical training and support throughout a program=s life-span are essential to a viable investment, as is an understanding of the environmental factors necessary to ensure sustainable ecosystems. Lastly, investors and citizens need to *understand and adhere to the financial conditions and expectations* of a greening project, just as the population needs to be aware of the economic benefits and constraints in order to support greening activities throughout the lifetime of each.

Section five itemizes the fundamental components that tend to make up a successful urban greening program. *Public outreach* needs to invite public *participation and* offer *education* to everyone, from children to senior citizens, about the benefits of green spaces in cities. More technical, but just as essential to a diverse urban green system is the inclusion of a *variety of greening strategies*, consisting of public parks with recreational and ecological components, street and residential trees, agricultural projects and greenways. It is crucial that green systems are designed to achieve the overarching goals of watershed and natural resource management and the contribution to *a network of protected ecosystems* to safeguard wildlife habitats and biological diversity.

The final section deals with the financial aspects of urban greening. Securing of at least two investment sources is essential to countering the risk of unstable financial support. Strategists can use a *wide variety of public funding strategies*, including general taxes, greening-specific taxes, permit and fee revenues, and municipal bonds, among others. *Private funding is an essential* counterpart to public financing, and it includes an equally diverse range of options, including advertizing opportunities, entrance fees, philanthropic donations, contributions in kind, green improvements as a component of development projects, etc. *Cost avoidance and reduction mechanisms* provide a means of accounting to show the public and city officials how a *green area saves city money*, for example, by avoiding flood damage or by reducing sediment buildup in reservoirs due to erosion protection mechanisms. *Cost recovery and sharing* can be achieved, for example, by renting out agricultural plots or offering firewood collection in exchange for labor inputs. Lastly, debt-for-nature swaps and the establishment of innovative trust funds with the private sector may provide communities with financing for green areas without making additional drains on capital-scarce public accounts.

Introduction

Sometime around the turn of the millennium, an urban baby will be born whose birth will tip a crucial balance. That day will see humanity change from being a predominantly rural to a predominantly urban species. In 1810 there was just one city of a million people: London. Today, there are 35 cities whose population surpasses five million inhabitants, and most of these are located in developing countries (Girardet 1995). What are the implications of this urban explosion? Can the world=s cities accommodate so many people sustainably? Will people find these urban environments sufficiently hospitable? What impact will such growth have on the natural environment?

As more people leave rural environments for the steel and concrete surroundings of cities, there is a growing recognition that they will need and want some form of vegetation present in their daily lives. Whether it is a shady city park for recreation, a tree border for noise reduction or a wetland area for flood control, the concept of *urban greening* is fast becoming a reality. The term evolved from Miller=s (1988) definition to mean Aan integrated, citywide approach to the planting, care and management of all vegetation in a city to secure multiple environmental and social benefits for urban dwellers.@ While Aurban forestry@ typically refers to the planting and maintenance of groups of trees and Aurban agriculture@ to food grown by city and suburban dwellers, Aurban greening@ is a more general term. For the purposes of this paper, urban greening refers to any revegetation effortCincluding the planting of trees, shrubs, grass, or agricultural plotsCwhose design is intended to improve the environmental quality, economic opportunity, or aesthetic value associated with a city=s landscape. Urban greening is seen as a strategy for simultaneously making our cities more enjoyable, liveable and sustainable.

Urban parks and other vegetated areas in cities have traditionally been viewed principally as recreational amenities. Urban greening comes from the recognition that such urban green areas can and should be used in an integrated, holistic manner for many other environmental and social benefits beyond recreational use and aesthetics. These include improving basic sanitation, providing potable water, controlling floodwaters, treating sewage, reducing air pollution, disposing of solid wastes, moderating both macro- and microclimates, increasing biodiversity and reducing poverty.

This report examines the role of urban greening in Central and South America (hereafter referred to collectively as ALatin America@) and the Caribbean. The report is intended to be of interest to a broad readership, ranging from government officials and city planners to local business owners, concerned community members, and the staff of organizations such as the Inter-American Development Bank. While the objective is not to be exhaustive on any one part of the topic, the goal is to cover the major elements

necessary in project initiation. The report seeks to outline the fundamentals of urban greening programs—including the benefits, challenges, and principal elements of successful projects—for a diverse audience of city planners, government officials, and concerned citizens.

Drawing on the expertise of a wide range of professionals, this draft reflects the comments, revisions, and discussions of numerous working groups that critiqued an earlier draft at the 1996 Mexico City Seminar on Urban Greening, sponsored by the Inter-American Development Bank (IDB 1996b). The report uses a variety of examples from actual projects around the world in order to serve as a learning resource guide that investigates lessons of the past and present in hopes of improving urban greening projects of the future.

Urban Growth

United Nations figures indicate that in 1990 only 37 percent of the total population of developing countries lived in urban areas. By the year 2025, it is estimated that 61 percent of the population will be urbanized. There are many reasons to explain this rapid urban growth, including falling death rates, industrialization (which concentrates job opportunities in urban areas), high fertility rates, a popular perception of greater opportunities in urban areas, and political and economic problems in rural areas (UNDP 1996).

Latin America is the most urbanized region in the developing world, claiming almost half of the most populous cities. In 1995, the ten largest cities in the world were Tokyo (28.4 million), Sao Paulo (21.1 million), Seoul (19.1 million), Mexico City (16.8 million), New York City (14.6 million), Osaka-Kobe-Kyoto (14.1 million), Bombay (13.5 million), Calcutta (12.9 million), Rio de Janeiro (12.8 million), and Buenos Aires (12.2 million)

Distribution of Population in Cities in Developing Countries

Population	Share of Urban Population (%)	
	1990	**2000**
> 4 million	20.2	23.2
2 to 4 million	8.6	10.0
1 to 2 million	11.0	11.0
0.5 to 1 million	10.3	8.8

Source: Bartone *et al*., 1994

(US Bureau of the Census International Data Base 1995). In addition, twelve Latin American cities are among the 65 largest cities in the world. These twelve cities are projected to grow at approximately 3 percent annually between 1995 and 2000. The table shows that the urban population in developing countries is becoming more concentrated and that large cities are growing faster than smaller cities.

The Composition of the Population

Who are the people that comprise these statistics on growing urban populations in the region? Who are the people living in the cities of Latin America and the Caribbean, and thus most affected by urban environmental problems and sustainability issues? How does urban greening fit into their varied lifestyles and livelihoods?

Urban greening must not only serve the needs of all urban residents, but they must also participate fully in it. There are numerous subgroups that compose the

population of urban dwellers in Latin America, including recently arrived poor migrants, migrants that are beginning to settle, well-established urban dwellers, single workers, families, people from various economic strata, groups with varied educational levels, those with and without rural links, and those with and without tenure to their residence, among others.

The majority of the population of the region=s cities is poor. The state and quality of the economy and environment of the cities are shaped predominantly by people whose incomes are in the mid to low range; namely, factory workers; those making clothes, foods, and crafts in their homes; government clerks; and peddlers (Porritt 1991). Given the numbers and needs of this lower income population, it is imperative that they play a central role in planning and implementing urban greening in their cities.

Many of the people migrating to urban centers in Latin America and the Caribbean are political, economic or environmental refugees. In general, the poor arriving from rural areas or smaller cities gravitate to high density, low cost housing in an urban center or to squatter settlements on its outskirts. Squatter settlements (also known as illegal settlements, illegal occupations, or *invasiones*) are found in most cities in Latin America and vary greatly in their origin and evolution.

The term *informal settlements* will be used for migrant communities whose residents lack title to their land. These lands are typified by inadequate potable water, sewage disposal, electricity or other public services. In general, such informal settlements are created illegally and, once established, are not easily acknowledged by planning authorities and thereafter suffer from an inadequate infrastructure.

Nevertheless, after several years of existing as viable communities, many of the region=s informal settlements become integrated into their cities= overall planning and eventually may receive some public services. Many of these squatter communities are established on the worst possible sites for building as, for example, on the steep hillsides of La Paz, Bolivia; in marsh and lake bed preserves and in junkyards in Mexico City; on steep riverside slopes in Asuncion, Paraguay; in the shallow bays and inlets of Salvador, Brazil; and in the polluted lagoons of Cartagena, Colombia. (See Appendix A, Photo #1).

The Urban Environment

The accelerating rate of urbanization is exacerbating the serious environmental problems already found in the cities of Latin America and the Caribbean. The urban poor, usually residing on marginal, environmentally sensitive land, often face the greatest exposure to urban environmental hazards. Despite the fact that the poor are most often the hardest hit by these hazards, air, water and noise pollution affect people of every economic stratum. The social and ecological costs of urban pollution will continue to affect the growing urban populations in the region unless the cycle of degradation and poverty can be broken.

Cases of soil, air and water pollution as well as other environmental concerns, can be found in any city in Latin America or the Caribbean. For example:

- Of the 1,100 tons of garbage generated every day in Guatemala City, only 750 tons are collected by private and municipal companies. The rest ends up in clandestine garbage dumps or rots in vacant lands in and around the city.

- Landslides in Caracas, Venezuela, most often occur on the steep hillsides surrounding the downtown area that is inhabited by the city=s poor.

- In 1992, powerful explosions in the sewer system of Guadalajara, Mexico killed at least 212 people and injured 1,000 more. The explosions were caused by liquid hexane that had been dumped into the municipal sewer system by a manufacturer. (Source: Bertone *et al.*, 1994)

Water pollution in the region is particularly prevalent. For instance, it is common for industries in many cities to discharge untreated wastewater into municipal sewers or to dump it directly into urban rivers. Another source of contaminants is human excrement, which is often deposited in or near a city=s waterways. The infectious and parasitic diseases thus spread are among the leading causes of morbidity and mortality in the region.

Air pollution is another major cause for concern. The increasing number of vehicles with untreated exhausts, expanding industrial sectors, and poor natural ventilation in many cities have combined to create serious smog problems. In addition, the use of coal and highly toxic fuels for cooking and heating have helped create unbreathable air in many of the region=s cities. This, in turn, has resulted in pollution-induced hypertension, respiratory diseases and other serious health problems.

Urban expansion has also been detrimental to the land in and around cities. Conversion of open space and agricultural lands to concentrated urban development decreases water permeable areas, upsets natural drainage patterns and has caused serious flood problems in a many of the region=s cities. Sao Paulo is a dramatic example of this uncontrolled conversion of open space resulting in extensive flooding and air pollution problems. Currently, urban spread over the land occurs faster than urban population growth by a factor of three to four times (Smit 1996).

The political future of most developing nations will be influenced by their success or failure in managing their cities (Porritt 1991). Given the immensity and complexity of urban needs, many governments and international agencies have no clear picture of what to do with their cities or have effective action plans for aiding the urban poor. Numerous expensive urban development projects in the region have neither an understanding of, nor a partnership with, the very people they are supposed to be helping, nor have they considered questions of ecologic or economic sustainability. Even some of the urban projects that appear to be successful are actually treating symptoms rather than causes.

Urban Planning

In order to maximize the value of urban greening projects and minimize the associated costs, city planners need to be

thinking about greening possibilities whenever they are considering urban public works projects. Retrofitting a paved or otherwise developed section of a city with a park or greenway is generally far more expensive and controversial than incorporating greening as part of a project in a previously undeveloped area.

Quantitative Targets: When designing a city=s green space infrastructure, planners should aim to fulfill certain quantitative targets. The World Health Organization (WHO) recommends that cities provide $9m^2$ of undeveloped (unpaved) open space for every inhabitant. The WHO also suggests designing green area networks so that all residents live within a 15 minute walk of an open space. Other proposed goals are: the development of a biodiversity index used to rank green spaces based on the number and percent composition of native species; maintenance of a permanent record of changes in air and water quality; an increase in cost-effectiveness from project to project; and charting public use and appreciation by measuring user-days (equal to the number of visits per person per year summed over all users), willingness to pay, or other preference indicators.

Maximizing Use and Benefits: Planners are also needed to design urban green areas in a way that maximizes the potential uses. Whereas urban green areas have been traditionally designed for recreation and aesthetic value, their usefulness far exceeds these functions. With proper design, green areas can also improve air and water quality, protect biodiversity, reduce erosion and flood risks, provide agricultural output, etc. But all this requires planning. It requires cross-sectoral communication where city planners talk with water and sewage engineers, transportation specialists, agronomists, businesses, and local communities to design green areas that best serve the intended beneficiaries.

There are myriad possibilities of implementing green areas outside of the traditional contexts of city parks, tree-lined streets, or greenways. For example, creative planners have integrated green areas into water treatment projects, business parks, highway construction, flood-plain protection, and urban farms. One of the additional benefits of integrating green areas into other projects is that some or all of the costs are absorbed into the budgets of these projects. Greening costs become a natural part of infrastructure programs when developers are required to set aside project areas for ecological benefits, or when urban planners work in conjunction with the transportation or water and power departments.

Lastly, planners must think ahead about ensuring the longevity of the green spaces they create. It is not enough to secure the funds for the establishment of a particular green area. That area also requires funds for maintenance, protection and monitoring. Without this money and public participation, the plants die, the soil is compacted, the area may be vandalized or covered with litter, and could become crime-ridden or taken over by squatters, thus losing the benefits that they were designed to generate.

The best chance for a green area to remain a viable source of multiple amenities to sur-rounding communities comes not only when there are provisions made for upkeep, but when there is citizen participation. Because a safe, well-maintained green area provides

multiple benefits for the surrounding community, planners should be able to stimulate citizen and local business participation in the upkeep of the area. By garnering local participation, the community is made a vital and effective stakeholder. Once a community feels a sense of ownership of its green space, the citizens will help provide far more effective maintenance and protection than the city alone could provide.

IDB Participation in Urban Greening

By providing fora for technical experts, the Inter-American Development Bank hopes to foster a multidisciplinary working environment to generate creative urban greening solutions. Improving the urban environment and quality of life was a central focus at the IDB=s 1997 Annual Meeting in Barcelona, Spain, where more than 700 people attended a two-day seminar on the importance of environmentally sustainable cities. The IDB was also an active participant at the Second United Nations Conference on Human Settlements (Habitat II) held in Istanbul, Turkey in May 1996. For that event, the Bank and the United Nations Development Program (UNDP) published a report on ways to make the urban environment in Latin America and the Caribbean more liveable for all socio-economic groups, in particular via equal access to urban infrastructure, economic opportunity and a clean environment (IDB-UNDP 1996).

In 1995, the IDB sponsored the Sixth Consultative Meeting on the Environment in Curitiba, Brazil. This regional conference drew together representatives of 76 nongovernmental organizations from 23 countries in Latin America and the Caribbean (IDB 1995). It is by sponsoring conferences like this one and the 1996 Seminar on Urban Greening in Mexico City (which included the participation of 300 people from 26 countries), that the IDB hopes to continue promoting the management of urban green areas as a crucial element in improving the environmental quality of urban centers and the general quality of life itself (IDB 1996a).

The Mexico seminar, for example, provided the framework for the creation of a network for the management of green areas in Latin America and the Caribbean. It also facilitated the first postgraduate university course on arboriculture in Latin America, in which 83 people participated (IDB 1996b). This guidebook is a direct product of the suggestions and revisions on an earlier draft that was scrutinized during the seminar workshops. The principal recommendations from the workshops were as follows:

- Stress the importance of public participation at all stages.
- Promote the creation of an urban greening resource network for Latin America and the Caribbean.
- Stress the importance of setting quantitative targets, and monitoring and evaluation systems.
- Integrate greening into other municipal improvement projects, e.g., sanitation, housing and transportation programs.
- Facilitate sustainability of investments for long time horizons (program instead of project approach and financing in phases).

- Provide multiple sources of financing with strong participation of the private sector.

- Encourage use of native species and management for biodiversity objectives.

The Inter-American Development Bank views urban greening and the environmental improvement of urban centers in Latin America as a crucial area for investment projects. The IDB has led the way by funding multiple urban development projects with components of open space management to promote awareness of the importance of the topic in the region.

In response to the natural environment needs of urban centers, the IDB has made a commitment to fund projects that increase the number of urban greenspaces and improve existing ones, as well as integrate a greening component into urban planning in general. This commitment has been incorporated into the Bank=s mission statement, evident in both the Report on the Eighth General Increase in Resources (IDB 1994a) and the IDB Basic Information pamphlet (1996b), which stipulate that the Bank will continue to earmark funds for urban environmental resources as a fundamental means of improving the quality of life in urban centers. In 1996, for example, the majority of the US$605 million in environment-related loans went toward improvements in urban areas (IDB 1997). In Mexico City, the Bank is currently involved in a US$200 million ecological conservation project (IDB 1992). Other IDB-funded urban development programs with green area components include: Bogota, Colombia (IDB 1990); Guatemala City, Guatemala (IDB 1996d); Port-au-Prince, Haiti (IDB 1986); Quito, Ecuador (IDB 1996); some 20 small towns in Nicaragua (IDB 1996f); Sao Paulo, Brazil (IDB 1994b) and others.

Through advance planning, careful investment, and attention to the lessons learned from previous urban greening efforts, the IDB intends to contribute to securing the environmental health and natural amenities of Latin America=s urban centers.

Benefits of Urban Greening

Urban greening offers improvements in air, water, and land resources by absorbing air pollutants, increasing water catchment and floodplain surfaces, and stabilizing soils. Urban forests act as temperature buffers**C**providing shade in the summer, and wind break in the winter**C**in addition to reducing noise pollution and CO_2 levels, and providing a habitat for wildlife. The economic benefits include marketable timber and agricultural products, as well as a variety of nontimber forest products such as artisan wares and honey. Lastly, the overall benefits to society, particularly to low-income residents, are significant. They include the contribution of trees and vegetation to the mental and physical health of the populace, and the provision of recreational opportunities and an outdoor classroom for environmental education. In addition, they provide aesthetic improvements to an environment otherwise dominated by asphalt and concrete.

Environmental Benefits

Air Quality Improvement

While air pollution indices in many cities in more developed countries have dropped over the last ten to twenty-five years, air pollution levels have been rising in cities throughout much of Latin America and the Caribbean. In Mexico City, for example, the average level of particulate suspension in the atmosphere rose from 65 mg/m^3 to 400mg/m^3 between 1974 and 1990 (Carter 1993). One study rated the air contamination of Mexico City as the eighth worse in the world, surpassed only by levels in Beijing, Calcutta, Delhi, Jakarta, Milan, Shenyang and Tehran. Suspended particulate matter, carbon dioxide and ozone are also serious problems in Sao Paulo (Carter 1993). Those most affected by such detrimental air contaminants are children, the elderly and people with respiratory problems.

Topographical features frequently exacerbate the hazards of air pollution in certain cities. The mountains that ring Mexico City and Santiago, Chile, cause inversions and other climatological phenomena that worsen air pollution problems. Therefore, in these cities an aggressive and multifaceted approach to combating pollution is all the more urgent. Using vegetation to reduce air pollution is an effective technique that also provides other benefits such as city beautification.

Urban greening can reduce air pollutants to varying degrees. Air pollution is directly reduced when dust and smoke particles are trapped by the vegetation. In addition, plants absorb toxic gases, especially those from vehicle exhausts, which are a major component of urban smog (Nowak et al. 1996). Santiago, Chile, which has a serious air quality problem, has recently named its urban parks program the ALungs of Santiago@ to reflect the benefit of urban vegetation in reducing the city-s air pollution (See Appendix A, Photo #4).

Integrated Air Quality Improvement

Mexico City emits 4,300,000 tons of contaminants into the air annually. Its geographic location in a valley surrounded by mountains exacerbates air pollution by reducing dispersion of the emissions. Warm winds from the northeast create thermal inversions and increase pollution levels further by trapping contaminants in the valley. In addition, because the city is 2,200 meters above sea level, the oxygen content of the city's air is approximately 23 percent lower than it would be if the city were at sea level. Air pollution levels exceed Mexican safety standards approximately 250 days of the year. In response to this dire situation, Mexico City officials are applying four principal strategies to improve the quality of their air: 1) improving the quality of fuels used in the city; 2) reorganizing the urban transport system; 3) mandating emission control systems; and 4) reforesting the city and suburban areas. The IDB is currently providing partial financing for a US$200 million Mexico City Environmental Conservation Program with urban and suburban reforestation components (IDB 1992).

High temperatures accelerate the formation of smog. The moderating effect that urban vegetation has on a city's climate can reduce temperature extremes and thus reduce this phenomenon to some degree. Carbon dioxide is also a major component of air pollution and is one of the principal causes of the "greenhouse effect" (see Glossary). Urban vegetation can reduce carbon dioxide levels in two ways. First, all plants, through photosynthesis, absorb carbon dioxide directly into their biomass and release oxygen in return. Secondly, when extensive vegetation cover reduces the "heat island effect" in an urban area, residents use fewer fossil fuels to cool buildings, thereby reducing power plant emissions of carbon dioxide (McPherson, E. Gregory *et al*., 1994).

Climate Improvement

One of the most important benefits of urban vegetation is its impact on the climate. Two distinct influences can be identified. First, there is a direct effect on human comfort. Secondly, there is an effect on the energy budget of buildings in cities where air-conditioning is used. Both of these effects can be significant, or negligible, depending on the size, spacing and design of vegetated areas.

The direct impact on human comfort is one that every person is familiar with, although it is hard to quantify. Anyone who has walked on a city street on a rainy, hot, or windy day knows from personal experience that trees can significantly increase human comfort by influencing the degree of solar radiation, air movement, humidity and air temperature and providing protection from heavy rains. Wind speeds 2 meters above the ground in a residential neighborhood were shown to decrease by 60 percent or more in areas of moderate tree cover compared to open areas (Heisler 1990). The urban poor in Latin America and the Caribbean have a further appreciation for trees for the shelter they can provide in lieu of a more permanent structure.

Trees and other vegetation can also have an important impact on the energy budgets of buildings and, in turn, of entire cities. This effect is most noticeable in urban centers with little or no vegetation and extensive paved areas. Large areas of paved surfaces dissipate the heat of the sun only very slowly. This results in the urban heat island effect where a city heats up rapidly and then maintains a high temperature. Furthermore, as city temperatures increase, so too do airborne pollutants and smog (Kuchelmeister 1991). Studies in Sao Paulo show that the

temperature in the concrete-covered center of the city is consistently several degrees warmer than in more open and vegetated outlying areas (See Appendix A, Photo #2). Akbari *et al*. (1992) found that tree shade could reduce the average air temperature in buildings by as much as five degrees Celsius.

Expanded research is currently being conducted in several climates in the United States and Puerto Rico through a joint partnership between Cool Communities (a research program of American Forests) and the U.S. Department of Energy. The U.S. Forest Service is also studying the effects of vegetation on urban climates as diverse as Austin, Texas and South Dade County, Florida. These studies will no doubt be of benefit to city planners in Latin America and the Caribbean and in other developing regions (Nowak *et al.* 1996).

Energy Savings

Various components of an urban greening program can contribute substantially to reducing a city=s overall energy budget. As mentioned previously, inner city concentrations of pavement and concrete produce an urban heat island effect that causes discomfort and health problems, especially for the poor who cannot afford air-conditioning. On the other hand, cooling air-conditioned buildings requires considerable amounts of energy. High electricity demand during hot months can often cause Abrownouts@. This can be greatly reduced by planting substantial amounts of vegetation in dense downtown areas. To date, the most extensive studies on the influence that vegetation has on the energy budget of cities have been carried out in largely temperate climates in developed countries. Studies in Chicago show that increasing tree cover in the city by 10 percent may reduce the total energy used for heating and cooling by 5 to 10 percent (McPherson *et al*. 1994).

Urban green areas can supply fuelwood and other substitutes for imported fossil fuels, thereby providing sources of renewable energy. According to Smit (1996), food production amounts to approximately 40 percent of the economies of Latin American cities. Producing it in urban and neighboring green areas reduces transportation costs to market. Studies done in the United States show that it may take seven or eight calories of fossil fuel for rural agriculture to deliver one calorie of food energy to the consumer. Urban agriculture uses only an average of one calorie of fossil fuel for each food calorie delivered.

Another area where large energy savings can accrue is in waste management. Treating wastewaters in biological systems (see discussion above) eliminates the need for major sewage treatment plants that operate with costly usage of fuel. Similarly, handling solid waste at its source in each neighborhood (using organic wastes for animal feed, composted fertilizer and mulch for green areas), reduces the energy costs associated with trucking it away and treating it in landfills or elsewhere. Given the large populations of many of the region=s cities, these savings can be quite substantial (Smit 1996).

Water Supply Catchment Protection

Contaminated water sources and waterborne diseases cause a high percentage of illness and death, especially in infants and young children, throughout Latin America and the

Caribbean. Typically, the poorest communities are hardest hit by the problems associated with unsanitary water supplies. One of the significant challenges for city planners is providing potable water to all the city=s inhabitants.

Given the importance of maintaining quality water supplies, it is imperative that cities adequately preserve their water supply catchment areas. Determining how the costs of protecting such areas will be allocated between urban and rural residents, who both need and use these resources, is a complex issue of equity and practicality.

Water catchment areas for most cities tend to be in close proximity to their location and are often found in the *suburbs* (defined as areas of urban sprawl on the perimeter of urban centers and sometimes referred to as Aperi-urban@). Cities in the region have employed a diversity of strategies to protect the suburban or rural areas that serve as the source of their water supplies. Since many of these watersheds are fairly close to the city=s edge, some of them have inevitably been depleted or polluted, and those cities now have to pipe water in from quite a distance away.

One of the principal functions of *urban forestry* (see Glossary) has been to control erosion and protect the watersheds of urban water supplies. For example, a major impetus of forestry in and around Hong Kong in the 1870s, and again in the 1950s, was erosion control and protection of water catchment areas so as to ensure a clean, regular water supply for the urban area. Similar efforts are being carried out in cities such as Kathmandu (Nepal), Lima (Peru), Panama City (Panama), and Kingston (Jamaica) (Braatz 1993). In Sao Paulo, Brazil, the state-sponsored *Projecto SOS Mananciais* is working with poor riverside dwellers to protect suburban watersheds.

Wastewater Treatment

The practice of at least partially treating wastewater in stabilization ponds has to be considered an alternative for urban wastewater treatment as much as its economic and ecological advantages may indicate. Most cities in the region have significant wastewater treatment challenges and could explore whether stabilization ponds, integrated into park systems, would economically and ecologically serve some of their treatment needs.

The ponds, rivers and wetlands that become part of natural wastewater treatment or pre-treatment can also serve for recreation, wildlife habitat, aesthetics and educational use. Wetlands are among the world=s most biologically diverse ecosystems. Using wetland resources for tertiary wastewater treatment can significantly increase habitats and enhance the biodiversity of flora and fauna in and along the waterways.

For example, a multiple-use park system in Durban, South Africa, uses the park=s retention ponds and artificial wetlands to partially treat its wastewater. Instead of being whisked away through concrete channels (as occurs in many cities), the water entering this park area slowly passes through a series of natural watercourses with floodplains and wetlands. The biological functions and physical aeration that occur in the water during the time it spends in these waterways remove many of the toxic effluents from the wastewater (ICLEI 1995). These wetlands

are utilized as low cost wastewater treatment for residents of low-income neighborhoods close to the park system. In addition, the waterways that allow these natural wastewater cleansing processes to occur also serve the purpose of flood prevention.

Wastewaters in the upper parts of the Bogota River watershed are being treated by 22 plants in small municipalities (IDB 1990). Adequately analyzed urban runoff waters may be sent to suburban agricultural fields to be used in irrigation, providing needed nutrients for the crops (see Appendix A, Photo 3). Similarly, the University of the West Indies in Kingston, Jamaica, is experimenting with the school=s wastewater by sending it through lily ponds to be purified, then applying it as irrigation water on university grounds and in vegetable gardens. In both instances, wastewater is essentially recycled into food production, creating a more holistic, integrated system within a city=s bioregion.

There are several alternatives to wastewater treatment and disposal that can incorporate green areas of various types. The water can be used to irrigate urban and suburban agriculture and forests, horticultural projects (such as flowers for export), city landscaping and parks, and tree farms. All of these options provide for a safe and productive means of wastewater disposal (Braatz 1993). In arid and semi-arid regions this practice can also recharge groundwater reserves. For example, wastewater reuse is especially important in Lima, Peru, an extremely arid city. Since 1969, the city has used stabilization ponds to hold wastewater from some 150,000 residents, returning the treated water to those communities to use for irrigating food crops and fruit trees, to water woodlots and as drinking water for livestock (UNDP 1996). This reuse of city water supplies not only recharges the aquifer, it also reduces the demand on scarce water reserves.

An innovative way to purify wastewater is through the use of duckweed. This prolific plant can completely purify wastewater in 20 days, doubles its weight in two to four days and can yield as much as ten times the amount of protein of soya beans. It has been used in the United States for water purification since 1985 and is sold as a cash crop and as fish feed. Israel exports duckweed as an exotic salad crop to European health food stores. Not only does this weed clean wastewaters that need to be treated anyway, it also is a good cash crop for animal feed or human consumption. In experiments in Bangladesh, farmers are harvesting about one ton of duckweed per hectare per day and earning more than US$2,000 a year. Clearly, this is an alternative worth exploring to treat wastewater (UNDP 1996).

When using wastewater for irrigation purposes, city planners need to coordinate with environment officials to avoid potential health risks to farmers and consumers. For example, Santiago, Chile, has had laws regulating sewage irrigation since 1941 but they were not strictly enforced. As a result, when there was a cholera outbreak in 1992, raw contaminated sewage was applied to vegetable crops and the disease was thus spread to consumers. Consequently, the government had to bulldoze several thousand hectares of vegetable crops and relocate farming activities to areas with a safe supply of irrigation water. Such severe measures can be avoided if wastewater is properly

handled and continually monitored.

Recycling wastewaters into green areas deserves thoughtful consideration by the region=s city planners. Recycling wastewater into parks or forested, farmed and degraded lands may also be more economical than finding ways to dispose of it somewhere else. A new computer program offers an exhaustive exploration of wastewater treatment alternatives that can help define the most appropriate system for a given set of circumstances. The program takes into account the resources and constraints of each particular city and can aid city planners in designing the system best suited to their needs and budgets (Gearheart et al, 1994).

Flood Control

Floods cause considerable damage in Latin America and the Caribbean every year. Buenos Aires suffered over US$200 million in flood damages in 1985. Estimates of 1993 flood damages from the Mississippi and Missouri Rivers (USA) have been calculated to be in the realm of US$10 billion. Chile has suffered serious floods throughout the country in the last ten years.

In 1988, floods in Rio de Janeiro left 289 people dead, 734 injured, 18,560 homeless, and an estimated US$945 million in damages (Bernstein 1994). The damage included destruction of roads, bridges, canals, drainage networks, dikes, water and sewage networks, electric power systems, factories, residences and commercial establishments. In addition, there were the added costs of interrupted economic activity, lost revenues from tourism, and cleanup expenses (in this case, US$50 million). The flood in Rio left the predominantly low-income population the hardest hit, with limited access to schools, health facilities and basic sanitation for months thereafter.

Using wetlands and parks as important components of a city=s flood control system is not only recommended but is quite feasible. By locating city parks and green spaces in the flood plains of rivers, streams or other drainage systems, planners can increase the permeable surface area available for catchment, reduce flow rates (compared to nonvegetated surfaces such as asphalt), and avoid damage to buildings or settlements that might have otherwise been constructed in the area. This has been the case, for example, in Bogota, Colombia (IDB 1990). Green areas can also mitigate flood damage simply by increasing the permeable surface area in a watershed, thereby decreasing

Green Space and Flood Control in Curitiba, Brazil

The Iguaçu River and a number of its natural feeder springs run through the city of Curitiba. When the city was smaller and less developed, the annual flooding of the river and its tributaries during the rainy season was manageable. With a rapid growth rate and a population of more than 1.6 million, Curitiba started to experience problems: development and encroachment on the floodplain put businesses and lives at stake. Unfortunately, engineering strategies using diversion and channeling proved ineffective, only transferring the flooding risk to other inhabited areas. City planners decided to try reclaiming the floodplain through the creation of recreational green spaces. In a cross-sectoral effort, zoning laws were changed to limit subdivisions, construction of homes and roads, and to expropriate land for the creation of several parks and artificial lakes. The result is a system of green spaces and low density development that provides effective flood protection and has become the city=s principal recreational area. (Klaiye & Biller 1994).

runoff rates and abating peak flow levels. Interference with other park uses (such as recreation) only occurs in the short periods that the park=s wetlands and floodplains are actually flooded.

Some cities, such as Durban, South Africa, have pioneered urban greening flood control. The Durban park system is used to retain storm runoff waters in upland ponds and marshes and in downstream wetlands (ICLEI 1995). In Tulsa, Oklahoma (USA), the park service has selected certain tree species that can survive standing water for up to a week or more and has planted them in parks designed for flood control. The city of Curitiba, Brazil, which in the past experienced frequent flood damage, has used urban greening to reverse that trend. Almost all of Curitiba=s city parks created since the 1980s have a lake in the middle for flood control purposes, and old sand and clay mines have likewise been turned into lakes and parks.

Noise Abatement

Noise often reaches consistently unhealthy levels in large cities in Latin America. Poor populations living close to heavy industry, commercial and traffic corridors often get exposed to the highest levels. To make matters worse, the building materials used in low-income neighborhoods do not insulate the residents from noise as well as the more substantial materials frequently used in wealthier neighborhoods. Mexico City has a consistent noise level of around 75 decibels (the equivalent of listening to an alarm clock or a police whistle), which often reaches 100 decibels (which can cause ear damage) close to major highways and the city=s airport (Carter 1993). Noise pollution levels in Santiago and Rio de Janeiro have also been rated as some of the worst in the region.

Trees and vegetation can help reduce noise pollution in five important ways: by sound absorption (sound is transferred to some other object), deflection (the direction of sound is altered), reflection (sound is bounced back to its source), refraction (sound waves bend around an object) and masking (unwanted sound is covered up with more pleasing sounds). Thus, leaves, twigs and branches will *absorb* sound, as will grasses and other herbaceous plants. Tree or plant barriers will *deflect* sound away from listeners and, if at right angles to the source, will *reflect* it back to that source. If the noise passes through and around the vegetation, it is being *refracted* and thereby dissipated. Vegetation can also *mask* sounds to the extent that people will filter out unwanted noise by selectively listening to the sounds of nature (bird songs, leaves rustling, etc.) over the sounds of the city (Miller 1988).

Particularly advantageous to humans is the fact that plants absorb high frequency noises better than lower ones, since higher frequency noises are most distressing to people. The optimum planting design to lessen noise pollution is dense vegetative cover in a range of heights. Such green barriers can be established throughout Latin America and the Caribbean along major highways and on the boundaries of noisy industrial and commercial corridors.

Erosion Control

Many large cities in the region are located below, on or above steep hills and mountains, or on coastal slopes. Given the

general lack of vegetative cover and the hard seasonal rains most of these cities experience, erosion and landslides have become common occurrences. Informal settlements are hit especially hard by landslides, as they are most often built on marginal slopes. Because of the potential for loss of life and property that eroded embankments represent, many countries enacted legislation long ago to prevent urban development on excessively steep hills. For example, sections of the Brazilian Forest Law of 1959 specifically address this issue.

In Bogota, Colombia, an environmental rehabilitation project includes the reforestation of 4,450 hectares in the watershed of the Bogota River, and reducing erosion and sedimentation over about 6,800 hectares (IDB 1990). The planning authority in Rio de Janeiro estimates that three million people (nearly two-thirds of Rio=s *favela* dwellers) live on the steep hills surrounding the city (Bernstein 1994). Mud slides at the end of the rainy season are a constant threat to people=s lives and homes there. Development on high- risk sites, combined with little vegetative cover, increases susceptibility to the landslides that often follow heavy rains (Bernstein, 1994). Much of that risk can be reduced by planting hardy species to hold eroding soil on steep slopes.

Solid Waste and Land Reclamation

Solid waste disposal in most large cities has become a serious and permanent problem. While some cities have managed to keep pace with their growing populations, the majority suffer from significant garbage dilemmas, especially in and around informal settlements. Quite often, a substantial percentage of a city=s solid waste accumulates in vacant lots and alleys or adorns the slopes of gullies and urban riverbanks.

Urban greening can help abate the solid waste disposal dilemma. Many forms of waste and nutrient recycling exist and are already in use in other parts of the world. For example, Asian countries have developed Aclosed loop@ cycles wherein organic wastes are used to feed chickens, pigs and livestock; settling pond sludge is used for agricultural fertilizer; and wastewaters are recycled into irrigation for aquaculture and agriculture. In Latin America and the Caribbean, a few wastewater recycling systems for irrigation are already operational, notably in Lima, Peru, and Bogota, Colombia. Bogota is constructing systems to treat slaughterhouse wastes and 25 sanitary landfills for the final disposal of solid waste in the metropolitan area (IDB 1990).

Composting is another viable alternative to waste removal. Organic materials in a city=s waste stream can be composted to produce quality soil amendments while at the same time reducing the volume of urban refuse and thus the city=s waste disposal expenses. An example of an effective composting system can be found in Milwaukee, Wisconsin (USA). The city=s sewage goes to a special treatment facility that turns it into a soil amendment called Milorganite which is highly valued by gardeners and farmers and is very cost effective for the municipality. A sizeable element in many solid waste disposal sites is tree prunings and other plant trimmings that can be used as fertilizer or mulch. In poor developing countries, such refuse may have a high value as fuel and fodder.

Unused or degraded lands can be reclaimed through urban greening activities. The idea of creating parks over terminated landfills seems to be rapidly gaining popularity in Latin America. Brazil and Chile have implemented very successful landfill-to-park conversions. By planting vegetation over landfills or other reclamation sites, a city can effectively cover an eyesore and add more vegetation to its park system. For example, in San Jos J, Costa Rica, a former airport overtaken by urban growth was converted into a huge city park, complete with lakes, swimming pools, a gymnasium, basketball courts and a host of other recreational amenities. On any given day of the year, this park is crowded with city dwellers enjoying hundreds of acres of reclaimed land.

Wildlife Habitat and Biodiversity

Urban green areas have been found to provide habitats for a surprising number of species and for large populations of birds and animals. Most urban residents are familiar with at least some local species of birds and animals that have adjusted to urban conditions. Where more parks and vegetation exist, local and migrating species can find suitable habitats.

In particular, suburban wetlands may offer some of the world=s most productive natural ecosystems as transitional areas between terrestrial and aquatic environments (Bernstein 1994). Wetlands that are incorporated into urban greening projects, including those designed or maintained for flood control and wastewater treatment settling ponds, provide particularly important habitats for local and migrating fauna contributing to maintaining a healthy biodiversity in the area. An example of preserving and enhancing wetlands for biological diversity can be found in Bogota, Colombia, where an environmental project is managing irrigation waters and cropping patterns to allow water levels to be restored in the Herrera Lagoon, a wetland of enormous biological wealth and the last vestige of the prehistoric Humboldt Lake (IDB 1990).

On a larger scale, urban greening can create or restore biological diversity that will reconnect a city to its surrounding bioregion. Cities are built in an existing ecosystem and often destroy it. The flora and fauna that once lived in that system are either destroyed, displaced or have to adapt to the new urban environment. This process seriously depletes a region=s genetic diversity (both plant and animal) and can threaten with extinction some species that are essential to the area=s natural ecosystem and consequently to the resident human population.

Incorporating green areas throughout a city can reverse the trend of biological destruction. For example, greenbelts and greenways (see Glossary) can provide biological corridors for wide-ranging species of plants and animals from the surrounding bioregion, allowing them areas large enough to disperse their genetic material, a process crucial to species survival. Urban agriculture can also provide biodiversity on a small but important scale. Diversity protects wild and domestic species from adverse conditions (including natural and economic fluctuations) and thus ensures survival.

Material Benefits

Food and Agricultural Products

Farmers, from backyard gardeners to low-income market farmers to multinational corporations, raise food and cash crops on urban lands in Latin America and the Caribbean. Smit *et al.* (1996) cite surveys that found that from 28 percent to 80 percent of urban households in developing countries practice some form of *urban agriculture*. Jac Smit, President of the Urban Agriculture Network (USA) estimates that in Latin America 25 percent to 75 percent of all urban families raise some food in green spaces, depending on the availability of plots, and the local climate and culture (Smit 1996). Urban farmers maintain open spaces and transform urban waste into food and biodiversity, thereby saving the municipality the expense of landscape maintenance and waste management (*ibid*).

Virtually every major city in the region has at least one central market, or one to several farmers= markets, where local growers can sell their products to the general public. Many of these farmers grow their produce within the urban or suburban area and make a significant contribution to the feeding of the urban population. Their proximity to markets gives them a competitive advantage through lower transportation and storage costs. Furthermore, farmers can tailor their production to meet market demand for high-value perishable items (UNDP 1996). In JerusalJn (a suburb of Bogota), Colombia, a cooperative of more than 100 low-income women produces hydroponic vegetables on rooftops to supply a metropolitan supermarket chain. They are earning up to three times more than their husbands who work at semiskilled jobs (*ibid*.).

Where available, small gardening plots can help urban growers, especially the poor, to provide food for their own families, and thus reduce drains on their already scarce financial resources or on strapped government subsidy programs. Container horticulture (in boxes, rain gutters, pots, used tires and even plastic bags) is also a popular alternative for low-income families without access to land. In Mexico City, for example, the city=s agricultural department is assisting rooftop gardeners to produce cacti for salads and as a cash crop (UNDP 1996). Similarly, low-income rooftop and pavement gardeners in Port-au-Prince, Haiti, are using shallow beds with three to five inches of composted materials to grow vegetables for food and market (*ibid*). Studies have shown that these household farming systems can provide one-tenth to one-third of a family=s annual vegetable consumption. In addition, these gardeners eat more vegetables and their families are healthier than other comparable low-income families (*ibid*).

The value of providing green areas and other facilities or services to urban growers has not been lost on the city planners of ViZa del Mar, Chile. A municipal program there gives seeds and technical assistance to families to encourage them to plant their own gardens. In another innovative project in Arlington, Virginia (USA), residents can apply for and plant food on community garden land located in the wide medians of the city=s highways. This program has the dual purpose of food production and citizen maintenance of the medians, both cost-saving measures for the municipality. In Lima, Peru, a division of the Ministry of Agriculture cooperates with 100 other

agencies and institutions (including a prison and several NGOs) to promote urban agriculture. Its programs benefit more than 220,000 people through 44,500 farmers in 33 towns in the Lima, Cuzco and Piura districts. A particularly successful aspect of its programs is the community kitchens run by women in poor communities who raise vegetables and livestock on government land to supply the kitchens (UNDP 1996). (See Appendix A, Photo #5.)

A good example of urban agriculture that combines production, marketing and recreation can be found in Xochimilco Park in Mexico City. The ancient Aztec system of *chinampas* (floating beds of woven mats covered with mud and then planted) has been revived and they are now used for livestock, poultry, vegetables, ornamental plants, flowers and trees. The canals between the *chinampas* provide irrigation, transportation, aquaculture, recreation and tourism. A flower market has been built within easy access of the area. Extensionists in Xochimilco Park are teaching neighborhood residents to work in apiculture and encouraging beekeeping in the park (UNDP 1996). Such integrated systems of urban agriculture are beneficial to growers, consumers and the city itself in meeting both the supply and demand for food as well as providing other amenities.

Forest Products and Fodder

Urban greening can provide significant material benefits in areas where poles, firewood and fodder are in high demand. Tree species that produce poles for fence posts are highly valued, especially in arid regions of where low cost fencing materials are scarce. This is especially true in suburban areas and small towns where fence poles are more commonly used to surround livestock or cultivated plots. Poles are also used in construction, furniture making and crafts.

There are many species of trees adapted to urban and suburban growing conditions, such as *Leucaena leucocephala*, that provide high quality fodder for livestock. Similarly, a large percentage of urban dwellers, especially the poor, use firewood as their primary cooking and heating fuel and depend on nearby green areas for their source of wood. Urban greening can provide sustainable fuelwood plantings to meet the needs of these urban residents.

Fruits, nuts and fiber are some of the other forest products that are valued and harvested in urban and suburban green areas. Most trees that provide these useable products are found in private patios and gardens and not in public. Traditionally, the criteria for selecting species for standard horticultural plantings in urban areas have stressed ornamental value over the value of material products that could be harvested from the vegetation. While fruit trees and other species that provide material benefits are frequently highly valued in private lots, the great majority of species selected for use on public lands are ornamentals. Their products are rarely factored into their selection.

Often, the ornamental and status value of a landscape plant appears to be enhanced by the plant being useless for practical purposes and exotic in origin. On a practical note, ornamentals are less subject to damage and theft than are fruit trees or other beneficial species and there may be an element of cost-saving objectives by municipal planners when choosing which species to plant in public

green areas.

Social Benefits

Health

Although they may be difficult to quantify, the benefits of urban greening to human health can be considerable. Certainly, improvements in air quality due to vegetation have positive impacts on physical health with such obvious benefits as decreases in respiratory illnesses. Perhaps less obvious, however, is the fact that urban forests also reduce stress and improve health by contributing to an aesthetically pleasing and relaxing environment (Nowak *et al*. 1996). Ulrich (1990) found that convalescing hospital patients recuperated significantly faster when placed in rooms with views of trees and outdoor settings than patients without such views.

Tree Preferences in Quito

The experience of *Fundaci \n Natura*, an NGO in Quito, Ecuador, has shown that residents of low-income *barrios* strongly prefer plants that produce economic benefits over purely ornamental ones. Neighborhood meetings plus a local survey revealed that a plant's ornamental value alone was insufficient to interest locals in dedicating time and effort to its care. The NGO discovered that plants that provided medicinal products, hedges, and edible fruits were most successful. Some of the preferred species were *Rubus prasina* (raspberry) and *Prunus serotina* (cherry). Residents valued raspberry bushes for their edible fruit and usefulness as a dense and spiny hedge. Cherry was valued for its edible fruit and wood for construction and firewood (Cobo & Sullivan 1996).

Urban forests provide a connection between people and their natural environment that would otherwise be missing in a city. This connection is important for everyday enjoyment, worker productivity and general mental health (Nowak et al 1996). Shade from trees and the resulting cooler temperatures, especially in the summer, explain why people tend to flock to city parks and green spaces to spend time together during both the weekends and during the week. Thus, they also serve a very important social function. Shade also reduces ultraviolet light exposure thereby lowering the risks of harmful health effects such as skin cancer and cataracts (Heisler et al. 1995). In sum, urban forests supply numerous direct and indirect physical and mental health benefits to a city's population.

Employment

Another important aspect of urban greening is the jobs provided for poor, skilled and unskilled laborers. Urban greening projects are often labor-intensive and provide both initial start-up jobs (soil preparation, planting, etc.) as well as more permanent employment (maintenance, management, etc.). For example, a forestry component of Mexico City's urban greening program will require extensive use of unskilled labor. Project managers have estimated that the program will need approximately 3,380 workers to produce and transport plants, 3,700 working in the plantations, 800 in management and more than 100 for protection and surveillance in existing green areas (IDB 1992).

Recreation

Green areas provide recreational sites, especially for lower income residents who tend to frequent city parks more than wealthier citizens because of financial constraints and restrictions on leisure time. This, of course, depends on two conditions: first, the park must be within an affordable traveling distance for the individual or family; and second, it must have the amenities those people prefer. In Latin America and the Caribbean, the preferred activities tend to be barbecuing, playing soccer or volleyball, walking or just enjoying the natural surroundings. (See Appendix A, Photo #6.) In Mexico City, the centrally located Chapultepec Park draws up to three million visitors a week who enjoy a wide variety of recreational activities (Gonzalez 1996).

The urban poor generally have few affordable options for recreation, and thus place a high value on green areas. Nevertheless, their preferred recreational activities may vary from city to city, or even among neighborhoods. Therefore, research or social surveys about their preferences should be considered as a tool to help city planners design appropriate new green areas. For example, Brasilia was planned more according to central European than Latin American criteria. It does not have the traditional central area, or *plaza central*, where people can meet to socialize, go for a stroll, or sit in the shade to chat.

On the outskirts of Bogota, Colombia, a group of low- to middle-income volunteers cooperatively developed a golf course for recreation and finance its maintenance. Membership fees are affordable enough to accommodate modest wage earners such as industrial laborers and chauffeurs.

Volunteers have donated their labor and materials to develop this recreational outlet which, in turn, benefits Bogota with its many green acres and wetlands. (IDB 1990).

Education

Parks and other green areas also provide educational opportunities for urban residents. Many cities in Latin America boast botanical gardens, zoos, nature trails and even visitor information centers that can inform residents and tourists alike about the area=s flora and fauna. Individuals, families and school groups can take advantage of a city=s green areas to learn about the environment and natural processes. For urban children, as well as adult students, the learning experiences available in urban parks may be some of the few opportunities they have to learn about nature through first-hand experience. Moreover, by getting the public involved in educational activities associated with urban green spaces, planners can raise the consciousness of the public concerning the importance of these spaces.

Another way to educate the public on the importance and benefits of urban greening is to involve people in the greening process itself. Examples of this can be found throughout Latin America. In Sao Paulo, Brazil, *Projecto Frutificar* made use of the city=s environmental secretariat to distribute 2000 trees to every elementary school in the urban area. Each child then received at least one tree in a folder to take home to plant in the yard. The project=s objective is for the children to educate and motivate their families about the need to participate in the city=s environmental programs. Similarly, a

municipal tree program in ViZa del Mar, Chile, provides seedlings of native tree species to classes for planting on school grounds.

Aesthetics

While not considered as important as filling basic needs such as food and shelter, the aesthetics of green areas can also be very meaningful to many urban residents. There are many examples of civic groups sponsoring the planting of trees to improve the aesthetics of key parts of their cities in order to increase civic pride. Vegetation reduces sun glare and reflection, complements architectural features and tones down the harshness of large expanses of concrete.

Areas of a cities with enough greenery to be aesthetically pleasing, are attractive to residents and investors alike. The beautification of Singapore and Kuala Lumpur, Malaysia, was one of the factors that attracted significant foreign investment that assisted those cities= rapid economic growth (Braatz 1993). In the Black Country district of England, (a region with a legacy of derelict, polluted lands left from the Industrial Revolution), urban greening is focused along roadways and railway lines in an attempt to improve the area=s image and attract investment (Jones 1995). (See also Appendix A, Photo #7.)

Another advantage of aesthetically pleasing green areas is their positive effect on property values. When unsightly vacant lots or garbage dumps are replaced by attractive parks, not only does the residents= quality of life improve, but the value of their property increases. In addition, rehabilitating lands with vegetation is often more attractive and cost-effective than constructing new buildings on them.

Urban greenery, used as a boundary line, can improve the aesthetics of small private landholdings in urban or suburban areas. One of the most common sights in Latin America and the Caribbean is the home dwelling, however rich or poor, bordered by hedges of greenery, flower pots or food plantings. On large areas of municipal lands, such borders may be maintained through community efforts by nearby residents who value the green areas and join their efforts in order to protect them.

The range of benefits that urban greening provides is both practical and comprehensive and addresses many of the social, environmental and economic problems most cities face. Though not the panacea for every current urban ill, urban greening nonetheless can significantly treat a great many of them and create a much more salutary and desirable environment in which to live.

Challenges Facing Urban Greening

Several recurrent obstacles stand in the way of the planning and execution of more green areas in urban landscapes. The first major challenge is getting city officials, businesses and the public to include the real benefits of urban greening when making capital investment decisions based on cost benefit analyses. Although the benefits described in the previous section are very real, they are often overlooked in traditional accounting comparisons.

Developing institutional capacity, using appropriate technology and securing sustainable funding from a variety of sources are also crucial yet elusive goals. Another important challenge is maximizing public participation at all levels of project implementation, and breaking down the barriers that prevent this, including lack of land tenure, inequality in participation between the sexes, and outdated legislation. Finally, planners face the hurdle of greening areas that have experienced moderate to severe environmental degradation. Overcoming this problem may require a multi-tiered approach involving cooperation with other government sectors to reduce deleterious impacts, land reclamation and strict monitoring procedures. This chapter describes these challenges in more detail using examples from case studies to illustrate the importance of overcoming such barriers to success.

Economic Valuation for Urban Greening

Placing a value on the city=s green resources is one of the most significant challenges that city planners may encounter when implementing an urban greening program. While there are obvious costs involved in the establishment and upkeep of green areas, it is difficult to calculate the value of all the benefits associated with that area. It may also be difficult to avoid double counting benefits if several assessment methods are used independently to estimate a variety of benefits from the green areas.

Green areas provide a range of tangible, easily valued benefits such as food, fuel and fodder from agricultural plots, but they also provide intangible yet valuable amenities such as aesthetics and noise reduction. How can city administrators value such multiple and diverse benefits and then compare them to benefits from other projects with more easily calculated costs and benefits? How does one place an economic value on something intangible? Can non-market benefits and ecological services be measured in the same units as market goods?

If the government were willing to put land in green areas up for bid, with the restriction that it could only be used for urban greening purposes, the highest bid might be used as the economic value of green space. Equivalently, if the government acted as if it were a private developer, it could achieve

the same outcome by calculating the cash result of using the land in different green activities and choosing the most profitable. These procedures would be reasonable if the bids or the government=s calculations reflected all costs and benefits. Unfortunately, this is not likely to be the case. With the exception of the goods produced by urban agriculture, many of the goods and services provided by urban greening activities produce no cash revenues. They produce public goods (cleaner air, a prettier view, a quieter environment) that are enjoyed by many, but that cannot be charged to each user since people cannot be excluded from enjoying them.

Economic analysis of urban greening initiatives is particularly relevant when sizeable tracts of urban land are involved. Such land has high value in private use because it can yield commercial and residential services that are precluded when the land is set aside for urban greening. The loss must be compared to the gain. Furthermore, the government will incur large recurrent costs maintaining the greening activities. It is important to demonstrate that greening benefits (e.g., aesthetic improvements, wildlife habitat provision, etc.) more than offset the opportunity and cash flow costs of maintaining space as green areas. Thus, urban greening projects should be considered public investment projects and should be evaluated using economic analysis criteria.

If benefits are hard or expensive to quantify, or if the particular urban greening objective is specified in law or zoning regulations, a simple *cost-effectiveness* analysis (Savedoff 1994) could be used. If there is only one alternative, its local cost per unit could be compared to some generally accepted Abest practice@ standard. This approach might be useful in designing plantings along highways and industrial and commercial corridors to reduce noise pollution by a specified amount, for example.

If the several options achieve different degrees of objective attainment at different costs, a mere cost-effectiveness comparison of, say, the decibel reduction achieved per unit of monetary cost or the incremental costs of getting additional decibel reduction from increasingly expensive options does not tell us which alternative to select, or even admit the possibility of not undertaking the program. The benefit flows must be monetized in order to identify the socially preferred option, the one with the greatest positive net present value (i.e., greatest positive difference between discounted benefits and discounted costs). If the net present value of all proposals is negative, and the decisionmaker is confident that all benefits have been properly valued, the public program should not be supported. Moving to a social cost-benefit analysis complicates matters, but provides an answer to the question of whether an urban greening activity is worth doing, when *all* benefits and *all* costs (private and social, tangible and intangible) are included.[1]

The benefits of some urban greening activities can be measured in a straightforward way. For example, the direct gross benefit of urban agriculture can be approximated using the *market value* of

[1]Freeman (1979, 1993) provides a definitive, in-depth treatment of benefit estimation methods for environmental and resource problems. Also see Markandya (1991) for a review of benefit methods in the context of the types of projects the IDB finances.

product outputs (quantities multiplied by market prices). Flood control benefits can be estimated as the value of *damages avoided* to property and the loss of profits arising from the temporary disruption of commercial activity.

The *replacement cost* method is a rough-and-ready means of assessment that provides an upper bound for non-market benefits. This technique assumes a good or service is worth whatever it would cost to get the same benefit in the least expensive alternative way. In other words, the value is based on what a substitute would cost. For example, the city of Chicago, Illinois (USA) has sued the city of Milwaukee, Wisconsin (USA) for polluting the waters of Lake Michigan and affecting Chicago. Consequently, Milwaukee is spending $2.3 billion on a deep tunnel water system to contain runoff waters until they can be treated and released into the lake again. The cost of this tunnel system is the replacement cost of a natural wastewater system of wetlands and ponds that the city could have incorporated into its land use plans decades ago. Another example of replacement costs can be found with the Lemna Corporation of the United States which processes wastewater in nine of its facilities using duckweed. The company calculates that this process is 50 to 75 percent less expensive than competing technologies, thus giving a concrete value to the duckweed technique (UNDP 1996). Similarly, reforesting a degraded watershed would save on the cost of dredging the yearly sediment from erosion.

The recreational benefits of public parks that attract visitors from near and far can be approximated using a *travel cost* model. The number of trips taken over a season by a sample of visitors to an existing site (that is similar to the new, proposed site) will generally fall as travel cost rises. Assuming that visitors would react to a hypothetical fee in the same way they react to actual out-of-pocket travel expenses allows the analyst to derive a demand curve (price-quantity relationship) from the travel cost data. The total willingness to pay (gross benefit) is the area under the curve. This relationship breaks down for small urban parks where travel distances are short, or for new parks that do not have an existing close substitute for comparison. A less satisfactory approach is to multiply the expected number of annual visits to the park by *user day values* per visit, based on expert judgement or averages of values reported in a large number of individual studies. Such values may not exist for much of Latin America.

Air pollution reduction benefits have often been obtained by applying a *hedonic* model that statistically captures the relationship between property values and the characteristics of the housing unit and the surrounding neighborhood. Neighborhood characteristics can include particulate and sulphur dioxide concentrations, traffic noise and other ambient quality measures. The estimated increase in property value resulting from decreases in one or more air pollutants brought about by an urban greening effort is a proxy for the expected benefits.

Other kinds of benefits are quite difficult to quantify in money terms, particularly the value of habitat preservation for biodiversity, and general aesthetic improvements. In such cases, and even for water quality improvement projects using natural wastewater treatment, the logical alternative is *contingent valuation*. Analogous to a

market research survey for a new product, this approach asks survey respondents how much they would be willing to pay for a hypothetical improvement or bundle of improvements in environmental quality that an urban greening program could provide.

Urban greening provides a number of valuable yet intangible benefits that are difficult to price. Examples of such economic advantages are the health benefits derived from cleaner air and water, a better quality of life due to an improved climate, increased commercial and housing development in aesthetically attractive areas, improved agricultural production using wastewaters, and several other such amenities. All these non-market benefits have clear economic advantages for a city and need to be quantified as well as possible given current economic methods.

In summary, valuation techniques for green resources are still being developed and tested. Each city in the region will need to explore how to quantify and monetize (where possible) their particular resources when making decisions about an urban greening program. When urban greening activities are included as components of larger urban improvement programs, it is important that they also be subjected to technical and economic analyses. It is not advisable to include them in the program without any scrutiny just because the benefits from the project as a whole are sufficient to indirectly subsidize urban greening expenses. When real resources are invested in public programs in countries that are not affluent, it is not sufficient to invoke the argument of implicit merit to justify greening activities**C** proof is needed to confirm that these projects respond to citizens**:** preferences and values.

Institutional Challenges

Urban greening is, by definition, an integrated process that requires a high level of institutional capability to plan, execute and maintain green areas throughout a city and its environs. Both Latin America and the Caribbean have a long history of bureaucratic obstacles to new initiatives, as experienced by urban greening officials in Mexico City who have had to contend with slow, unclear or overly restrictive bidding procedures that have delayed their planting schedule.

Governmental Capacity. Among the institutional obstacles to overcome is a general lack of coordination between the various levels of government, i.e., federal, state and local. For example, municipal environmental officials in Bogota, Colombia, stated that responsibilities are often unclear among the various levels of authorities. The situation has been exacerbated by the rapid pace with which Colombia has decentralized governmental responsibilities over the last decade. Many municipal authorities have been left unsure about which environmental responsibilities are theirs.

As with any municipal project, urban greening initiatives must be carried out under the reigning policies and regulations of the public institutions that govern them. In the case of government ministries, those policies may change with each successive political election. Thus, a current administration**:**s emphasis on environmental sustainability may not continue if the opposition wins the next election.

Nevertheless, strong institutional support is central to the process of providing useful and sustainable green spaces to urban areas. The question then is what kind of institutional capacity does a municipality need in order to achieve its greening goals? To make the most efficient use of limited resources, institutional support needs to be partitioned among national, regional/state and local governments. The challenge is to get the national government to provide services such as policy guidelines for planning, monitoring, environmental regulation and agricultural extension services. National governments can also be instrumental in directing both universities and NGOs in their research efforts, participation in planning process, and development of environmental education materials.

Zulauf (1996) suggests that the responsibilities of regional/state governments might be to develop more specific policies that complement the national ones, but refer to individual projects. Some Brazilian state governments with efficient means of taxation established urban forest funds. These funds were distributed to municipalities for the creation of green spaces with economic benefits such as firewood or agricultural products (*ibid*). It also makes sense that regional/state governments provide a portion of the agricultural and forestry extension services, since local governments might not have adequate access to research and development facilities, and since the geographic and economic conditions are likely to be more homogenous at the state/provincial level than at the national level.

The project-specific planning, construction, maintenance, monitoring, protection and environmental education are all tasks left for the local governments. While many municipalities may not be equipped institutionally to undertake all these tasks, sharing information and combining workforces among nearby municipalities may offer at least a partial solution to the problem of limited resources.

Technical Capacity. In addition to internal governmental encumbrances, city, state and local institutions must contend with a lack of skilled technicians in the various fields of knowledge that urban greening encompasses. As mentioned previously, a comprehensive urban greening program would likely involve information and experience in the fields of sociology, hydrology, psychology, geology, economics, horticulture, forestry, landscape architecture, public administration and soil science, among others. It is unlikely that individual city administrations would have very many of these technicians available. They would need to seek outside consultants or experts to assist in planning sessions or train administrators in whatever field is necessary for them to efficiently do their work.

Finally, many municipal governments do not coordinate with local or community organizations that could assist them in managing green areas. In some cases, the impediment is a lack of well-organized local groups to work with or the lack of strong administrative or managerial skills among existing groups.

Financial Sustainability

Securing the funds for the creation or extension of a green area can be a difficult task, especially in a developing country. It may

require funding and support from municipal, regional and national government agencies, as well as from NGOs and international agencies. Often overlooked, however, are the funding needs for the regular maintenance and protection of a green space—for few if any green spaces are self maintaining. Without a budgetary commitment to upkeep, a city's investment in this public amenity can become a waste of money.

The majority of funds for an urban greening program most likely need to come from local sources. Cities need to find ways of securing general tax revenues or encouraging private investment to fund tree programs and city parks (see Box 4). It may also be possible to create special taxes, bonds and fees for green improvements that target specific groups such as developers or businesses (Morgan 1996).

Even with budgeted maintenance costs, it is more than likely that the public sector will not be able to shoulder all of the funding for an urban greening program. The first challenge then, is for the local government to identify potential external funding sources. Ideally, municipalities will share financing with a wide array of community groups, foundations, schools, NGOs and private sector enterprises. Depending on the means available, these groups can provide direct financial contributions, payment in kind (e.g., trees and tools), or volunteer labor for planting, maintenance, and monitoring (*ibid*).

Land Tenure

Land tenure could conceivably be the most significant obstacle to urban greening in many cities. People who do not own a piece of land, or do not feel even partly responsible for one, are not likely to care for trees or other vegetation planted on it. Municipal lands that become parks or green areas present the least problem in ownership. However, individual or communal land ownership can become complicated, and even result in confrontations. In cases of illegal possession of land (as in informal settlements), residents may plant unauthorized food crops but are unlikely to care for common green areas when their tenure is in doubt.

Ownership or the right to use vegetation can be unclear in urban areas. In cases of common areas with unspecified title, there may be disputes as to who has the right to plant, gather a harvest, or otherwise use an area. There are many combinations of land tenure and rights of use that range from exchanging the right to harvest products for plant care to titling and exclusive rights of cooperative ownership and use.

In general, lands are owned by either the state or an individual, or they are open access. State or private lands may have limited access (rights to use are clearly designated) or in cases where the owner cannot protect the land from usage, may become open to any and all who wish to exploit its resources (as in the case of illegal occupations). Commonly owned land should be managed by a specific group or institution, such as a cooperative or neighborhood association (Berkes 1989).

As in all urban greening projects, the issue of management is critical. All planning schemes must take into account who will be managing the resources. To a large extent, this will depend on the tenure of the land and the

rights to its use. City planners need to consider ownership and usage of green areas before deciding what will be planted or protected. Furthermore, regional and national planners need to realize that communities may have historical precedents or agreements that make their situation peculiar, thus requiring extra sensitivity in the development of new land tenure arrangements.

Local Participation

Development projects of many types and scale have traditionally been of the Atop-down@ variety, although this has been changing in recent years. It is quite common for nationally mandated programs to not coincide with local priorities. This is usually the result of a lack of coordination and participation at the local level.

There has been much discussion in recent years about including as many *stakeholders* as possible from the very beginning of the project. Stakeholders are those people who have a direct or indirect vested interest in a green area, such as local residents, businessmen, farmers, neighborhood associations, sports groups, government agencies, nongovernmental organizations, schools, parents= associations, investors and other individuals or groups that have a common interest in the area.

Historically, participation at the local level has been limited to management tasks assigned by the project administrators, without any prior input as to the stakeholders= own priorities, ideas, skills, knowledge, aspirations or resources. Projects in this situation often fail, since the local resource users may not have much of a stake in them if they feel their opinions are neither welcomed nor valued. In addition, there are often personal or historical reasons for failing to participate, such as religious beliefs, a colonial legacy of paternalism and fear of reprisals under military regimes. (See the following chapter for an in-depth discussion of participation.)

Ecological Constraints

Project agronomists must address a number of practical constraints of planting vegetation in an urban environment. First among these is the condition of the soil in most cities. Much of the soil in urban areas is either compacted or made up of fill, and soil horizons are often inverted, with subsoils in the top layer and topsoils frequently absent (Center for Landscape Research 1993). To make matters worse, a city=s commercial areas or other densely populated sectors usually have concrete pavements that have to be broken through to allow planting. One of the major costs of planting in the Sao Paulo AOne Million Trees@ program is simply breaking concrete for the trees that are planted in built up commercial districts.

Creating planting sites where there is only fill or concrete makes initial planting much more expensive, as the city must cover the expense of either hauling in good soil or creating a suitable soil mixture to plant in. However, adding sand or coarse soil amendments to existing compacted soils will improve soil aeration and texture, thus encouraging good root growth and plant survival and thereby reducing maintenance costs for sick or dead plants.

Urban planting sites are often inhospitable to many species because of other stresses or

obstacles. Some of the city conditions that jeopardize the survival of urban vegetation are constant air pollution, water table disturbances, plant injuries caused by people and vehicles, extremes of heat and cold, and accelerated wind velocities channeled between tall buildings (Center for Landscape Research 1993). Sewer and water lines located near potential tree planting sites may represent incompatible uses, as roots frequently damage these lines. Electricity lines run above potential green areas may limit the height of vegetation, and thus the types of tree species that can be planted. Even fruit trees that line sidewalks can represent real dangers to pedestrians during storms.

Besides the difficulty of poor soils and inhospitable planting sites, there are also some plant species concerns. Many cities in Latin America and the Caribbean do not have ready access to sources of appropriate species, hybrids or cultivars suitable for their particular situation. Some cities are able to maintain their own nurseries (generally through the Ministry of Agriculture), but without private sector participation they may not be able to produce enough seedlings in time for their planting projects. (See Appendix A, Photo #8.)

Legislation and Customs

Today=s modern cities all started out as small communities that developed, prospered and expanded in size and population. Laws were created along the way to meet the daily needs of the people. Many laws however, were simply left in effect even when their usefulness was long outgrown. Many countries in Latin America and the Caribbean today have a mixture of laws and customs that are legacies of a long history of blended cultures and conquests.

Many of these laws and customs reflect the dominant beliefs and attitudes of their time as, for instance, the idea that Man is meant to dominate and conquer Nature. Even now, many land reform laws determine that a piece of land is Aimproved@ if all the trees are cut down and it is built upon, thus denoting ownership. Similarly, the notion that Athe river will take it away@ has led generations of rural and urban dwellers to use riverbeds and gullies as garbage disposal sites. Many of these customs persist today.

The industrial revolution exacerbated these attitudes. For example, factories were Alogically@ situated on rivers where they could dump their toxic waste products. When zoning laws came into existence, green areas were not necessarily considered, nor were areas sensitive to development such as flood plains, steep slopes, watersheds or ecological restoration zones. Likewise, health codes written half a century ago are no longer appropriate for reusing waste to green a city or irrigate food crops.

Most city ordinances did not contemplate urban greening at the time they were created, and government bureaucracies have been slow to come up to date. In addition, urban greening is a relatively new concept and does not always have the necessary political support needed to be successful. Since most urban greening projects take years to come to fruition, it may be difficult to gain popular support without immediately visible benefits.

Gender Issues

Female participation in urban greening programs is an important but frequently overlooked factor. Women are often responsible for the family=s interaction with the environment, including gardening, care of trees, harvesting, disposal of household wastes, taking children to parks, and education. Although women comprise half the urban population, they typically assume a disproportionate share of the responsibility for the Agreen@ elements of a family=s welfare. In spite of the importance of their role, women are rarely surveyed for their input at the planning and execution stages of greening projects. Urban greening programs must seek the active participation of women; more than one development and conservation scheme has failed because it did not consider women=s roles and inputs.

Growth Management and Integrated Planning

Modern urban centers are growing very differently than they were, say, in the 1950s. The preponderance of urban growth today occurs not only on the city=s edge, but more and more in satellite settlements on or outside the city=s borders (Smit pers. comm.). In Latin America many of these edge and satellite towns are informal, squatter encampments located on or adjacent to city green spaces. Such settlements, rarely ordained by city planners, frequently lack basic services including potable water, sewer, garbage pickup and utilities. The lack of services can result in unmanageable environmental pressures on the green spaces, including dumping of wastes, trampling of plants and the cutting of trees for firewood.

Whether satellite or edge settlements are of the squatter type or simply small towns that experience rapid growth to accommodate urban migration, the people who live in these areas have the same range of green space needs as other urban dwellers. Not only are the poorer communities frequently the last to be the beneficiaries of urban greening projects, but the green spaces that are potentially available to people living in the suburban zone are often desired by developers. In Mexico City, for example, settlements and construction contribute to the city=s 3.7 percent annual decline rate in urban green space (Nilsson *et al*.). Thus, the challenge to city planners is (1) to anticipate the direction and magnitude of growth; (2) to secure resources for the establishment, maintenance and protection of green areas to serve these communities; and (3) to evaluate the probable uses of green areas so that they can provide the optimal combination of services.

If planners are able to anticipate the direction and magnitude of a city=s urban growth then they can provide services and amenities in a way that can influence where the growth occurs. For example, in Curitiba, Brazil, one of the fastest growing cities in Latin America, planners channeled urban growth along structural axes. With the extension of water, sewer and roads in combination with bus service connecting the growth areas to vital parts of the city, planners reduced traffic and directed urban expansion to the places most capable of accommodating growth (Rabinovitch 1993). Similarly, enforced zoning and density laws can safeguard open spaces and environmental amenities before intense colonization occurs in unplanned, fragile areas such as steep slopes, riparian corridors, flood plains and

the upper reaches of watersheds (Miller 1996). In fact, the provision of infrastructure services can be used as a bargaining chip offered to a community in exchange for agreement to observe open space or density zoning regulations. Most important, there needs to be a dialogue between planners and citizens, as well as an effort to tell people where they *can* live, before telling them where they cannot.

Zoning is equally important in downtown areas. Frequently these are the areas with daytime traffic, serious air pollution, and high densities of people. Adding open green space to an otherwise congested downtown center can take away the harsh edge and add a calming, revitalizing element to daily life (see: Benefits of Urban Greening). Municipal governments have a variety of techniques for acquiring and zoning downtown land for this purpose, including purchase, claim of eminent domain for the public good, and green space obligations for developers (e.g., for every $5m^2$ developed, $1m^2$ of open space must be provided). (see: Miller 1996). In addition to zoning and purchase of downtown land for green spaces, city planners need to consult with and garner the endorsement of the community and local businesses**C**for this is the only way to ensure that the city will be providing a valuable, sustainable amenity.

Green spaces are living systems that depend on a certain level of environmental quality in order to produce benefits. The level of environmental quality required and the size of the green space depends on the intended function of the green space. For example, an area managed for biodiversity needs to be relatively more pristine and larger than an area managed for recreational team sports.

Nevertheless, the jurisdiction over regulation of such important environmental factors as air quality, ground and surface water, and park management usually does not fit neatly into one governmental department. Furthermore, the integrity of one green space may rely not only on the environmental conditions in that location, but also on the condition of other nearby greenspaces because of the interdependence of biotic elements such as seed sources and migratory species. Thus, many different government authorities may share responsibility for the environmental factors affecting a particular green space (see: Tlaiye & Biller 1994).

As a result of the cross-sectoral nature of environmental systems, there is a need for management to extend across the multiple governmental agencies whose actions will affect green spaces. For example, a riverside park that is also bordered by a highway may be affected by actions of the parks, water, transportation, and commerce departments. Cooperation among government offices must occur **C**especially since there may be competition for the same funding. A successful example of cooperation exists in Curitiba, Brazil, where a system of parks was created to protect the IguaHu River and part of the city=s water supply (see Box 2). These parks provide a cross-sectoral distribution of benefits including recreation, drinking water quality, flood protection, and development on up to 30 percent of the land (Tlaiye & Biller 1994; Rabinovitch 1993).

As mentioned above, the ecological integrity of any one green space may be dependent on a number of surrounding greenspaces. This is especially true in cases where biodiversity is a management objective. AGreen corridors@ that connect urban green spaces to larger,

rural green spaces allow plant and animal species in the city to maintain contact with the larger rural populations (Nilsson et al. 1996). The smaller the green space, the higher the perimeter (or edge) to area ratio, and the further it is from a sustainable genetic reservoir (e.g., a large rural park or undeveloped area). Isolated species populations with little genetic variability are more susceptible to stochastic events, such as weather, or changes in environmental conditions, such as water pollution or the location of a nearby factory (MacArthur, 1971). Thus, while it may be impossible to interlink all the major green spaces in an urban center, planners will maximize the ecological benefits of greenspaces if they can design areas in proximity to one another and connect them by greenways or river/stream corridors.

Basic Requirements for Developing an Urban Greening Program

This chapter describes the structural support needed to give an urban greening program the greatest chance for success. It discusses the types of projects, in addition to the institutional, infrastructural and financial frameworks that facilitate program execution. The actual elements, or activities, of an urban greening program are described in the following chapter, and depend on the requirements described here being in place.

Types of Projects

There are three principal investment designs for urban greening programs, depending on the number and size of the cities involved, and on the priority of greening among the investment project=s objectives. The three types are (1) individual self-sustaining projects, (2) multiple works projects, and (3) subcomponent projects; they are described below.

Individual projects are primarily for major cities and metropolitan areas that require enough funding to merit consideration as individual investment projects. Large amounts of infrastructure development, technical assistance and mobilization of resources make it economical to approach a citywide greening effort as a single project.

Multiple works projects fund urban greening efforts for more than one city or region at a time. Such projects are usually for smaller urban centers that would be costly to fund on an individual basis, but when combined make efficient use of resources. Greening programs of this type may share resources, using similarly formatted approaches that work toward more general, and less city-specific solutions.

As a component of integrated city projects, urban greening can be accomplished without going through the process of instituting an exclusive funding project. For example, this method might incorporate urban greening into water and sewer projects by requiring additional forested land around settling pools and reservoirs to serve as a catchment area, or requiring greenways along aqueducts to protect flood plains. While this strategy generally makes smaller contributions toward a city=s urban greening than the above methods, it may be much easier and faster to approve and effectuate. As much as this integration method facilitates additions to a city=s greenspaces, urban greening components should still only be included to the extent that their economic returns warrant and that they contribute to the overall success of the project.

Training and Information Exchange

In addition to increasing the acreage devoted to green spaces, investment projects in urban greening are also intended to empower cities to maintain and add to their green areas in the future. Essential to this second objective is the provision of adequate technical assistance in the form of training courses, extension services and capacity building for urban forestry, agriculture, tree care and park upkeep.

Although designing urban greening programs will generally be the responsibility of city planners, there are scores of people in various institutions who will eventually become responsible for administering or managing the various components of the system. These people will no doubt already have experience in their chosen field of work, but they may lack the skills or knowledge needed for their new responsibilities or for interacting with new program counterparts. Additionally, care and management of certain green areas may be delegated or contracted to local community groups (farmers, neighborhood associations, companies, NGOs, etc.) that would also benefit from further education. A strategy for training these individuals to meet their professional duties will greatly contribute to the success of a city=s program.

Most large cities have one or more universities or technical schools that offer courses related to urban greening; city officials can take advantage of these to upgrade the skills of their staff. For example, administrators may need some training in biological sciences to better understand and manage the city=s green areas, while technical personnel may require some training in extension and interpersonal communications in order to deal more effectively with the public.

Where training courses already exist within city departments, a cross sectoral exchange could take place. In Curitiba, Brazil, for instance, the city has an urban ecology training course for its own administrators and offers the course to authorities from other cities as well. Alternatively, many international agencies, from conservation groups to financial institutions, offer technical assistance or funding for training. For example, the Environmental Secretariat in Santiago, Chile, has a technical exchange program with the London Ecology Unit, wherein the latter is sharing its expertise on how to take an ecosystem approach to park management. Regardless of the form that training may take, it must be responsive to the expressed needs of the program=s staff. A simple survey of these employees will quickly ascertain what those needs are.

Assessing Employee Training Needs

In Chicago, Illinois (USA), the Green Industry Project conducted a training survey among companies that employ Hispanic field technicians in the nursery and landscape industry. The project=s survey of employers and employees resulted in the following recommendations for increasing the effectiveness of the region=s Hispanic field technicians (Mendoza 1996):

Overcoming Stress

- **$**Provide a trainee handbook
- **$**Create a casual and familiar setting for the workers (such as a company lunch room)
- **$**Keep classes to 30 minutes or less
- **$**Train entire crews together at the same time
- **$**Train in Spanish

Overcoming Limited Skills

- **$**Create nonthreatening study materials
- **$**Avoid excessive detail
- **$**Teach some preliminary study skills

Provide Incentives

- **$**Document training in performance reviews
- **$**Recognition with certificates and/or salary raises

One of the major products to come out of the 1996 Seminar on Urban Greening in Mexico City was the creation of an urban greening network. As this network grows and becomes more established, it will bring together resource and training information as well as case studies to be made available to any municipality in Latin America wishing to establish an urban greening project (IDB 1996b).

There are a few training programs involving urban greening already established in the region. For example, Panama City=s extension service trains neighborhood volunteers, while Argentina=s *Pro Huerta* (a semi-governmental collection of organizations), runs a program to train the trainers for community, school and institutional gardens (UNDP 1996). In Bogota, Colombia, a government environmental project includes training for officials and users in the operation and management of the program works (IDB 1990). Mexico City has adopted a similar arrangement with a total of 57 training courses (to be held in the Federal District, the state of Mexico and abroad), for officials working on an urban ecological conservation project (IDB 1992).

Training can also be carried out through NGOs, as is the case of SEMTA, an NGO in La Paz, Bolivia, whose center includes a greenhouse, windmill and classrooms. *Peru Mujer*, an NGO in Lima, Peru, works with low- and middle-income urban women in community gardening and has developed its own training manuals. These include not only the technical aspects of urban farming, but also nutrition and health issues as well. *Peru Mujer* has a good relationship with the government: one of their training centers is on the grounds of a government hospital and several community gardens are on public land (UNDP 1996).

Environmental Education

As so much of the success of urban greening depends on public participation, it is crucial to inform people of the how and why of these projects. Clearly, if communities are to be partially responsible for maintaining green spaces, they will have to know how to take care of their resources and what to do if they have problems. Equally important is informing people of the environmental benefits of their projects which, together with recreational benefits, may be the motivating factors for public participation.

The numerous opportunities for environmental education include, but are not limited to: primary and secondary school curricula; city-sponsored events such as festivals, tree-planting days, different types of races, etc.; community group involvement such as churches, sports teams, or boy scouts; and NGO-sponsored activities. The broader the citizen understanding and participation in the mission, the higher the probability for success and for green areas to flourish well past the time horizons of a single investment project.

Institutional Strengthening

It is critical that a part of any urban greening investment goes toward building local institutional capacity. While capital inputs make projects possible, the longevity of these efforts would be limited if recipient communities did not receive assistance to develop the technical, logistical, and infrastructural elements needed to sustain greening efforts. Green areas, for example,

may require zoning studies, plant and animal inventories, and monitoring and mapping **C**all of which require experts with special equipment, technology and access to research and development information.

Much of what goes into institutional strengthening **C**providing extension services, technical assistance, provision of information materials, small loan availability for urban agriculture**C** can be shared among communities or cities. For example, technical manuals and environmental education curricula can be developed and published in one location and then circulated regionally or even nationally, depending on the country.

Maps

The map is one of the most efficient tools for managing, monitoring and doing inventories of green space resources in cities. Maps provide pictorial representations of city resources, existing infrastructure and zoning that allow planners to identify the elements of a city scape that will limit, complement or hinder their work. Parks and green areas, water resources, utility lines, transportation routes, topographic and soil profiles, and manmade structures (such as dams, bridges or aqueducts that might affect a greening program) are features that should be included in any inventory or map system.

Currently, the most convenient and sophisticated mapping tools are Geographic Information Systems, or GIS. GIS are computerized mapping systems that digitally display natural or manmade geographic features on a map that can be manipulated for specific needs. Features such as vegetation, roads, population density, watersheds, slope and altitude can be displayed alone or in combination with other mapping characteristics. GIS can incorporate information from existing maps, typed-in input and even satellite images. While some components of GIS technology are very expensive, many of the basic elements are both affordable and cost efficient for developing countries. For example, Mexico City and Bogota, Colombia are building GIS databases, and the World Conservation Union (IUCN) is using GIS to categorize and manage conservation areas throughout Central America.

Social and Political Support

Social Support

Urban greening programs will have direct effects on several groups of people in and around each green area. It is important to recognize that these people will have a direct impact on the success or failure of the greening program. By involving the affected citizens and community groups in the design stages of a program, planners can garner public support at the outset and greatly increase the chances for success. To protect and maintain green areas, it is essential to understand how local people relate to the land and how they use its resources. Their full participation is necessary from the very beginning of the project, i.e., at the conceptual stage rather than just the implementation stage. Too often the stakeholders of an area are seen as the Atargets@ of conservation or education projects rather than as equal partners. They are usually involved only at the end of a project to take on some prescribed management task or to forfeit some personal benefit for the greater good. This approach

has led to innumerable conflicts and project failure around the region (Barzetti 1993).

The process of dialogue, consultation and coordination with each green area=s stake-holders should be an integral and continual part of urban greening programs. Although an integrated, broad-based participatory approach may sound difficult to achieve with limited budgets and personnel, it need not be an expensive undertaking. City planners can take advantage of the wealth of knowledge, skills and expertise that the neighborhoods have to offer. People support what they believe to be valuable, especially if they receive a direct benefit from it or perceive that it is threatened and in short supply. If project managers can elucidate to the public the multitude of benefits that green areas provide, enlisting their support should not be an overly difficult task (*ibid*).

Neighborhood associations and other nongo-vernmental organizations are among the most prevalent groups to work with. People living closest to a particular green area almost always have the most interest and have the most to gain from working with a municipality to improve their neighborhood. They can also contribute their time, labor and even materials to a project, as well as take responsibility for protecting and maintaining it. For example, the citizen=s group, Friends of Chapultepec, raised funds to restore this popular park in Mexico City. Similarly, FUSAI (the Salvadoran Foun-dation for Integrated Aid, an NGO) planted more than 100,000 trees in 46 communities and reforested 17 urban school grounds (IDB 1995). NGOs in Peru are conducting advanced research in composting, guinea pig rearing and microenterprise for urban farmers, and are promoting these technologies in neighboring countries as well (UNDP 1996). In La Florida, Chile, community interest groups chartered through official channels have legal rights to work in partnership with municipal governments to develop Community Action Plans. These plans can draw on appropriated funds to improve neighborhood parks, street lighting, and sidewalks (IDB 1996e).

It is important to include suburban as well as urban groups, as quite often these residents are living in critical watershed or wetlands. Involving such groups in planning an urban greening program can help avoid conflict later. For instance, when a city=s watershed policy restricts traditional agricultural activities in an area, residents may resist the new policies thereby causing degradation of the watershed. City officials in Sao Paulo, Brazil, have avoided these conflicts by soliciting resident input on the design of watershed protection policies.

It is also important to consider business owners and contractors as stakeholders. Many business owners in Sao Paulo, Brazil, and Bogota, Colombia, care for street trees in front of their stores in exchange for advertising on the tree protectors. In general, local companies take civic pride in their neighborhood and see their contribution to urban ecology as positive public relations. Aware of this fact, city officials in Sao Paulo solicit businesspeople to sponsor tree plantings, while in ViZa del Mar, Chile, some companies manage entire parks.

In poorer neighborhoods, working with smaller enterprises is feasible and critical to cooperation with low-income groups (Smit 1996). The city can contract these local companies for a wide range of activities

necessary for urban greening to be successful. Some potential jobs include: urban agricultural tasks such as beekeeping, fish farming, food crop production, irrigation, harvesting medicinal plants; managing tree nurseries and urban woodlots; staffing opportunities at educational and health facilities; managing recreational and park facilities; and maintaining low cost wastewater treatment in pond and wetland systems.

Participation in planning and implementation should also be extended to educational facilities. In Mexico City, for example, the University of Mexico assists the urban greening program in improving its seed collection. Sao Paulo=s environmental secretariat frequently consults with professors from city universities on technical aspects of the program. In Durban, South Africa, schools are consulted on management and design decisions for the park system. Primary and secondary schools are also a prime focus of greening activities. They can be the fundamental motivators for tree plantings and can contribute to environmental education, as witnessed in urban greening programs in ViZa del Mar, Chile, and Sao Paulo, Brazil (Ceballos 1995, Philippi 1995).

Political Support

Within the government, participation and communication are just as important, whether at the national or municipal level. Although national governments are not usually involved in the specifics of urban greening programs, they can greatly facilitate country-wide goal attainment by setting policy objectives, time tables, and standards, and by providing institutional and network support to regional and local governments that do not have the funds to develop such resources on their own. Furthermore, by integrating urban greening into national environmental plans and performing follow-up evaluations, a central government can monitor progress made in urban greening throughout the country (Lampietti & Subramanian 1995). In this manner, experience can be shared and support can be directed to those cities most in need of help. To the extent that national officials are aware of urban greening programs, the potential benefits, and the progress made therein, they can move the cause forward by pledging their political support.

Within the hierarchy of the municipal political system, active participation can be sought from local officials in urban subdivisions. These community authorities usually monitor the pulse of their localities and convey the needs and opinions of their constituents to the higher echelon administrators. Tapping into local authorities= knowledge and experience with diverse urban communities can smooth the way for city planners who cannot possibly have contact with every neighborhood in the metropolis. Such input can also influence political decisions regarding the type of urban greening that will be implemented and where in the city it will be located.

In a similar fashion, other government or municipal entities (such as water, gas and electric utility companies) may need to be included in a program=s planning sessions. For example, the electric company of Sao Paulo, Brazil, spends US$32 million annually on line maintenance and repairs caused by tree damage. Mexico City, on the other hand, coordinates its urban greening with

local utilities to avoid costly line maintenance problems. Other government agencies, such as secretariats or ministries of transportation, education, housing, energy and agriculture, should also be consulted during the planning process. (See Appendix A, Photo #10.)

Clearly, public opinions strongly influence political decisions and hence policy-making and budgeting. Therefore, it is imperative that the benefits of urban greening are publicly heralded and have broad public support. This can best be accomplished through the active participation of the many sectors of society affected by urban greening programs. Political decisions made at the national, regional and local levels can significantly change city scapes and thereby affect the lives of urban dwellers. Because change occurs in both directions, planners must see the opportunity for urban greening as a two-way top-down (government policy influencing city greenscapes and natural resources), and bottom-up (public opinion influencing the political) process.

Legal Framework

Regulatory Law

Public works projects such as urban greening need to fit in the existing legal framework and to enjoy legal support and protection against competitive uses and destruction. Laws and regulations are enacted at various levels of government, and therefore it is important that they are designed in such a way that they complement each other without overlaps or gaps. That is, national laws need to be the most general and overarching because they apply to the entire country. These laws should not attempt to serve as precise mandates or to enforce policies at the micro level, rather they should act as guidelines. Municipal law is much more appropriate for dealing with the specifics and peculiarities of individual cities.

Regulatory law allows the government to protect resources for the common good regardless of whether they are situated on public or private land. This often takes the form of regulations and permits enforceable by fines. For example, in Sao Paulo, Brazil, a 1966 law dictates that for any new development in the city, 15 percent of the land must be left as green area and another 5 percent must be slated for public use. In addition, a permit for cutting down trees must be obtained from the environmental enforcement agency. In Curitiba, which has one of the strictest environmental protection laws in Brazil, cutting or even pruning a tree on any public or private land requires a permit. Approximately 6000 to 7000 permits are applied for annually and about 30 percent are denied. Even if a landowner or developer gets a permit, for every tree cut they must plant two trees on their own land or donate two trees to the city to plant. While these laws offer strict protection to trees, the corresponding time and paperwork generated by the statutes may divert precious resources away from more urgent tasks (Philippi 1996).

Many cities start with tree care ordinances and gradually include more legislation to cover other aspects of resource protection and maintenance. Quite often the laws are created in reaction to an environmental situation that needs some form of regulation. In the absence of adequate laws, resources in green areas can be exploited and destroyed. Even when there are existing legal prohibitions on using resources in green

areas, enforcement may be too costly or impractical to be effective. This problem is particularly evident in the case of informal settlements. For example, 65 percent of Sao Paulo=s 1800 *favelas* (low-cost housing which is home to one million people), are located on municipal lands designated for green areas (SMVMA 1993).

Law Enforcement

Another way of improving compliance with regulations is voluntary private enforcement of regulatory laws. Private citizens or groups can contribute to the enforcement in four main ways: (1) by suing violators to recover monetary damages; (2) by lodging a complaint against a violator with the public authorities; (3) by bringing legal action against violators to bring them into compliance; and (4) by bringing legal action against public authorities who are responsible for enforcing the laws but fail to do so (Tietenberg 1996).

An example of lodging complaints with public authorities is found in Sao Paulo=s *Projecto Silencio Urbano* (PSIU). Citizens are encouraged to report any violations of the city=s noise code, and any other environmental infractions, such as illegal cutting of trees. The municipal authorities then respond to the complaint and enforce the regulations. Although heavy fines are often imposed on code violators, media coverage of the transgressors appears to be a bigger deterrent than the penalty (PMSP 1996).

In a case of bringing suit against a public authority, the citizens of Futrono, Chile, filed suit against the mayor for Aarbitrarily and illegally installing a rubbish dump@ without observing the minimal sanitation standards. They claimed his actions violated their constitutional right to live in an environment free of contamination. The claimants simultaneously filed an administrative suit with the town=s sanitation service and a civil suit with the local court and won on both counts. The dump was subsequently closed and the mayor ordered to pay an administrative fine and clean up the site (Tietenberg 1996).

Flexible Practices

Sometimes, land use in green areas is regulated through informal agreements. For example, the electric company in Rio de Janeiro, Brazil, leases land under its transmission lines to farmers to produce food for home consumption and market. The company issues land use permits with clauses that obligate the farmers to keep their area cultivated and fenced in, and to prune above a certain height. If the farmers adhere to these regulations, they can use the permits to receive credit and technical assistance from government agencies (UNDP 1996).

Some regulations allow for flexibility. For instance, in both Sao Paulo and Curitiba, Brazil, developers can exceed zoning limits on building height by Atrading@ vertical space for green space. Thus, a developer limited to a two-story building may be given permission to build a four-story structure if he or she provides additional open space in exchange.

A law can sometimes be interpreted in a flexible way, as happened in Ajusco, a rocky region outside Mexico City where squatter settlements developed along the highway. After repeated attempts to evict the squatters

from the degraded and polluted area, city officials decreed the zone a conservation area and decided to legally evict all the inhabitants and reforest the locality. To avoid being removed from their homes, the local residents decided to cooperate with the greening effort and began to plant trees and gardens and eliminate the sources of pollution. With the help of university biologists and environmental NGOs, these ecologically sustainable settlements soon included reforestation, micro-livestock, fisheries, mushroom farming and horticulture. Their efforts convinced the city government to adopt such activities as part of their plans for the area and the settlements were allowed to stay (UNDP 1996).

Whether legislation is mandatory or voluntary, unbending or flexible, for public or private resources, it is nonetheless an important tool of urban greening programs. Where existing laws are outdated or new regulations need to be created, an active participatory program can influence political decisions about environmental legalities. Such changes can be instantaneous (as with presidential decrees) or may take months or even years to go through the bureaucratic channels. Nevertheless, laws and regulations serve the purpose of protecting natural resources for the benefit of all urban residents.

Institutional Feasibility

Any urban greening program will need to consider the policies and dictates of the various institutions it has to work through and with. An ambitious greening program can be helped or hindered by how much an institution can cooperate within the limits of its bylaws and institutional ordinances. For example, existing land use or zoning policies may discourage urban agriculture or other new green areas or, conversely, may permit unused municipal lands to be cultivated within the city limits. Similarly, municipal staff already engaged in park maintenance may need to be reoriented from a horticulturally-based system to an ecologically sustainable one. There is also the question of whether or not government institutions have the resources to perform supervisory roles. That is, with the increasing trend of contracting out parts of projects to the private sector, there needs to be a governmental entity in charge of verifying that tasks are completed to satisfaction. Finally, greening projects often lack long-term planning and funds set aside for vegetation maintenance, so plant care is based on crisis management. Such policies could be rewritten to reverse that trend.

Appropriate institutional arrangements may need to be created to facilitate urban greening rather than inhibit it. In the case of urban food production, there may need to be some institutional restructuring to accommodate agriculture. For instance, specific agricultural extension efforts could be directed toward urban farmers. Waste management institutions could consider how to change their bylaws so that treated wastewater could be used for irrigation.

In many cases, simply integrating urban greening into existing city institutions could be the easiest way to get a program started. This is especially appropriate with transportation, neighborhood renovations, wastewater management and air quality control. For example, the Department of Public Works in Santiago, Chile, contracts companies for highway construction and

actively promotes highway tree planting. In Mexico City utility companies sublet the land under power lines for urban agriculture, while in Sao Paulo the promotion of tree planting is a task of the entity responsible for the new housing developments. In Bogota, Colombia, municipal staff is working with the city schools and public institutions to assist in their landscaping. Thus, as long as there is cooperation among the institutions involved, a city with limited financial resources can begin to implement some urban greening by taking advantage of these low cost opportunities to work within existing institutional frameworks.

Many municipalities delegate responsibility and management of trees and green areas to nongovernmental entities. In Mexico City, for example, companies with tree planting contracts are legally responsible for the survival and maintenance of the trees for six months after planting. Government agencies oversee the planting and care of the trees and can impose fines for noncompliance with the contract. If the dispute is not remedied, the government can cancel the contract and even assess a penalty (MartRnez and Chacalo 1994).

Agenda 21, an environmental plan of action that resulted from the 1992 Earth Summit, also has excellent guidelines for environmental efforts and institution building, and is being discussed in several major cities (UNCED 1992). In Sao Paulo, for example, planners and administrators from civic organizations and all the secretariats have regularly scheduled discussions of Agenda 21's recommendations and their execution by the participating entities (PMSP 1996). In a similar fashion, Santiago, Chile, is working with the London Ecology Unit to establish regulatory and management norms, as recommended in the Agenda 21 document. This important plan of action should be incorporated into urban greening planning wherever possible.

Technical Viability and Environmental Sustainability

The technical viability of an urban greening program depends on a city=s capacity to appropriately site, construct, maintain and monitor a green space in a way that ensures a continuous supply of the intended benefits. Municipalities need to have or be able to draw on the technical expertise to integrate environmental and technical variables such as watershed protection, and appropriate and compatible species composition into both the planning and operations stages of the green space. For example, if tools such as mapping equipment are provided, there should be specialists available locally who can instruct the users and make repairs. Similarly, local nurseries should have enough capacity to fulfill the demand for plants, and horticulturists should possess enough knowledge to alter species compositions and control biological pests in public green areas.

Environmental sustainability means that outside factors do not interfere with biological and ecological processes of a green space, resulting in a reduction of the benefits provided by the area. The challenge of environmental sustainability depends on the intended function of the green space. For example, a city park composed primarily of ball fields for team sports needs only to maintain grass cover and a few surrounding trees. In contrast, an urban forest with high species diversity may have elements that are much more sensitive to pollution, intensive use, or

other changes in environmental conditions. In any green space, preserving the variety of plant and animal species requires managers to (1) have knowledge of the various species= needs and sensitivities, (2) implement and maintain a monitoring system to inform them of changes in conditions, and (3) undertake the requisite remediation measures.

To ensure the environmental sustainability of an urban green space network, planners should first evaluate and rate the ecological sensitivity of the component green spaces. The next step would be to set up a monitoring system based on the priorities established in the evaluation. In this way, most fragile areas will get the attention they need.

Monitoring and subsequent remediation efforts should be able to control certain harmful elements such as soil compaction, local water pollution, and high pedestrian traffic on and off trails. However, there may be other elements, such as air pollution, that are beyond the mitigation powers of any park maintenance task force. In this case, planners need to confer with city officials to decide either to downgrade the acceptable environmental quality of a particular green space, or to modify the pollution sources, e.g., by rerouting traffic or altering emission requirements.

In some cases, the environmental quality of a green space may deteriorate in a way that will not alter the benefits that planners intended the area to provide. For example, the effectiveness of a green space established for the stabilization of a hillside or for water catchment purposes may depend on a stable root system and a varied tree canopy, respectively. Beyond this however, the species presence and distribution are inconsequential. Thus, while high biodiversity in such a system would be a bonus, its presence is not essential to the intended function of the area. This example illustrates how planners can rank the importance of desired benefits to help determine the desired environmental sustainability and resource allocation for a particular green area.

Lastly, planners need to consider the potential impact that might result from the green space itself. For example, pesticide use in urban agricultural plots could generate runoff that would pollute the local water supply. In other cases, certain trees or shrubs may have great quantities of pollen that cause allergic reactions, or they may have high water budgets that actually drain water tables. While these impacts are usually minor compared to the benefits, they are not always negligible and need to be considered (Basterrechea *et al*. 1996; Nowak *et al*. 1996).

Financial and Economic Viability

The two principal determinants for the economic viability of an urban greening project are as follows: Does the project provide the necessary financial rate of return to investors and therefore guarantee their continued financial support? And, does it provide the desired socioeconomic benefits to the public?

Assuring investors of a project=s financial viability is of primary importance, since the project would not be possible without their capital. It is therefore crucial to calculate as accurately as possible the economic benefits generated by a particular project. The first test, of course, is to verify that the net

benefits from the project are equal to or greater than those of alternative land uses. Calculating the benefits may require close scrutiny. Some are easy to identify, such as revenue from urban agriculture or concessionaire permits and increased property values. But many others are more difficult to quantify, such as pollution abatement and reductions in health care costs.

Once the direct and indirect benefits are identified, planners can solicit funding from parties that stand to gain the most. For example, companies that traditionally have caused air pollution may want to improve their image by providing financial support for the establishment of green spaces which abate pollution. Similarly, residents whose property values will increase as a result of tree-lined streets or a nearby city park, should be willing to contribute to a related municipal bond, beautification tax, or other revenue-generating mechanism (Morgan 1996).

Another key strategy to securing funding for green spaces is to incorporate their construction into larger infrastructure projects. Not only do planting costs in general pale in comparison to road or sewer construction or drainage, but it is also much more efficient to plant in an area where the ground is already torn up, and heavy equipment is already on-site for landscaping. Furthermore, the benefits can be directly related to the infrastructure project at hand, whether it is pollution and noise abatement for a road construction project or watershed protection and flood control for a sewer or water line project.

Determining the socioeconomic viability of green spaces in the public eye should be a two-part process if possible. The first step should occur prior to the establishment of the green space and consist of a survey of the public=s needs. In this manner, planners can design the project to cater to the public.

The second step is to make a comprehensive valuation of the benefits. Many environmental benefits are not commonly given a monetary value and therefore do not figure into cost-benefit analyses. The ABenefits of Urban Greening@ chapter discusses some of the environmental benefits frequently overlooked in accounting ledgers, and the AChallenges Facing Urban Greening@ chapter outlines some of the techniques used to approximate monetary values for these hard-to-handle amenities. While these valuation techniques are often considered experimental, Kielbaso (1993) and Tietenberg (1992) cite projects in the United States where savings in heating and cooling costs, air pollution abatement, visitor use, and CO_2 reduction were successfully figured into the economic analyses of urban forestry projects.

The basic legal, institutional, technical, environmental and economic requirements for starting up and maintaining an urban greening program need not all be present at once for a city to begin to green its surroundings. Most municipalities will have an assortment of advantageous and limiting factors to work with and will gradually update and revise those conditions that impede their progress. As long as there is a strong commitment to the process, such limitations can be overcome.

Activities of Urban Greening Programs

This chapter outlines specific activities or mechanisms that cities can use to obtain the benefits that a successful urban greening program will confer upon its citizens. By contributing to the implementation of the activities described below, citizens can help make their cities healthier, more enjoyable and more economically viable places to live.

Public Outreach and Education

The key to a successful urban greening program is the active participation of stakeholders and the general public in its planning and implementation. As already discussed, participation by those who will be most affected by urban greening projects is essential to preserving and managing those areas. Many cities in Latin America and the Caribbean have incorporated this type of outreach into their programs.

For example, the governor of Curitiba, Brazil, believes that cooperation is achieved by informing people through the media and then respecting their input. He has made this philosophy the basis of Curitiba=s environmental programs and solicits public input from people of all ages and occupations. To encourage participation from low-income residents, the city has provided weekend bus service from park to park so the poor can appreciate natural resources and become more active in environmental programs. In addition, an environmental training center constructed over an old landfill is being used to train citizens in ecology and community participation (FPFP 1990).

Other cities in the region have found innovative ways to incorporate public input into their urban greening programs. The Parks and Gardens Department of Vi?a del Mar, Chile, works with neighborhoods, ecology groups and students to educate them on ecological issues and to reduce vandalism of street trees. To encourage pride in neighborhood plantings, the Department gives prizes for the most attractive lawns and even for balconies with plants (See Appendix A, Photo #11.)

In some cases, there may be active resistance or simple indifference to a city=s efforts to create more green spaces. Officials in Mexico City discovered that when the city provided seedlings, transportation, labor and agronomic inputs for tree plantings in wealthier neighborhoods, the landowners did little to maintain the trees. Since the owners had not participated in the plantings, they did not value them and were indifferent to their care. Consequently, city officials now require landowners to become partners in any tree plantings on their property and to donate labor and other inputs to the program (Mart?nez and Chacalo 1994).

Getting input from stakeholders is important even at the conceptual stage of a program, before the actual planning begins. When city officials in Bogota, Colombia, decided to use wastewater for agricultural irrigation, they sought input from the farmers who would benefit from it so as to design an appropriate system (IDB 1990b). In a similar fashion, park development contractors in Santiago, Chile, now must specify how they intend to

include public input in park design. They generally hold community meetings on the issue, draw up alternatives based on that input, then return to the communities to see which alternative the people prefer before designing the new park (Ministerio de Obras Publicas 1995).

Public Parks

One of the most visible and popular components of an urban greening program is the city park. There is a long tradition of establishing a well-maintained, treed plaza as the major social gathering place in the center of cities in Latin America. Certain parks, such as Central Park in New York City, or Chapultepec in Mexico City, are so integral to a city=s identity that it is hard to imagine those cities without them. Such parks provide passive and active recreation, refuge from the car and concrete urban bustle, and improvements in a city=s aesthetic value and environmental quality. Depending on access, variety of services, upkeep and safety, parks have the potential of bringing together cross-sections of society that might not otherwise mingle: young and old, rich and poor, and different races.

City parks are especially important for the urban poor who cannot afford to travel to national parks or join private sporting clubs, and otherwise have few recreational outlets. City parks located within a reasonable walking distance from poor neighborhoods can substantially increase the quality of life for these people by providing opportunities for leisure activities.

Depending on the size and design of a park, it also provides a range of environmental services. While even grass playing fields increase water catchment area to decrease storm runoff, parks with some forested area also improve air quality, dampen noise pollution, reduce wind speeds and add aesthetic value (Kuchelmeister 1993).

Larger parks with more extensively forested areas also provide animal habitats, increase urban biodiversity, and can provide wildlife viewing pleasure for people.

Participation from Diverse Ethnic Groups

People of Vietnamese, Chinese, Mexican, Filipino, Cambodian and Indian descent make up almost half of the population of San Jose, California. Our City Forest, a local NGO, had to depend on the participation of all these ethnic groups to implement their AOne Million People, One Million Trees@ campaign.

The NGO chose to elicit participation through Afocus groups,@ or informal meetings, where people freely gave their opinions in response to the NGO=s questions. These focus groups advised Our City Forest on how best to reach the non-English speaking communities and even drafted brochures explaining the One Million Trees campaign. They also suggested distributing the brochures in highly frequented places such as churches, community centers and neighborhood grocery stores, advice the NGO followed.

When the campaign was launched, 110 representatives from 105 community based organizations such as student groups, chambers of commerce, senior citizen groups, AIDS service groups, and gang and drug abuse organizations participated. Once the program was underway, further participation was encouraged by offering an 11-hour training course in caring for the trees. Graduates became ATree Amigos@ and went on to coach other groups with tree planting projects (Berry 1996).

Street and Residential Trees

Businesses, residents and tourists alike appreciate the multiple benefits provided by trees along urban streets. In Sao Paulo, Brazil, trees are especially desired in the business district where local shop owners can advertise on the recycled plastic tree protectors. They generally prefer to sponsor trees in high traffic, central locations where the growth conditions are poor, but where a good business sponsor can better ensure a tree=s survival (See Appendix A, Photo #12.)

One of the primary activities of any street tree project is tree location and maintenance. In Santiago, Chile, two criteria for siting new parks are tree density and low income population. The small city of Waukesha, Wisconsin (USA) spends almost US$500,000 a year on its parks program and has been designated ATree City@ of the USA for 17 consecutive years. Approximately 1000 trees are planted annually and all trees are on a six-year pruning and maintenance cycle. Waukesha citizens and the Urban Forestry Department ensure that trees are planted at all newly constructed public or private buildings.

While city tree projects beautify a city and provide a range of environmental benefits, they can also provide more tangible benefits to needy people. For example fruit and nut trees provide real nutritional inputs; fast growing species, properly culled or pruned provide firewood, natural fencing, and mulching material (Kuchelmeister 1991). Furthermore, the use of species that have such immediate economic benefits should encourage a community to take an active role in the care of the trees.

Urban Agricultural Projects

Family garden projects can easily be implemented at a very low cost to the city. For example, in Vi=a del Mar, Chile, any family desiring an urban garden can receive land, free seeds and free technical advice from the city=s Parks Department. The family provides all other inputs and labor and collects the resulting harvest. School classes are entitled to participate as well and gain the added benefit of having a venue for agricultural education for urban youth.

A similar approach is being implemented in Appleton, Wisconsin (USA), although it is sponsored through a church group instead of a municipality. Church volunteers plow a large tract of land and plant it with several vegetables, one type per row. Low-income families then buy the rights to as many rows as they can afford for the season and thereafter maintain and harvest their plots through the fall. Urban greening programs in Latin America and the Caribbean could institute an agricultural program similar to Appleton=s by coordinating with the various religious, social and environmental groups in their cities. The government could provide the urban land for such a project while the implementing groups and beneficiary families could supply the necessary labor and inputs.

Urban Agriculture

No urban greening program would be complete without an urban agriculture component. Agriculture includes activities such as beekeeping, fish farming, market gardening, micro-livestock (rabbits, guinea pigs, etc.) and poultry production, flower beds, woodlots for fuel, orchards, harvesting medicinal plants and fodder, managing tree nurseries, field crops and irrigation projects, among others. Smit (1996) estimates that agriculture, in all its many guises, occupies more than half of all Agreen@ uses of urban land.

The poor of the region particularly value urban land that can be used to produce both

food and cash crops. Several cities have family garden programs as part of their urban greening system, and in Mexico City there are beekeeping courses for low- income residents living near Xochimilco Park. Planning committees for urban greening can include residents in the process of deciding which tree and plant species to include in particular green areas in order to maximize the production of specific material products.

Several cities around the world have adopted goals of food self-reliance. Included among them are: Ahmedabad, India; Toronto, Canada; Shanghai, China; and Bulawayo, Zimbabwe (Smit 1996).

Urban agriculture can benefit large numbers of residents by working through both government programs and NGOs. For example, *Peru Mujer*, an NGO in Lima, Peru, runs a community gardening program that reaches approximately 5,000 low- and middle-income families in and around the city. In Costa Rica, various security forces work with public agencies and NGOs to create large community gardens for their families in downtown San Jos J. *Pro Huerta*, a national collective of government and private institutions in Argentina, lists over a half million beneficiaries of its gardens program. These residents are reached through 1,100 cooperating institutions that support 62,000 community, school and institutional gardens in 1,800 towns and cities (UNDP 1996).

Urban agriculture can also be integrated into other urban greening components, as seen in an innovative aquaculture project in Lima, Peru. The World Bank funded a demonstration project by the Pan American Centre for Sanitary Engineering and Environmental Sciences (CEPIS) to test the possibility of producing fish in mature wastewater stabilization ponds. The project confirmed that fish raised in such ponds are free of pathogens, heavy metals and chemicals and are thus suitable for human consumption. In addition, the productivity of the aquaculture in wastewater ponds compares well to the more traditional tropical fish ponds that use expensive feeds (Khouri *et al*. 1994). Integrating these two components of an urban greening program can multiply the benefits to city residents.

Greenbelts and Greenways

Greenbelts are large parcels of land in and around cities where urban development is totally prohibited through zoning, public ownership, easements or development restrictions (Miller 1993). Greenbelts provide such environmental benefits as noise and air pollution reduction, climate amelioration, biodiversity, watershed protection and wildlife habitat. Greenbelts are basically open space buffers amid the congestion and pollution of most large cities.

An example of a greenbelt can be found in Santiago, Chile. The mountain range outside the city serves as the principal watershed for municipal water supplies and electricity. As the city-s population expands and begins to invade this mountainous area, municipal officials have designated the cordillera a greenbelt to prevent any further development and to preserve this valuable resource area.

Greenways, by contrast, are narrower vegetated corridors that can have multiple uses and functions such as improving environmental quality, providing recreation, and serving as alternative transportation

routes (bicycle and foot paths). Greenways are often sited along natural systems such as rivers, ravines, ridge lines and floodplains. These are usually less expensive lands and cannot be built on, due to environmental and physical limitations. Siting utility lines along greenways is a common practice, since it reduces the cost of land acquisition as well as conflicts over land use rights. In Rio de Janeiro, Brazil, the electric company provides land under its transmission lines to farmers free of charge. In return, the company benefits by having its greenways maintained and avoiding squatter settlements as well as having a source of fresh produce for its canteens (UNDP 1996). Greenways can also be incorporated into a highway system as wide, vegetated medians, such as those required by the Ministry of Public Works in Santiago, Chile.

Greenways have the additional benefit of serving as natural corridors that connect larger wildlife habitats. Such corridors permit wildlife populations to survive in urban environments and contribute to the overall biodiversity of the area (Labaree 1992). A more specific type of greenway is *riparian reforestation*, or riverside tree planting. Many urban riverbanks have been used as garbage dumps and are unsightly. Planting these areas with various forms of vegetation cannot only prevent use of the banks for waste disposal, but can also make them aesthetically more attractive, help in flood control, and create more biodiversity.

Curitiba, Brazil, has instituted an increasingly common adaptation for its greenways: neighborhood trails. These cost-effective ecological transportation corridors provide a meter-wide paved path in the middle of the vegetation that winds through city neighborhoods. In Durban, South Africa, greenway parks have been established along the coastline, ridgelines and river valleys. The city uses an ecosystem approach (biogeographical design principles) to allow natural succession processes to vegetate and maintain native plant communities in these parks.

Watershed Management

One of the most urgent priorities in any large metropolis is providing clean water to residents and adequately disposing of wastewaters. An abundant supply of clean water depends on a healthy water supply catchment area or watershed. City planners need to work with urban and suburban residents and other stakeholders in watershed areas to ensure adequate protection of this important resource. This element of an urban greening program can be integrated with other sections such as tree planting, school education and flood control.

Wastewater disposal is also a major component of urban greening. As previously mentioned, wastewaters can be filtered through settling ponds and wetlands and/or used for irrigation in urban agriculture or parks. Bogota, Colombia, already has a wastewater irrigation system for croplands near the city. Durban, South Africa uses wetlands and settling ponds to economically and ecologically dispose of its urban wastewater (See Appendix A, Photo #13).

Another integral part of watershed management is erosion and flood control. Many cities in Latin America and the Caribbean are spread over hills and mountains or coastal slopes and have serious erosion and flooding problems. Millions of dollars a year are

spent on repairing damages caused by landslides and floods, when for a fraction of that expense urban greening could have greatly diminished such tragedies. The Inter-American Development Bank has participated in watershed protection programs such as the one in Port-au-Prince, Haiti, where 500 hectares of steep, degraded land were reforested to stabilize hillsides and reduce sedimentation in local streams and reservoirs (IDB 1986).

Natural flood control can be accomplished with trees and other plantings along riverbanks and in watershed areas, and by utilizing wetlands or park lakes to retain storm runoff and allow it to disperse gradually. Mud and landslides can likewise be minimized with tree plantings and other erosion control methods (See Appendix A, Photo #14).

Protected Areas

The term Aprotected area@ in this case refers to natural or reconstructed habitats that receive some level of legal protection in order to preserve their ecological or biological functions. In particular, conservation of biological diversity, or maximizing the number and range of species in a given area, is receiving increasing attention as a primary objective of protected areas. Managing for biodiversity also includes attempting to maintain variety in the genetic stock of organisms in order to maintain their evolutionary viability. This genetic viability is important to humans for many reasons including the source of new medicines, cultivates, disease resistant crops, and other economic benefits (Wilson 1990).

Preservation of biodiversity tends to be most favored in large, rural protected areas where human impact is minimal. Typically, such preserves form the core of a country's national parks program. The goal of these parks is to offer wilderness viewing experience to citizens and to protect a wide range of plant and animal species, frequently by conserving entire ecosystems. Although it is seldom possible to create a reserve of this magnitude in or near a major metropolitan area, they should still be included in any country=s system of protected areas. Moreover, if an adequate network of green corridors can be established, then the larger rural parks can directly enrich the bio-diversity of urban parks by serving as a source of species and genetic stock.

While protected areas include grasslands, deserts, migration corridors, and seashores, the most common types in urban settings tend to be wetlands, riparian habitats and forests. In urban regions, protected areas vary in size from a couple of hectares of bird nesting habitats to forests of a thousand hectares or more, though they tend to be smaller the closer they are to the city center.

Although often overlooked as swamps, wastelands, or obstacles to development, wetlands merit consideration as a priority candidate for protected status. They contain unusually high levels of biodiversity, and offer a range of environmental services. Despite the fact that wetlands are fragile ecosystems they have considerable pollution abatement properties. They also provide flood protection, ground-water recharge, wildlife habitat, entrepreneurial opportunities (fishing, tourism, etc.), wastewater purification and in some cases shoreline stabilization. Large wetlands in or near cities

also act to moderate surrounding air temperatures, especially in warmer months when they cool down the summer heat. Thus, rather than draining, dredging or filling wetlands, city planners need to appraise these important ecosystems for their value as a protected resource.

Urban greening programs need to take advantage of all the benefits wetlands can provide by preserving or expanding existing areas, and by creating new ones. An excellent example of this can be found in Waukesha, Wisconsin (USA) where half of the city-s 800 acres (364 ha) of community parkland has been preserved as wetlands. Similarly, in Bogota, Colombia, efforts are underway to improve water quality and levels in the Herrera Lagoon to reduce odors considerably and make it more attractive to humans and local and migratory fauna (IDB 1990).

Wildlife habitats must also be protected wherever it is still intact. Many cities in the region have created protected areas in urban sites that are unsuitable for development, such as ravines, river sides, upper watersheds or steep slopes. These areas serve as sanctuaries for birds and animals native to the area while providing limited access for recreation or other uses. Planners should also consider protecting part or all of the transition zones between ecosystem types, as these areas tend to be highest in biodiversity. These areas, because they contain elements of two ecosystems (e.g., shorelines or river banks), provide a habitat for the plants and animals from both systems (e.g., water and land dwelling species). Greenbelts in and around cities also provide important habitat areas, as do many suburban areas. Urban greening programs must integrate urban and rural planning into biological, ecological planning that creates a more sustainable bio-region in and around urban centers (Smit, 1996).

The above described activities of an urban greening program are important and beneficial. City planners and participating stakeholders can be as creative and enterprising as they want to be in incorporating other elements into their programs according to their specific needs and desires. Whenever possible, innovative approaches should be shared with planners and participants in other cities in the region.

Financing Urban Greening

Regardless of the funding mechanism used, it is clear that urban greening programs need a sustainable source of revenue to achieve their greening goals. Long-term financial planning as well as clearly defined strategies and goals will help to prioritize a city=s projects and will allow stakeholders and investors to participate in making them a reality. Urban greening programs also need to take their place beside other urban needs as worthy of public budget allocations that provide for a city=s future.

Potential Funding Strategies

Possibly the most important strategy for funding an urban greening project is to secure more than one, and preferably several sources of financing. Having a variety of funding sources boasts at least three distinct advantages. First, it provides a backup if one source pulls out of the investment. With budgetary crises in the public sector, fluctuations of the business cycle, and emergencies that divert funds from nonprofits and the public and private sectors alike, any one source of funding is at risk of drying up. Spread across a variety of sectors, however, the future funding of a given project is less subject to chance (Morgan 1996). For example, a forestry development program in Nicaragua has local funding and three outside funding sources. The project is going forward despite the initial hesitancy of one of those sources, because the others have pledged their continued support (IDB 1995).

The second advantage of diversified financial support is that it encourages additional investors. Multiple funders means reduced risk for any one party. For example, a project with financial backing from the municipal and national government, NGOs, and the international community would be likely to attract a number of private investors.

The third advantage is that multiple investors means multiple stakeholders. Presumably, every party wants to see its investment succeed. Thus, if the investors work together to form a monitoring network, then attention to detail is easier to accomplish and less of a burden for all parties involved. While division of labor can simplify tasks for all, too much division and too many parties can create ambiguities and lead to inefficiencies. Ferguson and Maurer (1996) describe an eight-way split of responsibility for the environmental infrastructure of Sao Paulo that has resulted in the incomplete provision of services, as well as delays in design and approval of water and sanitation projects. A clear delineation of tasks is essential if a project is to benefit from multiple investors.

Public Funding

Most governments in Latin America and the Caribbean face serious fiscal constraints and are struggling to meet their basic needs with limited funds. The overwhelming external debt of the region=s nations is contributing to this situation. Consequently, any new

ventures at the national, state or local level have to pass stringent budgetary scrutiny and much political persuasion to free up public funds. Yet, if urban greening components generate substantial positive externalities, then the public sector should have a mechanism to fund them.

At the municipal level, annual operating budgets are hotly debated, with each government sector defending its current expenditure and rationalizing a budget increase to meet growing demands. Yet, the majority of urban greening funds will have to originate at the municipal level. In this milieu, an urban greening program would need to be included in an already established department and hopefully share some of its funding, sometimes at the expense of a previous project. In general, urban greening will be integrated into either environmental or public works ministries or departments and obtain public funding via their budget.

To the extent that trends in governmental decentralization continue, discretionary spending at the local/regional level will increase (see Fernández 1996). Furthermore, lending institutions like the IDB are increasingly willing to make loans directly to cities. It is important to note that in most countries cities have the tax and fiscal autonomy necessary for financing urban greening projects. Because cities develop their own budgets and have certain powers to levy taxes, they possess the wherewithal required to provide funding for priority projects. There are a variety of other fund-raising strategies at the local level (see Morgan 1996). Taxes can also be levied to pay for greening projects, including: beautification taxes (for annual improvements or specific projects); frontage taxes (based on the linear feet of property that abuts public rights-of-way); district benefit assessments (in which residential sections are divided into districts, and then each district decides on the amount to dedicate to improvements); municipal greening bonds; and so on. For example, in Santiago, Chile, citizens must pay a vehicle tax (approximately US$250/car/year) and can indicate how they would like that money to be spent, i.e., on parks, crime prevention, street lighting, etc. Each municipal program competes for the funds by convincing the taxpayers that the moneys are spent on their particular projects. An urban greening program can yield enough benefits to convince city residents to appropriate funds for its projects.

Another common way to get funding for green areas is through permit fees and fines. In Viña del Mar, Chile, for example, when utility companies, developers or home owners have to excavate close to a tree, they are required to pay for a permit and leave a deposit as a guarantee that the work will not damage the tree. The permit fees and deposits pay for inspectors' salaries in the Parks and Gardens Department. If a tree cannot be transplanted and has to be cut to make way for construction, landowners or developers must pay a fine. In addition, all developers are required to include tree plantings in new commercial or housing projects. Unauthorized tree cutting or pruning is punished by fines which go back into the urban greening program.

Finally, cities can reduce some of their operating costs through tax incentives. For example, in Curitiba, Brazil, landowners who maintain or reforest areas of over 2000m^2 are exempted from paying the land tax. More than 500 landowners have qualified for this exemption so far. This waiver has helped keep many areas green and raise the possibility that they may be converted into

private parks.

Cost Avoidance, Reduction and Recovery

When looking at the overall budget of an urban greening program, city officials can adopt a strategy of increasing or generating revenue as well as avoiding, reducing or recovering costs wherever possible. Such cost recovery can be accomplished by various means and is limited only by one=s creativity. For example, Mexico City has a cost sharing agreement with local utility companies for employing the city=s greenways for utility lines. In Curitiba, Brazil, for every tree cut during development, two must be planted or donated to the city to plant, thereby reducing plant stock costs to the city.

Urban greening programs in all their various components can save a municipality money by avoiding such costs as waste management, flood and erosion control, infrastructure demands, temperature control, dike and dam construction, health costs, etc. Some of these expenses are directly saved in the municipal budget while others are more indirect. Likewise, some of these savings will be immediate and others will add up over the long term (Smit 1996).

Costs can also be reduced through trades of maintenance costs for goods or services. For example, rather than pay for maintenance expenses in city parks and green areas, these costs can be absorbed by private companies, NGOs or other stakeholder groups in exchange for reaping the benefits of that area. Such benefits could be in the form of concessionaire rights, harvestable products or exclusive use of a particular area.

Urban agriculture can contribute to cost recovery as well. Farmers are willing and able to pay for the right to use land, water and waste and will even pay for police protection if need be. In addition, urban agriculture provides one third or more of the food consumed in the region=s cities. This production is the equivalent of one eighth of the economy of the average city in Latin America. The savings are even more pronounced in the low income areas of cities, where 30 percent to 70 percent of the residents produce food (depending on access to land), accounting for 60 percent to 80 percent of their economies. It may thus be more cost effective to enable the poor to green the city than to fund large bureaucracies to do so (Smit 1996).

Urban greening can also save a municipality money in other areas outside of its greening focus. For example, a project to improve the water quality in Bogota, Colombia, will result in better health for the populace that consumes that water, thus reducing health care costs for water-related diseases. These medical savings are estimated to be approximately US$2.5 million over 20 years, a substantial savings (IDB 1990).

Debt-for-Nature Swaps

This form of obtaining funds for environmental projects was, for a time, embraced enthusiastically, but due to decreased indebtedness and risk of repayment of the loans, it has lost some of its early appeal. The general mechanism for doing a Aswap@ is the following: an interested party (usually an NGO) buys a portion of the commercial debt of a developing country at a discount and then makes a deal with one of the country=s national banks to pay back the

full face value of the debt in local currency instead of dollars. The novelty of the deal is that the national bank, rather than paying the northern NGO the owed money, pays it to a national entity (usually an NGO) to finance conservation projects.

In the case of private sector debt there are four main advantages to this arrangement. According to Godwin (1993) they are: (1) the commercial bank gains tax benefits and reduces the risk of a loan default and currency devaluations; (2) the developing country bank saves scarce dollars while investing in local currency with funds that otherwise would have been used to pay foreign creditors; (3) the northern NGO gets more leverage for its investment; and (4) the local conservation NGO gets funds that it probably would not have had otherwise.

Mexico City=s ecological conservation program is the first in Latin America to utilize a form of this funding mechanism for the public sector with the help of the Inter-American Development Bank. The IDB lent the National Bank of Mexico US$100 million to help finance Mexico City=s US$200 million urban greening project. The national government bank used the IDB funds to reduce its outstanding foreign debt by redeeming its long-term bonds on the secondary market. Since these bonds were sold at a discount rate (less than their face value), for every dollar lent by the IDB, the Bank was able to retire approximately US$1.21 in debt. The purchased securities were then converted into local currency and deposited into special accounts to be used exclusively for the urban greening project. In this manner, the national bank was able to obtain local currency resources in excess of the equivalent of the IDB loan (a net savings of approximately US$9.6 million) while financing its urban greening program in local pesos (IDB 1992).

Trust Funds

The definition of a trust fund differs from country to country, depending on the legal system. However, a trust fund generally consists of money set aside for the benefit of a certain party and held by a trustee. The trustee can be a person, an institution or a board that is legally responsible for managing the investment. Trust funds can provide financing for park programs that might not otherwise have been possible (Wells 1992).

To ensure broad participation in deciding how trust funds will be spent, the board of trustees can be composed of representatives of the various stakeholder and donor groups. Trust funds can also be set up to accept future funds and manage grants. In countries where inflation and currency devaluations are a problem, city officials can explore the option of maintaining their funds in banks in other countries (where allowed to by national laws).

An endowment is a type of trust fund, usually a grant or gift of money that is invested. The interest on the investment is spent while the original capital remains untouched. A new program can sometimes get a start-up grant from private conservation organizations or other international donors interested in supporting green efforts (Mikitin and Osgood 1995) through a sustainable mechanism of financing ecological improvement through the income generated by the fund.

Private Funding

There are a number of different ways through which city managers can raise private funds, or reduce the costs, for urban greening and many examples already exist around the region. In Sao Paulo, Brazil, a condominium complex sponsored a nearby city park (zero cost to the city) and income from food concessions there goes to a foundation to maintain the park. In the city=s One Million Trees project, many tree plantings also incur no net cost to public entities because they are paid for by business advertisements on the plastic tree protectors. Similarly, 60 percent of Guatemala City=s Aregreening the city@ project was financed by private and corporate sources (Carter 1993).

Private funding obtained from concessions is an attractive financing mechanism. Some parks sell souvenirs, publications or other merchandise to tourists, as well as marketable products such as food or medicinal plants. Concessionaires can pay for either permits to sell their products in green areas, or they can retain the right to operate their businesses there in exchange for maintaining the park. In either instance, the city pays less for the park=s maintenance.

Depending on the type of green area being managed, some private funds could be raised through individual donations (especially in wealthier neighborhoods), entrance fees (as in the case of city zoos), or through ticket sales for sponsored events (such as movies, auctions or concerts in the park).

Corporate donations in exchange for publicity are another way to garner private funds. ViZa del Mar, Chile, is proposing to other municipal authorities and to private sector companies that they take over complete responsibility for managing entire parks (rather than individual trees) in exchange for the company publicizing its green contribution to the overall betterment of the city. Private foundations, military bases, universities and other institutions are also frequent contributors to urban greening programs.

National, Regional and Local Funds for Protected Areas Systems or Nature Conservancy

The National Environment Fund (FNMA) of Brazil was established in 1989 to provide grants to NGOs, small municipalities and research institutions. Its goal is to promote private and/or local initiatives to improve environmental quality and conservation of natural resources. The administration of the Fund rests with the Ministry of the Environment, but the board of directors is a mix of government and NGO members representing all regions of Brazil. Three years after the fund was created, the IDB approved a US$22 million loan to the federal government in support of the initiative. The government made a counterpart pledge of US$8 million, and the FNMA has received several additional contributions from the public budget since. By 1995 several hundred projects had been initiated with this money, and further efforts to replenishment and increase the Fund were under consideration. (Dourojeanni 1996).

Conclusion

The growing urban populations of Latin America and the Caribbean, the majority of whom are poor, have an urgent need for the basic necessities of a reasonable quality of life: adequate food, shelter, potable water and jobs. A good portion of these needs can be provided through urban greening. Green areas can provide land for food production, lumber for housing, fodder for livestock, protected watersheds for clean water, sound recreational environments and a variety of entrepreneurial opportunities for employment.

For the middle and higher income residents in the region=s cities, other concerns will take precedence: aesthetically pleasing work and home environments, wildlife preservation, waste recycling and climate improvements. These too can be supplied by a comprehensive urban greening program.

Urban greening can address the concerns of city officials and urban planners for protecting the populace from natural tragedies such as floods and landslides, as well as improve the city=s overall air, water and climate quality for everyone. Additionally, green areas provide citizens and visitors alike opportunities for recreation and education.

Implementing an urban greening program need not be a burden on the public budget. Many cities in the region have already begun some form of greening through existing programs in various ministries or other institutions. In addition, political and legal considerations have made it possible to share costs with both government and nongovernmental agencies and to work out creative ways to get an urban greening program started. Depending on the particular components of a program (trees on the sidewalks, wastewater treatment, etc.), funding from private and international sources can also be solicited. Urban agriculture may improve the access of urban residents to good quality food at reasonable costs.

Although almost every large city in Latin America and the Caribbean has some form of urban greening already in progress, much more research and information sharing needs to be accomplished in this area. Experiences from other areas of the world, as well as information about what does and doesn=t work in the region, can help city planners avoid costly experimentation and maximize scarce resources. In addition, region-wide training courses and shared research facilities would greatly benefit all the region=s cities. Although programs should be designed to meet each city=s particular circumstances, all metropolitan areas share some urban problem whose solutions may be similar.

Urban greening is not just another project implemented in a metropolitan environment **C**it is an integrated part of a larger whole, inextricably connected to the social, economic, political, biophysical, spiritual and cultural surroundings of major cities. It is precisely because urban greening is so connected to other aspects of life in a city

that it is imperative that people from all social and economic groups participate in its design and implementation. Broad participation by the various stakeholders will diminish potential conflicts and help generate the strong support needed to initiate and maintain a viable program.

Urban greening is also part of a much larger natural system. Cities are situated within a general ecosystem and as such are a part of a larger bioregion. The ever expanding urban environment subsumes or comes in increasing contact with natural systems. To preserve natural systems then, we need to integrate nature into our cities. Whether it is greenways, wetlands or protected watersheds that provide a habitat for wildlife, or cultivated farmlands that preserve the genetic variety of native crop species, green areas contribute to maintaining and expanding the biological base for diversity that is essential to human survival into the next millennium. A well-planned participatory urban greening program can thus secure a healthy sustainable future for the urban populations of Latin America and the Caribbean.

The Inter-American Development Bank is dedicated to making cities greener and healthier through its support of urban greening projects. The IDB intends to continue financing projects whose primary goal is to establish city parks and greenways. Equally high on the Bank=s priorities is to increasingly integrate urban greening into a wide variety of urban development projects including sanitation, drainage, housing and infrastructure. This second type of project, which is much more prevalent, holds great promise for expanding the opportunities of greening our cities. Creative implementation of greening in existing programs promises significant economic, environmental and aesthetic benefits for minimal added cost. Finally, through the creation and expansion of an urban greening network in Latin America and the Caribbean, the IDB hopes to make accessible a wide breadth of information, technical expertise and experiential knowledge so that new projects can integrate the lessons learned from past efforts and the wisdom of today=s competent professionals.

References

Akbari, H., S. Davis, S. Dorsano, J. Huang, and S. Winnett. 1992. *Cooling our Communities: A Guidebook on Tree Planting and Light-Colored Surfacing*. Washington, D.C.: United States Environmental Protection Agency.

Ali, Mohamed Harez and Michael T. Mahoney. 1991. Trees and Tree Lovers of Egypt. In *Proceedings of the Fifth National Urban Forest Conference*, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Augusto, Luis. 1995. Personal Communication.

Baines, Chris. 1996. Selling Urban Forestry: 15 Years Experience in the United Kingdom. In *Proceedings of the Seventh National Urban Forest Conference*. Washington D.C.: American Forests.

Bartone, Carl, Janis Bernstein, Josef Leitmann, and Jochen Eigen. 1994. *Toward Environmental Strategies for Cities*. Washington, D.C.: The World Bank/Urban Management Program.

Basterrechea, M., A. Dourojeanni, L. Garcia, J. Novara, and R. Rodriguez. 1996. *Lineamientos para la preparaci \n de proyectos de manejo de cuencas hidrogr<ficas*. Washington, D.C.: Inter-American Development Bank, Environment Division.

Barzetti, Valerie, ed. 1993. *Parks and Progress*. Washington D.C.: World Conservation Union/Inter-American Development Bank.

Berkes, F., ed. 1989. *Common Property Resources: Ecology and Community-Based Sustain able Development*. London: Belhaven.

Berry, Rhonda. 1996. Commitment to Diversity. In *Proceedings of the Seventh National Urban Forest Conference*. Washington D.C.: American Forests.

Berstein, Janis D. 1994. *Land Use Considerations in Urban Environmental Management*. Washington, D.C.: The World Bank/Urban Management Program.

Braatz, Susan M. 1993. Urban Forestry in Developing Countries: Status and Issues. In *Proceed ings of the Sixth National Urban Forest Conference*, edited by Cheryl Kollin. Minnesota: American Forests.

Carter, Jane. 1993. The Potential of Urban Forestry in Developing Countries: a Concept Paper. Rome: Forestry Department of the Food and Agriculture Organization of the United

Nations.

Ceballos, Waldo. 1995. Personal Communication.

Center for Landscape Research. 1993. Heritage Forest Vegetative Study. Toronto: Center for Landscape Research, University of Toronto and Municipality of Metropolitan Toronto Transportation Department. Internet document.

Cobo, Wania, Rodney T. Sullivan, and Sylvia Vinueza. 1996. Urban Forestry and Poverty. In *Proceedings of the Seventh National Urban Forest Conference*. Washington D.C.: American Forests.

Cohen, Michael A. 1991. *Urban Policy and Economic Development*. Washington, D.C.: The World Bank.

Collins, Kevin D. 1995. A Strategy for Urban Forestry in Ireland: A Review and Case Study. Internal document of the National Youth Environmental Organization of Ireland.

Daughters, Robert. 1995. Personal Communication.

Denning, James. 1994. When the Levee Breaks. *Civil Engineering* (January 1994):38-41.

Dourojeanni, M.J. 1997. *Public Sector Roles and Economic Policies Affecting Biodiversity Conservation in Latin America and the Caribbean*. Workshop on Investing in Biodiversity Conservation. Washington, D.C.: Inter-American Development Bank.

Dwyer, John F. 1991. Economic Benefits and Costs of Urban Forests. In *Proceedings of the Fifth National Urban Forest Conference*, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Fergusen, B. and C. Maurer. 1996. Urban Management for Environmental Quality in South America. *Third World Planning Review*, Vol 18 (2), pps. 117-153.

Fern<ndez, G. 1996. *Decentralization in Latin America*. Inter-American Development Bank, Working Paper Series, No. 104.

Fox, William F. 1994. *Strategic Options for Urban Infrastructure Management*. Washington, D.C.: The World Bank/Urban Management Program.

Freeman, A. Myrick III. 1979. *The Benefits of Environmental Improvement*. Baltimore: Johns Hopkins University Press.

Freeman, A. Myrick. 1993. *The Measurement of Environmental and Resource Values: Theory*

and Methods. Washington, D.C.: Resources for the Future.

FundaHao de Pesquisas Florestais do Parana. 1990. Encontro Nacional Sobre ArborizaHao Urbana (National Meeting on Urban Forestry, October, 14-18, 1990). Curitiba, Brazil: FUPEF.

Fundaci \n Natura. 1990. *Arborizaci \n urbana: metodolog*Ra *para la planificaci \n*. Quito, Ecuador: Fundaci \n Natura.

Gad \, Gy `rgy P<l. 1991. Planting Hope in Hungary. In *Proceedings of the Fifth National Urban Forest Conference,* edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Gearheart, Robert A., Brad Finney and Mac McKee. 1994. Water and Wastewater Treatment Technologies Appropriate for Reuse (WAWTTAR). A computer model. Arcata, California: Humboldt State University.

Girardet, Herbert. 1995. The Urban Age: Sustainable Cities in an Urbanizing World. Internet document.

Godwin, Lamond. 1993. Statement Before the Fourth World Congress on National Parks and Protected Areas. In *Parks and Progress*, edited by Valerie Barzetti. Washington D.C.: IUCN/IDB.

Gonz<lez Claver<n, J. 1996. Enverdecimiento urbano de la Ciudad de Mexico. Draft document to be published in Procedings of Urban Greening Seminar held at Mexico City December 2-4, edited by Krishnamurthy, L. and J. Rente Nascimento. Mexico City: Universidad Aut \noma de Chapingo.

Gray, John. 1991. Prospects for Urban Forestry in Australia. In *Proceedings of the Fifth National Urban Forest Conference,* edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Heisler, G.M. 1990. Mean Wind Speed Below Building Height in Residential Neighborhoods with Different Tree Densities. *ASHRAE Transactions*: 96(1): 1389-1396.

Heisler, G.M., R.H. Grant, S. Grimmond, and C. South. 1995. *Urban Forests -Cooling our Communities?* In: Kollin C. and M. Barratt (Eds), Proceedings of the Seventh National Urban Forest Conference, pp. 31-34. Washington, D.C.: American Forests.

Hill, Deborah B. 1991. Developing Urban Forestry Awareness in Quito, Ecuador. In *Proceed ings of the Fifth National Urban Forest Conference*, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Hoesterey, Roger. 1991. The Ecosystem Strategy. In *Proceedings of the Fifth National Urban Forest Conference*, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Inter-American Development Bank (IDB). 1986. Port-au-Prince (Haiti) Sewerage Project. Internal Bank document.

_____ .1990. Upper Bogot<River Environmental Rehabilitation Program. Internal Bank document.

_____ . 1992. Ecological Conservation Project for the Mexico City Metropolitan Area. Internal Bank document.

_____ . 1994a. Report on the Eighth General Increase in the Resources. Internal Bank document.

_____ . 1994b. Drainage Program at Sao Paulo (Second phase). Internal Bank document.

_____ . 1995. *Sexta consulta sobre el medio ambiente*. 27-30 November, 1995. Curitiba, Brazil. Washington, D.C.: IDB.

_____. 1996a. Preface to invitation to: Green Urban Environ ment in Latin America and the Caribbean. Report of International Urban Greening Seminar, Mexico City, 2-5 December, 1996.

_____. 1996b. Green Urban Environment in Latin America and the Caribbean. Report of International Urban Greening Seminar, Mexico City, 2-5 December, 1996. Internal Bank document.

_____. 1996c. Hillside Project for Quito, Ecuador. Internal Bank document.

_____. 1996d. Guatemala: City Environmental Program. Internal Bank document.

_____. 1996e. Inter-American Development Bank: Basic Information. Washington, D.C.: IDB.

_____. 1996f. Socio-environmental and Forestry Development Program for Nicaragua. Internal Bank document.

_____. 1997. Annual Report on the Environment and Natural Resources 1996. Washington, D.C.: IDB.

International Council for Local Environmental Initiatives. 1995. *Multi-Functional Park Design and Management*, Durban, South Africa. Case Study #27. Toronto: ICLEI.

Johnston, Mark. 1991. Urban Forestry in the United Kingdom. In *Proceedings of the Fifth National Urban Forest Conference*, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Jones, Nerys. 1996. The Black Country Urban Forestry Initiative: A United Kingdom Case Study. In *Proceedings of the Seventh National Urban Forest Conference*. Washington D.C.: American Forests.

Jones, Nerys. 1995. *The Black Country Urban Forest: A Strategy for its Development*. West Midlands, England: Black Country Urban Forestry Unit.

Khouri, Nadim, John M. Kalbermatten, and Carl R. Bartone. 1994. *Reuse of Wastewater in Agriculture: A Guide for Planners*. Washington, D.C.: The World Bank.

Kielbaso, J. J. 1993. Urban Forestry and Quality of Life in Cities in *ANAIS. 7º Congresso Florestal Brasileiro* Curitiba, Paran<, Brazil: Sociedade Brasileira de Silvicultura and Sociedade Brasileira de Engenheiros Florestais.

Kuhns, Michael, Gretchen Ferenz, and Dale Blahna. 1996. Effective Community Involvement inUrban Forestry Programs. In *Proceedings of the Seventh National Urban Forest Conference*. Washington D.C.: American Forests.

Kuchelmeister, G. 1991. *Urban and Peri-Urban Multipurpose Forestry in Development Cooperation**C**Experience, Deficits and Recommendations*. Commission on the European Communities. Illertissen, Germany.

Kuchelmeister, G. 1993. Trees, Settlements and People in Developing Countries. *Arboricultural Journal*. Great Britain. 1993: 399-411.

Labaree, Jonathan M. 1992. *How Greenways Work: A Handbook on Ecology*. Ipswich, MA: National Park Service and Atlantic Center for the Environment.

Lampietti, J.A. and U. Subramanian. 1995. *Taking Stock of National Environmental Strategies*. Environmental Management Series, Paper No. 010. Washington, D.C.: The World Bank.

Laverne, Robert J. 1991. Aerial Photography and Mapping in Urban Forest Management. In

Proceedings of the Fifth National Urban Forest Conference, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

MacArthur, R. and E. O. Wilson. 1967. *The Theory of Island Biogeography*. Princeton, NJ: Princeton University Press.

Markandya, Anil. 1991. The Economic Appraisal of Projects: The Environmental Dimension. Project Analysis Department. Washington: D.C.: Inter-American Development Bank.

Martínez, Lorena, and Alicia Chacalo. 1994. *Los árboles de la Ciudad de México*. Mexico City: Universidad Autónoma Metropolitana.

McPherson, E. Gregory, David J. Nowak and Rowan A. Rowntree. eds. 1994. *Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project*. Radnor, Pennsylvania: Northeast Forest Experiment Station.

McPherson, E. Gregory. 1991. Environmental Benefits and Costs of the Urban Forest. In *Proceedings of the Fifth National Urban Forest Conference*, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Mendoza, Rachel. 1996. Developing Successful Training Programs for Hispanic Tree Care Technicians. In Proceedings of the Seventh National Urban Forest Conference. Washington D.C.: American Forests.

Miller, Robert W. 1993. Greenbelt silviculture. In *Proceedings of the Sixth National Urban Forest Conference*, edited by Cheryl Kollin. Minnesota: American Forests.

_____. 1988. *Urban Forestry: Planning and Managing Urban Greenspaces*. Englewood Cliffs, New Jersey: Prentice Hall.

_____. 1996. Planning Urban Greening. Draft document to be published in Procedings of Urban Greening Seminar held at Mexico City December 2-4, edited by Krishnamurthy, L. and J. Rente Nascimento. Mexico: Universidad Autónoma de Chapingo.

Mikitin, Kathleen and Diane Osgood. 1995. Issues and Options in the Design of GEF Supported Trust Funds for Biodiversity Conservation. Environment Department Paper 011, Biodiversity Series. Washington, D.C.: The World Bank.

Ministerio de Obras Públicas. 1995. *Manual de revegetación de caminos: Plantación y mantención*. Santiago, Chile: Ministerio de Obras Públicas.

Morgan, N.R. 1996. Financial and Economic Aspects of Urban Greening. Draft document to be published in Procedings of Urban Greening Seminar held at Mexico City December 2-4,

edited by Krishnamurthy, L. and J. Rente Nascimento. Mexico: Universidad Aut \noma de Chapingo.

Murray, Sharon P. 1991. Urban Forest Planning in Quito, Ecuador. In *Proceedings of the Fifth National Urban Forest Conference,* edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Nilsson, K., T.B. Randrup, and T. Tvedt. 1996. Technological Aspects of Urban Greening. Draft document to be published in Procedings of Urban Greening Seminar held at Mexico City December 2-4 ,edited by Krishnamurthy, L. and J. Rente Nascimento. Mexico: Universidad Aut \noma de Chapingo.

Nowak, D.J., J.F. Dwyer and G. Childs. 1996. The benefits and costs of urban greening. Draft document to be published in Proceedings of Urban Greening Seminar held at Mexico City December 2-4, edited by Krishnamurthy, L. and J. Rente Nascimento. Mexico: Universidad Aut \noma de Chapingo.

Parker, John H. 1996. Integrating Energy Conserving Landscaping into Low-Income Housing Projects. In *Proceedings of the Seventh National Urban Forest Conference*. Washington D.C.: American Forests.

Philippi, Arlindo 1995. Personal communication.

Porritt, Jonathon. 1991. *Save the Earth*. Atlanta: Turner Publishing, Inc.

Prefeitura do Municipio de Sao Paulo (PMSP). 1996. *Agenda 21, local: Compromiso do municipio de Sao Paulo*. Sao Paulo, Brazil: Secretaria Municipal do Verde e do Meio Ambiente,

Rabinovitch, J. and J. Leitmann. 1993. *Environmental Innovation and Management in Curitiba, Brazil. Urban Management and the Environmen*t. Washington, D.C.: Working Paper # 1.

Redwood, Tovah. Tree Time. *Planning* (September 1994):13-15.

Rodriguez Parris, Luz. 1991. The Hispanic Perspective. In *Proceedings of the Fifth National Urban Forest Conference.*

Sando, Joe. 1991. The Native American Experience. In *Proceedings of the Fifth National Urban Forest Conference*, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Santamour, Frank S., Jr. 1991. The Pros and Cons of Native and Exotic Trees. In *Proceedings of the Fifth National Urban Forest Conference,* edited by Phillip D. Rodbell. Los

Angeles, California: American Forestry Association.

Savedoff, William D. June 1994. AA Review of Indicators Used in Economic Analysis of Projects: Strengths, Weaknesses, and Cautionary Tales@. Project Analysis Department/Project Advisory Office Working Paper No. 107-94. Washington, D.C.: Inter-American Development Bank.

Secretaria Municipal do Verde e do Meio Ambiente. 1993. *A questao ambiental urbana: cidade de Sao Paulo*. Sao Paulo: SMVMA.

Simpson, James R. and Gregory E. McPherson. 1996. Potential of Tree Shade for Reducing Residential Energy Use in California. *Journal of Arboriculture* 22(1):10-18.

Smit, Jac., 1996. Personal communication.

Smit, Jac, Anna Ratta and Janis Bernstein. 1996. Urban Agriculture: Opportunity for Sustainable Cities in Sub-Saharan Africa. Report to the World Bank.

Tejeda Vargas, Carlos. 1995. A Plan for All Reasons: Future Vision for Mexico City. *Business Mexico* (April 1995):6-9.

Tietenberg, T. 1992. *Environmental and Natural Resource Economics*. 3rd. Ed. New York, NY: Harper Collins.

_____. 1996. Private Enforcement of Environmental Regulations in Latin America and the Caribbean: An Effective Instrument for Environmental Management? Washington D.C.: Inter-American Development Bank, Social Programs and Sustainable Development Department, Paper ENV-101.

Tlaiye, L. and D. Biller. 1994. Successful Environmental Institutions: Lessons from Colombia and Curitiba, Brazil. LATEN Dissemination Note No. 12. Washington, D.C.: The World Bank.

Tschantz, Barbara A., Paul L. Sacamano. 1996. Municipal Tree Management in the United States. In *Proceedings of the Seventh National Urban Forest Conference*. Washington D.C.: American Forests.

Ulrich, R.S. 1990. The Role of Trees in Well-Being and Health. In: *Proceedings of the Fourth Urban Forestry: Make Our Cities Safe for Trees* held in St. Louis, MO. Washington, D.C.: American Forestry Association.

United Nations Conference on Environment and Development (UNCED). 1992. *The Global Partnership for Environment and Development: A Guide to Agenda 21*. Geneva: UNCED.

United Nations Development Programme (UNDP). 1996. *Urban Agriculture: Food, Jobs and Sustainable Cities*. New York: UNDP.

Unsoeld, Olaf. 1979. *Analysis of Some Municipal Tree and Landscape Ordinances*. Washing ton D.C.: United States Department of Agriculture.

U.S. Bureau of the Census International Data Base. 1995.

Wagar, J. Alan. 1991. Computerized Management of Urban Trees. In *Proceedings of the Fifth National Urban Forest Conference,* edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Wells, Michael P. 1993. A Summary of the Benefits, Costs and Risks of Using Environmental Trust Funds for Biodiversity Conservation. In *Parks and Progress*, edited by Valerie Barzetti. Washington D.C.: IUCN/IDB.

Wells, Michael, and Katrina Brandon. 1992. *People and Parks: Linking Protected Area Management with Local Communities*. Washington, D.C.: The World Bank.

White, R. 1992. The International Transfer of Urban Technology: Does the North have Anything to Offer the Global Environmental Crisis? *Environment and Urbanization* 4(2):109-120.

Willeke, Donald C. 1991. A True and Full Accounting of the Urban Forest. In *Proceedings of the Fifth National Urban Forest Conference*, edited by Phillip D. Rodbell. Los Angeles, California: American Forestry Association.

Williams, Philip B. AFlood Control vs. Flood Management.@ *Civil Engineering*. (May 1994):51-54.

Wilson, E.O. 1990. Biodiversity. Washington, D.C.: National Academy Press.

Yap, S.K. 1996. Urban planting and biodiversity conservation in Malaysia. In *Proceedings of the Seventh National Urban Forest Conference*. Washington D.C.: American Forests.

Zulauf, W.E. 1996. Legal, institutional, and operational structure of urban green-area systems. Draft document to be published in Procedings of Urban Greening Seminar held at Mexico City December 2-4, edited by Krishnamurthy, L. and J. Rente Nascimento. Mexico: Universidad Aut \noma de Chapingo

Appendix B:
Glossary of Terms

Arboriculture - the planting and care of trees and, to a lesser extent, shrubs, vines and ground cover; focuses on small groupings of trees and plants.

Focus Groups - informal meetings where people freely give their opinions in response to prepared questions or guided discussion.

Greenbelts - large parcels of land in and around cities where urban development is totally prohibited through zoning, public ownership, easements or development restrictions in order to preserve natural aspects of the landscape and/or vegetation.

Greenhouse Effect - the warming of Earth=s surface due to pollutants that form a layer of heat-trapping gasses in the atmosphere, thereby creating a heating effect similar to a greenhouse.

Greenways - narrow vegetated corridors that can have multiple uses and functions such as improving environmental quality, providing recreation, and serving as alternative transportation (bicycle and foot paths). Greenways are often sited along natural systems such as rivers, ravines, ridgelines and floodplains.

Informal Settlements - migrant communities, usually unplanned and unauthorized, where the residents settle without title to their land; often called squatter settlements, slums or illegal occupations.

Nurseries - a location where seeds, seedlings, and mature plants are cultivated in greenhouses or plots prior to being transported to their ultimate planting site (e.g., city park or greenway); good for trees and shrubs as well as herbaceous species.

Pioneer Species - plants that colonize an area in the early stages of ecosystem succession and facilitate the subsequent colonization of transitional or climax species in that area.

Riparian Reforestation - riverside tree planting.

Rural Forestry - planting trees in rural areas principally for wood production and recreation.

Seed Banking - seed-rich topsoil is brought from one site and the seeds within it allowed to germinate and revegetate on a second otherwise barren area; particularly good for wetland species.

Stakeholders - people or groups who directly or indirectly benefit from a green area, such as local residents, businesses, farmers, neighborhood associations, government agencies, nongovernmental organizations, schools, investors and others who share a common interest in the area.

Suburban - areas of mostly-residential urban sprawl on the perimeter of urban centers;

sometimes referred to as Aperi-urban.@

Suburban Forestry - planting and managing trees and other vegetation in suburban or peripheral areas of a city; a mixture of urban and rural forestry.

Urban - settlements of over 20,000 people; cities have over 100,000 inhabitants and big cities have over five million.

Urban Agriculture - food grown within a city or suburban area; produced directly for market or for home consumption and frequently sold by the farmers themselves.

Urban Forestry - planting and managing trees and other vegetation within a city=s limits; focuses on larger groupings of trees and vegetation such as in parks.

Urban Greening - an integrated, city-wide approach to the planting, care and management of all vegetation in a city to secure multiple environmental and social benefits for urban dwellers; projects may involve planting of trees, shrubs, grass, or agricultural plots.

Vegetation - all the plants or plant life of a place, including trees, shrubs, annuals, perennials, grasses, vegetables, weeds and water plants.

Appendix C:
Directory of Projects, Contacts and Organizations

A. Organizations in Latin America and the Caribbean

Municipalidad de la Provincia de Buenos Aires
Ricardo H. Revagliati**
Subsecretario de Medio Ambiente
Gobierno de la Ciudad de Buenos Aires
Carlos Pellegrini 211 Piso 6
Capital Federal, **Argentina**
Phone: 54 1 327-1829 / 326-8040
Fax: 54 1 393- 2190 / 393-2405

Subsecretar Ra de Salud y Medio Ambiente
Salvador Alberto Barroso**
Direcci \n de Programaci \n y Acci \n Ambiental
Av. Velez Sarfield 5016
2300 C \rdoba, **Argentina**
Phone: 54 51 69-6769
Fax: 54 51 69-4975

Alcald Ra Municipal de la Paz
Jaime Cardozo S <inz**
Director de la Unidad de Forestaci \n
Jard Rn Bot <nico
Calle Lucas Jaimes 2073, Miraflores
Casilla 9206. La Paz, **Bolivia**
Phone: 591 2 37-5274/5761
Fax: 591 2 37-5061

German Agency for Technical Cooperation (GTZ) La Paz
Fernando Prado Pino*
Gr <ficos U. Salome C5 No. 524
La Paz, **Bolivia**
Tel/Fax: 591 2 22-5461

Secretaria Municipal do Meio Ambiente
Alfredo Vicente de Castro Trindade, Director of Environmental Planning
Av. Manoel Ribas, 2727 - Merces
CEP 80810-000
Curitiba, Paran< **Brazil**
Phone: 55 41 335-2112
Fax: 55 41 335-5141

Secretaria Municipal do Verde e do Meio Ambiente
Werner Eugenio Zulauf, Secretary*
Av. Paulista 2073,
Piso superior 01311-040
Sao Paulo, **Brazil**
Phone: 55 11 283 25 18
Fax: 55 11 283 11 84

Sociedade Brasileira de Arboriza-ao Urbana (SBAU)
(International Society of Arboriculture: Brazil chapter)**
Maria Alice de Lourdes Bueno Sousa
Departamento de Horticultura, Faculdade
de Ciencias Agron \micas
UNESP CEP 18603-970
Botucatu, SP, **Brazil**
Phone: 55 14 921-3883
Fax: 55 14 921-3438

Notes: This society is perhaps the largest urban forestry society in Latin America and the Caribbean. The society holds an annual conference on urban forestry.

Universidade Estudual Paulista
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Facultad de Ciencias Agron \micas
Campus de Botucatu
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Phone: 55 14 822-1698
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Universidad de Sao Paulo Secretaria do Verde e Meio Ambiente (SVMA)

Arlindo Philippi, Jr., Coordinador*
Department of Environmental Education
and Planning
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CEP 01311 940 Sao Paulo
Sao Paulo, **Brazil**
Phone: 55 11 282-3842 / 853-0681 / 284-1737
Fax: 55 11 852-9630

Universidade Livre do Meio Ambiente
Cle \n Ricardo dos Santos**, Director Executivo
Rua Victor Benato, 210- Pilarzinho
82.120-110 Curitiva-PR-**Brazil**
Phone: 55 41 254-5548
Fax: 55 41 335-3443

Ministerio de Vivienda y Urbanismo
Sergio Le \n Balza**
Asesor Sr. Ministro de Vivienda
y Urbanismo Programa de Parques Urbanos
Alameda 924 piso 4o. Santiago, **Chile**
Phone: 56 2 633-7829 / 639-6448
Fax: 56 2 639-7370

Ornato, Parques y Jardines
Ximena Olivia Ureta, Directora**
Santo Domingo No. 916, piso 8
Santiago, **Chile**
Phone: 56 2 630-8036 / 630-8043
Fax: 56 2 639-6017

Municipalidad de ViZa del Mar
Waldo Ceballos Ibarra, Chief of Parks and Gardens*
El CiprJs 2628 Depto 13. Miraflores
ViZa del Mar, **Chile**
Phone: 56 32 97-7120
Fax: 56 32 97-8360

Corporaci \n Regional Cundinamarca
Alfonso Herr<n, Subdirector Planeaci \n
Calle 10/**, N/ 1**6**-8 2,6 / Piso**
Bogot<, Colom bia
Phone: 57 1243 -8 506

Departamento de Medio Ambiente
Eduardo Uribe Botero, Director*
Cra. 5 # 26 A 47 apt. 1701
Bogot<, Colombia
Phone: 57 1 338-3643 /337-7710

The Urban Agriculture Network
Jorge Zapp**
Calle 114 # 28-68 Ap. 201
Bogot<, Colombia
Phone/Fax: 57 1 612-3883
jzapp@hotmail.com
jzapp@impsat.net.co

Municipalidad de Bucaramanga
Carlos Ibaez Muoz, Mayor**
Calle 35 No. 10-43
Oficina 204 Segundo Piso
Bucaramanga, Santander, Colombia
Phone: 57 76 33-4208 /33-7808
Fax: 57 76 52-1777

Ayuntamiento del Distrito Nacional
Rafael Castillo**
Director de Foresta y Medio Ambiente
Ayuntamiento del Distrito Nacional
Fray Cipriano de Utrera
Centro de los Hjroes, Urb. La Feria
Santo Domingo, Repdblica Dominicana
Phone: 809 535-2222
Fax: 809 535-9184
Fundaci\n Natura
Wania Cobo, Executive Regional Director*
Av. America 5653 y Voz Andes
Quito, Ecuador
Phone: 593 2 44-7341
Fax: 593 2 43-4449

Alcaldra Municipal de San Salvador
Oscar Valle Flores**

Gerencia de Parques y Zonas Verdes
Despacho del Sr. Alcalde
Alameda Juan Pablo II
y Av. Cuscatancingo
San Salvador, Repdblica de El Salvador
Phone: 503 242-3163 / 221-1581
Fax: 503 222-8223 / 222-8670

Municipalidad de Guatemala
Axel Velasquez**
Divisi\n de Parques y Areas Verdes
Palacio Municipal. 21 calle 6-77, Zona 1
Guatemala, Guatemala
Phone: 502 2 38-3770

Fundaci\n de Parques Nacionales
Analyda Melara de Franconi**
Parques Naciones Unidas AEl Picacho@
Apartado Postal No 20403
Comayagela, Honduras
Phone: 504 21-9126
Fax: 504 21-9127

Municipalidad de San Pedro Sula
Gerardo Francisco Nuñez**
Director del Ambiente
Departamento de Cortés
1ª Calle 5ª Avenida. Barrio las Palmas
San Pedro Sula, Honduras
Phone: 504 56-8432
Fax: 504 56-9191/57-2844

Comisi\n de Recursos Naturales
Adolfo Uriel Gonzálex Monz\n
Av. Adolfo Ruiz Cortines 3331
Mexico City, Mjxico **10200**
Phone: 525 683-2784 Ext.107

Comisi\n de Recursos Naturales (CORENA)
Jorge Gonzalez Claveran*
Planeaci\n Urbana

Georgia 1633-1 Col. Nápoles, México
Distrito Federal
Phone: 52 5 687-3347/669-3931
Email: JCLAVER@IPN redipn.M

Gobierno del Estado de México (GEM)
Leopoldo Pedraza Ceron*
Delegado Regional en Texcoco
Secretaría de Ecología
Coordinación General de Conservación Ecológica
Independencia 1110 a
Colonia Independencia,
C.P. 50070 Toluca, Estado de México
México
Phone/Fax: 52 72 14-5027

Municipalidad de Managua
Ren J Quesada Prado
Asesor del Alcalde de Managua**
Complejo Cívico. Apartado Postal No 141
Managua, Nicaragua
Phone: 505 2 65-0048 /65-0049
Fax: 505 2 65-0051/65-0620
505 2 65-1101

Municipalidad de Panamá
Tomás Vazquez**
Director de Ornato y Medio Ambiente
Despacho de la Alcaldesa
Avenida B y Calle 15
Apartado 5033, Panamá 1, Panamá
Phone: 507 262-7336 /262-5738
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Municipalidad de Lima
Arnold Millet Luna**
Director Municipal de Servicios a la Ciudad
3er, piso del Palacio Municipal
Lima, Perú
Fax: 511 433-5722 /426-0950

International Institute of Tropical Forestry
Nancy Robin Morgan*
United States Department of
Agriculture Forest Service
State and Private Forestry (USDA)
P.O. Box 25000 San Juan
Puerto Rico **00928-5000**

Intendencia Municipal de Montevideo
Alberto Ortega**
Director General Departamento de
Acondicionamiento Urbano
Av. 18 de Julio y Ejido No. 1360 3er piso
C.P. 11200 Montevideo, Uruguay
Phone: 598 2 91-2876 / 91-4992
Fax: 598 2 91-7981/98-4595

Municipalidad de Mérida
Rigoberto Colmenares Moret, Alcalde**
Municipio Libertador
Av. Urdaneta, al lado Colegio de Médicos
Mérida, Venezuela
Phone: 58 74 63-8284
Fax: 58 74 63-1977

B. Organizations in Other Countries (except U.S.A.)

Danish Forest and Landscape Research Institute
Kjell Nilsson*
Urban Forestry
Horsholm Kongevejll,
DK 2970 Hoersholm, Denmark
Phone: 45 4576-3200 / 45 4576 3283
Email: KJN@FSL.DK

National Urban Forestry Unit
Nerys Jones, Executive Director
Red House, Hill Lane, Great Barr
West Midlands, England **B43 6LZ**
Phone: 0121 358-1414

Fax: 0121358-7045

Food and Agriculture Organization of the United Nations (FAO)
Susan M. Braatz and Jane Carter
FAO, Room B-367 bis
Viale delle Terme di Caracalla
Rome 00100, Italy
Phone: 39 6 5225 3902

***Notes*: FAO started developing its urban forestry program in 1990 and has produced an annotated bibliography on urban forestry in developing countries as well as an issues paper on the subject.**

Ireland's National Youth Environmental Organisation
Kevin D. Collins, M.Agr.Sc.(Forestry)
Community Forestry Officer
39 Fleet Street
Dublin 2, Ireland
Phone: 353 1679-9673
Fax: 353 1679-4129

Environment, Urban Development Department
Debra Roberts, Manager
Physical Environmental Service Unit
P.O. Box 680
Durban, South Africa
Phone: 27 31 300-2527
Fax: 27 31 300-2225

C. Organizations Based in the United States

Greenbelt Alliance
Jim Sayer, Executive Director
116 New Montgomery Street, Suite 640
San Francisco, CA **94105, USA**
Phone: 415 543-4291

Urban Ecology

Kim Traber, Office Manager
405 14th St., Suite 701
Oakland, CA 94612
Phone: 510 251-6330
Fax: 510 251-2117
E-mail: UrbanEcology@IC.APC.org

American Forests
Gary Mall
Urban Forestry Program Director
1516 P. St. NW
Washington, DC 20005
Phone: 202 667-3300
Fax: 202 667-2756

Notes: American Forests is the oldest national citizen conservation organization in the United States. The association has developed techniques and computer software for measuring urban forests and for inventorying urban trees. The AF's biannual conference is the largest urban forestry conference in the United States and will be held next in 1997. AF has 112,000 members.

Cool Communities
Cool Communities Coordinator
P.O. Box 2000
Washington, DC 20021-2000
Phone: 202 667-3300

Global Releaf, International
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National Tree Trust
Sharon G. Bailey, Program Director
1120 G. Street, N.W., Suite 770
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Urban Agriculture Network (UAN)
Jac Smith, President
1711 Lamont St. NW
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International Society of Arboriculture (ISA)
Jim Skiera, Vice President
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Savoy, IL **61874-9902**
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Urban Forestry Institute
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***Notes*: The Institute conducts research on urban forestry in the United States and developing countries.**

USDA Forest Service
David J. Nowak, *
Urban Forest
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International Society of Tropical Foresters (ISTF)
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Bethesda, MD **20814**
Phone: 301 897-8720
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Parks and Recreation Department of Oklahoma

Joe Roberts
City of Tulsa
1712 West Charles Page Blv.
Tulsa, OK **74127**
Phone: 918 596-7871

Department of Public Works,
Division of Forestry, City of Milwaukee
Richard Meyer, Lead Forester
841N. Broadway, Room 804
Milwaukee, WI **53202**
Phone: 414 278-3595
Fax: 414 286-8097

Waukesha Parks and Recreation Department, City of Waukesha
Dave Liska, Head Forester
201 Delafeld St.
Waukesha, WI **53188**
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School of Natural Resources: Urban Forestry Department
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College of Natural Resources: Urban Forestry Department
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Stevens Point, WI **54481**
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****Participant at the same seminar.**