ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY
WORKING PAPER SERIES

Working Paper No: APFSOS/WP/44

URBAN FORESTRY IN THE ASIA-PACIFIC REGION: STATUS AND PROSPECTS

by

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August 1998

The Asia-Pacific Forestry Sector Outlook Study is being undertaken under the auspices of the Asia-Pacific Forestry Commission.

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INFORMATION NOTE ON ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY

At its sixteenth session held in Yangon, Myanmar, in January 1996, the Asia-Pacific Forestry Commission, which has membership open to all governments in the Asia-Pacific region, decided to carry out an outlook study for forestry with horizon year 2010. The study is being coordinated by FAO through its regional office in Bangkok and its Headquarters in Rome, but is being implemented in close partnership with governments, many of which have nominated national focal points.

The scope of the study is to look at the main external and sectoral developments in policies, programmes and institutions that will affect the forestry sector and to assess from this the likely direction of its evolution and to present its likely situation in 2010. The study involves assessment of current status but also of trends from the past and the main forces which are shaping those trends and then builds on this to explore future prospects.

Working papers have been contributed or commissioned on a wide range of topics. They fall under the following categories: country profiles, selected in-depth country or sub-regional studies and thematic studies. Working papers are prepared by individual authors or groups of authors on their own professional responsibility; therefore, the opinions expressed in them do not necessarily reflect the views of their employers, the governments of the Asia-Pacific Forestry Commission or of the Food and Agriculture Organization. In preparing the substantive report to be presented at the next session of the Asia-Pacific Forestry Commission early in 1998, material from these working papers will be an important element but will be blended and interpreted alongside a lot of other material.

Working papers are being produced and issued as they arrive. Some effort at uniformity of presentation is being attempted but the contents are only minimally edited for style or clarity. FAO welcomes from readers any information which they feel would be useful to the study on the subject of any of the working papers or on any other subject that has importance for the Asia-Pacific forestry sector. Such material can be mailed to the contacts given below from whom further copies of these working papers, as well as more information on the Asia-Pacific Forestry Sector Study, can be obtained:

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ACKNOWLEDGEMENT

This Working Paper on urban forestry in Asia and the Pacific is a voluntary contribution to the study, written by Dr Guido Kuchelmeister of TREE CITY, a Initiative based in Germany. It is a highly valuable input in a new area of sector growth potential. FAO wishes to express to Dr Kuchelmeister and TREE CITY its gratitude and appreciation.

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ACRONYMS

ADB	Asian Development Bank
CIFOR	Centre for International Forestry Research
DENR	Department of Environment and Natural Resources, Philippines
FAO	Food and Agriculture Organization of the United Nations
FRA2000	Global Forest Resource Assessment 2000
FRIM	Forest Research Institute of Malaysia
ICLEI	International Council for Local Environmental Initiatives
ICRAF	International Centre for Agroforestry
IDB	Inter-American Development Bank
IDRC	International Development Research Centre
IIED	International Institute for Environment and Development
IFF	Intergovernmental Forum on Forests
IUCN	International Union for the Conservation of Nature
LGU	Local Government Unit
MMDA	Metropolitan Manila Development Authority
NGO	Non-Governmental Organization
PG	Philadelphia Green
SALT	Sloping Agricultural Land Technology
SGUA	Support Group on Urban Agriculture
SURD	Australian-Indonesian Centre for Sustainable Urban and Regional Development
UNDP	United Nations Development Programme
UNCHS	United Nations Centre for Human Settlements (HABITAT)
WRI	World Resource Institute

HIGHLIGHTS

In the next decade, the Asia-Pacific region, which does not yet have an urban society, will become predominantly urbanized. For the first time in its history, rapid growth of population and its concentration in cities around, constitutes the crucial element affecting the long-term outlook for the people in the region and beyond. For better or for worse, the development of contemporary societies in the region will depend largely on understanding and managing the growth of cities.

The greatest challenge is the current “urbanization of poverty”. In resource-poor cities, and in poor neighbourhoods even in wealthier cities, the most threatening environmental problems are usually those close to home. Already straining under the pressures of meeting their peoples' needs for housing, jobs and basic services, cities must also address the environmental and social consequences of rapid urbanization. Consequently, urban development must be a major concern in development cooperation for the next decade.

The present trend towards urbanization in the Asia-Pacific region generates many unintended impacts on rural areas. If only for this reason, rural development policy, including forestry, needs to take into account the negative and positive aspects of urbanization.

This working paper examines the present status and the outlook of urban forestry in the Asia-Pacific region. The paper is deliberately biased towards urban forestry: (i) in poorer cities and vulnerable groups; (ii) in a more restricted scope, i.e. trees within the built environment and (iii) promising innovative approaches relevant to the region.

In this paper “urban greening” is used as a comprehensive term, comprising all urban vegetation management (green spaces or urban vegetated areas) including farming and forestry. Urban forestry is defined as the planning and managing of trees, forests and related vegetation to create or add value to the local community in an urban area.

Multipurpose urban forestry with a focus on the poor is still in its infancy. However, many local initiatives are evolving rapidly. Although many cities in the region have some kind of urban forestry programmes, little technology transfer, research and information exchange occurs in the region. International forestry circles are conspicuously inactive in urban development.

The urban forest is one of the resources of an urban area; it is part of the urban infrastructure and is integral to the quality of life of its residents. In poorer cities, urban trees and forests can directly meet basic needs including food, fuel, fodder and timber - products which remain important for the poor in many developing country cities. Social benefits of urban trees and forests relate to health, employment, education, recreation, aesthetic and landscape benefits, and community strengthening. Environmental services of urban forests are climate and air quality improvement, energy savings, reduction of global warming and carbon dioxide, noise abatement, water use, reuse and conservation, soil conservation, solid waste and land reclamation, and nature conservation - wildlife habitat and biodiversity. The relative importance of these functions varies for each city.

Major challenges to urban forest development are: inadequate appreciation of the economic value of the urban forest; institutional deficits including insufficient local participation; ecological and technical constraints of the urban environment; legislation, tenure and custom; sustaining funds for urban forests, and above all limited integration of forestry in urban planning and development.

Basic requirements for sustained urban forestry development include strengthening local capacity, securing social and political support, an appropriate legal framework, institutional flexibility, technical viability and environmental sustainability and financial and economic viability.

The contention of this review is that integrating natural and built environments is a key element of the strategy of making the region's cities more liveable. As the pressure to further develop open space continues, existing and future urban forests will take on an ever-increasing role as a necessary component of the urban landscape. In the search for making cities more sustainable for the 21st century, the outlook for urban forestry is promising.

Better integration of multipurpose urban trees and shrubs in urban design and urban development initiatives can significantly improve the quality of life, especially of vulnerable groups. To develop and sustain urban trees and forests in low income cities of developing countries, forestry must initially focus on meeting immediate needs for basic necessities. This can be best achieved by multiple resource use.

The overall benefits of urban forests are such, that it can be predicted that urban forest resources in the year 2010 will be regarded as a vital component of the urban infrastructure essential in maintaining a liveable and sustainable environment in the region. Forestry and related professionals can actively facilitate local initiatives to mitigate urban problems or risk to become a marginal professional group in development cooperation in the region in the next millennium.

Basic recommendations with regard to boosting urban forestry in the region are: (i) strengthening of rural-urban linkages; (ii) supporting and strengthening local urban forestry initiatives, especially those of vulnerable groups; (iii) allocating significant resources to multipurpose urban forestry (iv) protecting, rehabilitating and planting urban forests; (v) building into monitoring and evaluation systems of healthy cities urban greening related indicators; (vi) integrating urban forestry into urban development projects, (vii) facilitating long term sustainability of urban forestry investment; (viii) encouraging the use of a wide variety of multipurpose species; (ix) giving greater priority to research into participatory urban forestry and its functions; validation of urban forests, multipurpose trees and shrubs; (x) greatly increasing training opportunities and developing curricula and training materials; (xi) providing multiple sources of finance with strong participation of the private and non-governmental sector; (xii) incorporating tree budgets into regular municipal budget lines; (xiii) promoting the creation of urban greening research and development networks (national and regional level).

In all the above areas, external support would be valuable whether among developing countries or between them and traditional donors and technical assistance agencies in the developed world. The development cooperation community is therefore encouraged to extend its forestry sector attention significantly beyond rural areas towards the growing cities.

1. INTRODUCTION

In many developing country cities, the focus of urban forestry must be on contributing to fulfilling the immediate requirements for basic products. Less essential, yet also important, is urban green space for recreation. Forests need to respond to the wide range of needs by optimising combinations of locally accepted priorities, values and expectations.

The value of the forest is increasingly recognised as extending beyond rural areas and so trees must become compatible with and functional in the urban environment. This working paper examines the present status and the future prospects of urban forestry in the Asia-Pacific region. The objective is to make policy makers, foresters, urban planners and general public more aware about the essential role which urban greening can play to make cities more liveable, particularly in resource-poor settlements.

The paper is deliberately biased towards (i) urban forest needs of poorer cities and vulnerable groups; (ii) urban forestry in a more restricted scope, i.e. trees within built environments and (iii) promising innovative urban forestry-related approaches relevant to the region. This paper provides basic information on the benefits, challenges and approaches and requirements of planning, managing and conserving urban forests.[1] Urban forestry is not yet really recognised as a development issue probably due to ignorance; therefore much more in-depth information on the state-of-the-art in the region is required.

1.1 The phenomenon of urbanization in the region

Asia will be predominantly urban in the future. While most attention is given to mega-cities, the process of urbanization affects all cities. Urban areas of all sizes have important roles to play. Hence, urban policy should not necessarily concentrate on cities of any specific size. The development focus should be on poor cities and on poor people in more affluent cities.

Urbanization is a global phenomenon, although the degree of urbanization and the rate of urban growth vary in different parts of the world.[2] In 1975, only 38% of the world's population was urban. 25% of the people in Asia were urban. However, in Oceania already more than 70% were urban dwellers. In 1995 the world's urban population increased to 45% and in Asia to 35%. Currently the region is still less urbanized than North Africa (75%), Europe (73%) or Latin America (78%). It has the same level of urbanization as Africa (34%).

Globally, between 1990 and 2025, the number of people who will live in urban areas is expected to double to more than 5 billion people; about 90% of this growth will occur in the developing world (WRI 1996). The Asia-Pacific region will undergo a dramatic change from rural to urban; the trend will continue for several decades (Figure 1, and Annex 1). In the least

[1] The author appreciates very much the assistance and critical review by A. Widanapathirana, Social Forestry Expert, New Zealand, Ceceil Kronijnendijk, Urban Forestry Researcher, European Forestry Research Institute, Finland, Mr. Richard C. Lair Bangkok, and Mr. M. Chipeta, Michelle Gauthier, and other FAO staff.

[2] Urban area is the built-up or densely populated area containing the city proper; suburbs, and continuously settled commuter areas. The definition of "urban area" varies from country to country, e.g. in the USA most conservative delineation of urban land requires a population density of 620/km^2 (Rowntree 94). In India urban areas have 5,000 inhabitants and in Malaysia 10,000 respectively . (WRI 1996).

developed countries (Nepal, Bangladesh), urban growth rates are among the highest. Growth rates are also extremely high in the rapidly industrializing cities, located mostly in Southeast Asia (WRI 1996). Already, ten of the world's larger mega-cities (with populations of 10 million or more) are in Asia; by 2015, the world will have 27 mega-cities of which 17 will be in Asia.

While attention is often focused on the world's mega-cities, they contain a relatively small proportion of all urban dwellers. Today, only about 15% of urban dwellers live in cities of more than 5 million people, while over 60% live in towns and cities of one million inhabitants or fewer (ADB 1996). Indeed, many intermediate-size cities (with populations of between 1 million and 10 million) may actually be growing faster on average than the largest cities, at rates well over 5% per year. Small cities are often especially affected by inadequate investment in environmental infrastructure or services, because many countries direct their resources to the larger urban centres (WRI 1996).

Urban migration might account for between 40 and 60% of annual urban population growth and will be particularly significant in rapidly industrializing regions such as Asia and parts of Africa. China, for example, may see 200 million more rural labourers looking for work in the cities over the next decade (ADB 1996).

1.2 Urbanization of poverty

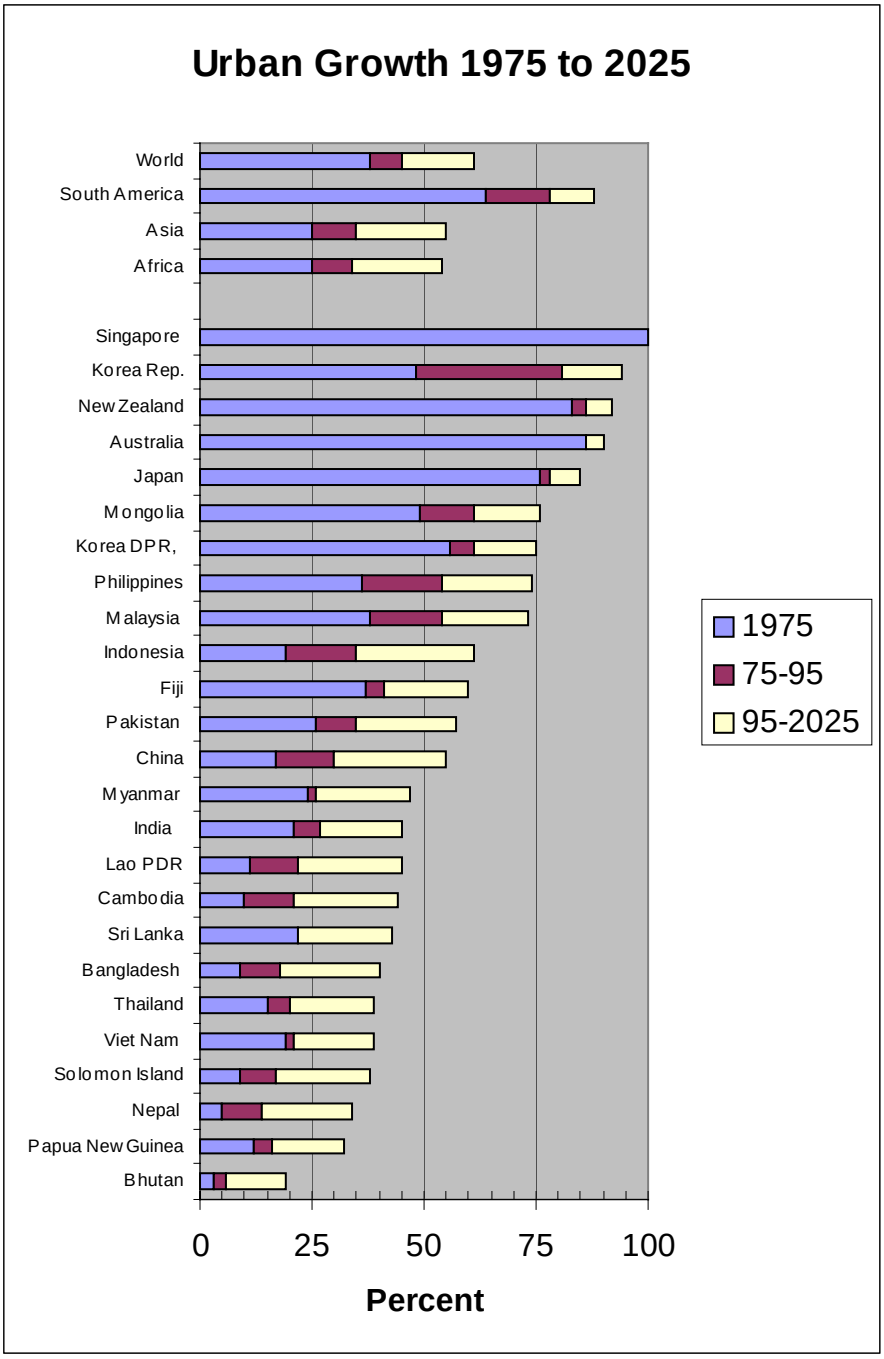
Historically, poverty has been concentrated in rural areas but is increasingly also becoming an urban phenomenon. In Asia, large decreases in the proportion of the population living in poverty have been reported for the rapidly growing economies but South Asia is expected to continue to contain a large share of the world's urban poor.

The urbanization of poverty has implications for the urban environment and for the quality of life of the poor, who usually reside on marginal and environmentally sensitive land.

1.3 Urbanization and the environment

Urban areas generate environmental problems felt at all levels from the household to the globe. These problems range from impairment of human health, economic and other welfare losses, to damage to ecosystems. Air and water pollution and hazardous waste generation are among key problems; conversion of open space and agricultural land to urban development is another problem. Urbanization can reduce water permeable areas, upset natural drainage patterns, and cause serious flooding.

Figure 1. Urbanization trends in the Asia-Pacific Region



One of the most important determinants of a city's environmental problems is its income level. As the wealth of a city grows, many types of environmental degradation first increase and then eventually diminish.

2. URBAN FORESTRY DEFINED

The broadest definitions regard urban forests as the entire area influenced and/or utilised by the urban population.[3] According to such definitions, urban forests include natural woodlands within the zone of influence of urbanization that traditionally is the realm of rural forestry. Some believe that urban forestry's main focus has to be on the portion of the forest found within the built environment and that the task of urban forestry is to make trees compatible and functional in an urban environment.

This paper uses **urban greening** as a comprehensive term comprising all urban vegetation management (green spaces or urban vegetated areas) including farming and forestry. **Urban forestry** is considered **as planning, management and conservation of trees, forests and related vegetation to create or add value to the local community in an urban area**.[4] This narrow definition includes all trees and related vegetation in and around places where people live and deliberately focuses on trees in the built environment and excludes urban farming in the sense of food production occurring within settlements. Although urban forest comprises natural woodlands within the zone of influence of urbanization (covered by conventional forestry) the focus here is on the urban forest found within the built environment.

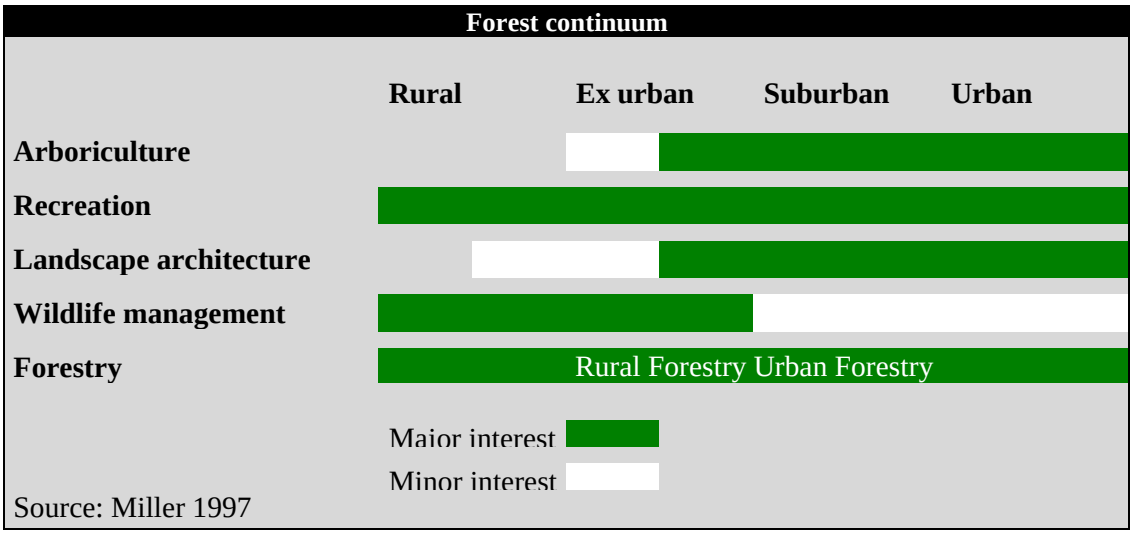
In the wealthier developed countries, urban forestry focuses on amenities and environmental benefits (Nilsson & Randrup 1997). In poorer countries urban forestry must first pay attention on assisting in fulfilling basic necessities (Kuchelmeister 1997, Lanly 1997).

While acknowledging the need for continuity with rural forestry, it would be a mistake to fit urban forests into established forestry models: urban planning and zoning systems must provide the framework in which forestry for cities should be considered.

[3] For example, see definition by Dunster & Dunster 1996. The question whether the urban forest should extend beyond the edge of urbanized areas is somewhat problematic. There have been liberal interpretations of the distance over which urban activities influence forests, but these do not justify the application of a new label to forests that can be understood and managed using accepted concepts and methods (Rowntree 1994).

[4] **Urban areas** are those areas where people live and work. it is the built-up or densely populated area containing the city proper; suburbs, and continuously settled commuter areas. There are great differences among countries in the definition of what constitutes an urban place (ref. to Footnote 2). Since the line between rural and urban areas is arbitrary, it can be hardly drawn, and, worse, it is in a flux, no distinctions between urban and peri-urban forestry is suggested anymore (Tinker 1994). **Communities** are socially identified groups (Coder 1996), they are first of all interest groups or organizations with declared issues. The community is not a homogeneous group and certainly not a spatially or temporarily fixed group, their boundaries change with issues (and it is issues that make the glue to hold the community together) (IUCN 1994). **Values** are always associated with a combination of tangible and intangible qualities people appreciate.

Figure 2. Relationship of various resource professions to the forest continuum



The types of urban forest range from undisturbed natural woodland to open areas nearly void of trees. The urban forest is also in a constant state of flux.

For many decades urban forestry has struggled for an identity separate from that of arboriculture and horticulture.[5] Urban vegetation management is still being debated as to whether it falls within the scope of landscape horticulture or forestry. Although arboriculture traditionally focuses on the management of individual trees and urban forestry on tree populations, the lines between the two have blurred (Ball 1997).[6] A further confusion arises because many urban foresters use "urban greening" and "urban forestry" interchangeably (Kuchelmeister 1997). The prevailing relationship of various professions on the rural-urban forestry continuum is presented in Figure 2.

Urban forestry is a modern approach to urban tree management encompassing long-term planning, interdisciplinary professional coordination and local participation. It is aimed at securing the ongoing health and vitality of the urban forest, and hence, the sustained delivery of benefits for both current and future generations of urban dwellers.

[5]One reason for the merely modest urban forestry research programme in Los Banos, Philippines is that urban vegetation (forestry) management is still being debated as to whether falling within the scope of landscape horticulture and not forestry (Palijon 1997).

[6]Arborists manage individual trees and urban foresters manage tree populations; at an individual tree level urban forestry and arboriculture are synonymous (Miller 1989).

3. ROLES AND IMPORTANCE OF URBAN TREES AND FORESTS

The benefits of the urban forest are such, that the overall urban forest can be regarded as a vital component of the urban infrastructure essential in maintaining a liveable and sustainable environment.

Urban trees and forests can contribute immensely to the quality of life in towns and cities in the region. In low-income settlements the most important benefits of the urban forest may be directly productive ones such as supply of building materials, fuelwood and even fodder. Many other functions are environmental, including protection of water-supply catchments for the cities, protection against landslides, climate mitigation. Yet others are aesthetic - the beauty and the room offered for recreation. Some roles cannot be quantified in money terms but this does not mean they are any less important.

Annex 2 presents forest and tree roles in urban areas in some detail; this should be treated as a checklist and not in any way as implying that all the functions are important in all circumstances or equally important at any one time in all cities. For example, as cities become more wealthy, the relative importance given to aesthetic functions may grow, and value as sources of fuelwood may tend to decline.

4. STATUS OF URBAN TREES AND FORESTS IN THE REGION

4.1 Regional overview of urban forest resources

There is a paucity of information about the situation of the urban forest resources in the poorer cities and countries of the region. While cities like Singapore, Kuala Lumpur and many cities in China have increased the urban forest cover, other cities have failed. There is much scope for increasing urban forests, provided social and political support is given. There is a need for more data on urban tree cover to aid urban planners and managers in determining the extent and distribution of the city's vegetation resource and its associated cost and benefits. Urban forest resource assessments should also be included in global monitoring efforts like FAO-executed global Forest Resources Assessment for the year 2000 (FRA2000).

Urban forestry in the region is underdeveloped and not well organised, especially in less developed countries (examples for Pacific see Box 1). There is little exchange of information and cooperation; country reviews hardly exist for less developed countries or are outdated.[7] While many wealthier cities, have ambitions urban greening plans, like Tokyo (Box 2), in most of the less developed countries trees have not been integrated into urban planning and design. The city of Chandigarh is a notable exception (Box 3).

Data on urban tree cover can aid urban planners and managers in determining the extent and distribution of the city's vegetation resources and their associated cost and benefits. However, there is a dearth of information of green space area in developing countries (Kuchelmeister

[7]Good references are found in FAO 1995, country reviews for Brunei, Fiji, Singapore, Solomon Islands, Hong Kong, India (Andresen & Plexman 1980), Australia (French & Sharpe 1976, Gray 1988, Moore. 1993), India (Tewari, 1994). Japan (RIN 1983), Brunei (Dayang Haktu 1989), Fiji (Williams 1980) Singapore (Lee 1985, Yu 1983), Pakistan (Sheikh 1976) on China two national workshops are available in Chinese (Li 1998).

1991). There is only incomplete global and regional information on the status of urban forests; few efforts exist to compile and synthesise it. For instance, in many cities and municipalities in the Philippines, green spaces are not mapped out. Tree population and tree canopy areas are also unknown. Often, information on green spaces includes only public green space (Palijon 1997). Problems related to urban greening resource assessment are: (i) in most cities in developing countries no comprehensive inventories exist; (ii) only data on urban forests managed by the government are collected; (iii) definitions and classifications of urban forests vary between countries and cities; (iv) definitions of urban areas vary as well and are changing.

The most recent information compiled by FAO about the global forestry situation, under the global "Forest Resource Assessment" of 1990 has not included urban forests and neither does the planned assessment for the year 2000 (FRA2000) (Singh 1997). The limited information available suggests, however, that the poor cities in the region are far from the international minimum standard set by WHO of 9 square meters green open space per city dweller. Cover of green space ranges from totally neglected to more than 25%, with a great variation (Table 1). Some situations stand out:

- **Tokyo** has a large forest of 21,630 ha to conserve water. The city management started planting many treeless areas more than 100 years ago. Now its forest management systems have changed to multi-storied forests from single-storied to improve water conservation. Hannou City, one hour from Tokyo, includes many artificial forests that covered 84% of the city area in 1990 (Yuji 1995).
- A study of 439 **Chinese cities** in 1991 shows that the overall green space was 380,000 ha or 20.1% of the urban area. Some 40% of the cities have more than 30% green cover (Su & Profous 1993). By the end of 1996, greening coverage in China's cities was 23.8% (Li 1997).
- **Beijing** aims to increase its green space to 40% by the year 2010 (Shan 1994).
- Since 1994 some 34 million trees have been planted in and around **Nanjing city**, China, 23 trees per inhabitant (Carter 1993).
- **Manila** aims to achieve a tree-to-person ratio of one to four (Palijon 1997).

In the region much "incidental greening" occurs (Furedy 1990) such as through deliberate retaining and planting of urban green. A great portion of urban greening falls under urban farming, which in many developing cities easily amounts to 50% of the total urban area (Smit 1997).

4.2 Rural/urban forestry interface

There is wide recognition that urbanization generates many unintended impacts on rural areas and that rural development policy frameworks should be broadened to include negative and positive aspects of urbanization. It is important to encourage the strengthening of mutually beneficial local rural-urban linkages.

The International Colloquium of Mayors - part of the International Conference on Governance - concurred that policy approaches to many urban-related issues, such as rural-urban migration, are beyond municipal and urban boundaries. For example, quite often, rural development investments are made in an ad hoc manner which only generate increased rural

migration into urban areas. Investments also tend to ignore opportunities in peri-urban areas and linkages between rural and urban areas, frequently contributing to increase competition and contrasts between them.

Table 1. Urban green space resources

Country/City	Green space % of total city	m^3/per capita (year)	Comments (Reference)
Australia Melbourne (residents) Melbourne (day-time pop.)	 17.80% 17.80%	 163.3 m^2 (97) 16.3 m^2 (97)	Daytime population is 400,000 and residential 40,000 only); Figure refers to parkland, garden and recreational reserves (Stokie 98)
China Average Beijing Hong Kong Hong Kong excl. country parks	 23.8% 28 (1994) 39.2%(97) 1.5% (97)	 5.7m^2 (96) 6.3 m^2 66.0 m^2 2.5 m^2	 Public parks and other green space Li 1997 increase to 40% by year 2000 (or 8 m^2/inhabitant (Shan 1994) (Jim 1998) (Jim 1998, Chan 1988)
India, Mean Bombay		 0.003 (80s) 0.12 m^2	Unclear if it refers to public green space (Andresen/Plexman 1980) (Pye-Smith 1996)
Indonesia Jakarta		 0.22 $m^{2(}$(86)	 Parks/per capita (Ait 1998)
Japan Takatsuki City urban forests Tokyo Metropolitan Area	 84% (1990)	 4.52 m^2	 5,000 ha (Yuji 1995) refers to parks, planned to increase to 6 m^2 (Box 1.)
Korea South Seoul	 25.2%	 14.57 m^2 (96)	 Public green space (Park 1997)
Malaysia Kuala Lumpur	 5%	 2.25 m^2 (97)	 Public green space (Adnan 1998)
New Zealand Christchurch	 12.2%	 0.018 m^2 (97)	Public green space, mainly sport fields with border trees (O'Reilly 1998)
Singapore	17.8%	7.5 m^2 (97)	Public parks and open space, increase to 8 by year 2000 and finally to 18 ha/capita (Yuen 1998
Sri Lanka Colombo	 4.4%		Green spaces 2.4% private (golf course etc.) and 2.0% public (municipal parks etc.) (Wickramasinghe 1998)
Thailand, Bangkok Metropolitan Area		 1 m^2 (97)	Planned to increase to 4-5 m^2 by the year 2000 (Charmniern 1998)
Latin America & Caribbean		3.5 m^2 (96)	(IDB 1997)
USA	30%		0.4 to 55% urban tree canopy (Nowak et al 1996)

Many rural forests at the urban fringe of today are threatened by urbanization in the region. The growing interface and inter-zone problem of turning rural forests into urban forests poses a great threat to not only the residents but the environment. Therefore planning and implementation in rural forestry needs to take urbanization into account.

There is need for foresters to participate in current dialogue on how to improve urban-rural relationships.[8] Among other things, it is important to recognise that the integrity of an urban forest may depend on the surrounding green spaces. It may require green corridors to connect urban green spaces to larger rural forests, allowing plant and animal species in the city to maintain contact with the larger rural population (Nillson & Randup 1996).

5. CURRENT EFFORTS TO MANAGE URBAN TREES AND FORESTS

The most innovative multipurpose urban forestry approaches are not yet widely implemented in the Asia-Pacific Region; however, they clearly demonstrate the urban forestry concept in action and indicate the direction urban forestry will develop.

5.1 Examples of urban forestry practices

In addition to more traditional urban forestry practices like street trees for beautification and parks for recreation, innovative urban forestry practices or a combination of practices and integration of urban forestry practices with urban agriculture and other urban services are evolving in the region.

5.1.1 Peri-urban plantations

Forestry plantations in peri-urban areas have tradition in the region. Most of them have been planned under the framework of rural forestry projects, some of them with the objective to respond to the pressure and needs of urban dwellers. Over the last decades more plantations have used multipurpose trees, with a focus on fuelwood and timber production.

Recognizing that deforestation in and around arid urban areas is closely related to fuel (energy) requirements, plantations with the aim top produce fuelwood adjacent to or in close proximity to population centres were promoted to meet urban fuelwood demands. However, such urban related plantations (usually of exotic species) with few notable exceptions, such as Ethiopia, have not improved fuelwood supply. Often, instead of fuelwood more lucrative poles were produced or poor people did not have sufficient income to buy fuelwood. There is a trend to resolve this paradox by implementing a mixture of agroforestry plantations and improve natural forest management, often managed by small holders. In some cites progress has been made in incorporating timber harvesting and related forest products with intensive outdoor recreation activities in urban forest (Kuchelmeister 1989).

[8] For instance, an International Workshop on Rural-Urban Linkages, organized by the United Nations Development Programme (UNDP), the Government of Parana State and supporting UN agencies, including UNCHS/Habitat is such an opportunity. International Workshop on Rural-Urban Linkages Curitiba, Brazil, 10-13 March 1998 (Rabinovitch 1998

5.1.2 Parks and greenways

Parks are traditionally one of the most obvious forms of urban greening. Some countries in the region have a long tradition of establishing well-maintained parks, or have recently established nice conventional parks, like the city of Hanoi. Other parks are neglected, or are threatened by buildings, spontaneous settlements, vandalism and environmental stress and restricted government funds. Many parks in the region can only be preserved and managed through a commitment of residents and innovative management approaches. This is the case of some parks in Delhi. In Yokohama, Japan, the city's Board of Parks and several citizens' associations operate an ecological park (Kaneko & Nanbu 1997). In Singapore a new programme has been developed, in which schools adopt a neighbourhood park (National Parks 1997).

Depending on the size and design parks can provide a range of environmental services. Parks with some forested areas also improve air quality, reduce noise pollution, reduce wind speed and add aesthetic and property values (Kuchelmeister 1993). Large parks with more extended forested areas also provide animal habitat, increase urban biodiversity, and can provide viewing pleasure for people (Parks Department 1994). Timber production combined with recreation has been practised as well.

Municipalities in developing countries face similar problems related to the lack of safe water, inadequate waste management and pollution control, occupation and degradation of sensitive lands, flooding, soil erosion and noise in unplanned settlements. Experience form other parts of the world suggest that alternative design of parks are a very efficient use of existing open space with the aim of serving the most urgent needs of underprivileged communities. One outstanding example is the case of Durban in South Africa. This city has successfully developed multi-functional parks as a component of slum improvement programme. These multi-functional parks are managed in new ways, e.g. the use of parks for storm water catchments or sewage treatment through the design of retention ponds or artificial wetlands has required close management cooperation between park and public work departments. Similarly, protecting sensitive habitat while encouraging diverse public uses requires active involvement of residents of communities (ICLEI NN). The potential of multi-functional park design and management is insufficiently known among urban planners and other stakeholders concerned with development of low-income communities.

In many parks in China fruit species and bamboo for building are harvested; and lakes are stocked with crabs and fishes (Kuchelmeister 1991). Innovative aquaculture, raising fish in mature waste-water stabilization ponds have been demonstrated in Lima (IDB 1997).

Public parks are especially important for the urban poor, because they have few affordable options for recreation and thus place a high value on green areas. Lower income residents tend to frequent city parks more than wealthier citizens do because they lack the financial resources and leisure time to reach distant recreation sites. For instance, in Bangkok, on Sundays and holidays 10,000 people visit Lumphini Park, most of them from low-income families in nearby residential areas (Pleumaron 1988). In Malaysia recreation areas that are developed and managed by government agencies have mainly satisfied the outdoor recreation needs of the urban lower income groups; commercial outdoor recreation areas have mainly catered for the middle and higher income groups (Wan & Wan 1993).

In intensive recreation areas, however, soil compaction and physical damage can create stress and shorten the life of trees. Developing greenways (linear parks) may help to take some pressure from traditional urban parks.

Greenways are also called linear parks, because they are narrow vegetated corridors. They can have multiple uses and functions, such as improving environment quality, providing recreation, and serving as alternative transportation route (bicycles and foot path) (IDB 1997).

Greenways can be sited along natural systems such as rivers, ravines, ridge lines and flood plains. They are usual less expensive land. In wealthier cities greenways are also incorporated into highway systems. Greenways have the additional benefit of serving as natural corridors that connect larger wildlife habitat.

Many cities in China have traditional greenways, designed for bicycle traffic. Cities like Kuala Lumpur and Singapore have ambitious greenway programmes. This park connector network of Singapore aims to maximize under-utilized land such as drainage reserves, foreshores and road reserves by turning them into green corridors, linking parks and natural sites. 14 park connectors comprising a total length of 40 km will be completed by the year 2000 (Briffet et al 1997, National Parks 1997). In other cities greenways are not yet sufficiently acknowledged among policy decision makers and planners in the region.

A very specific type of greenway is **riparian reforestation** or riverside tree planting. Many urban riverbanks are used as garbage dumps and are unsightly. Planting these watersides with various forms of vegetation cannot only make them aesthetically more attractive, but also assist in controlling flood and protect the biodiversity of the site.

For recuperation riverside ecosystems are best achieved by mimicking the natural planting as much as possible or maintaining historical park-like landscapes. Know-how about eco-sound urban riparian reforestation is still not sufficiently disseminated in the region.

5.1.3 Street trees

Rich and poor residents, business people and tourists all appreciate the benefits provided by trees along streets. However, street trees are often more difficult to establish and maintain than their counterparts in parks. Due to inadequate planting space and high costs of individual protection of trees collision and vandalism have destroyed many street trees.

When properly managed, street trees provide significant amounts of fuelwood, poles, fruits or medicine and can also be very attractive in poor neighbourhood (Kuchelmeister 1991).

Systematically planting of street trees for timber production is applied in China and Malaysia. Two of the most important amenity trees in Kuala Lumpur produce quality timber and there is a small industry exploiting such timber as is produced from roadside tree felling. Forest Research Institute of Malaysia (FRIM) (Webb 1998) is actively promoting a wider variety of timber trees.

Only a limited number of species are planted as urban trees in the region due to lack of systematic trials of species and poor access to planting material even though trials have shown some urban trees to be most hardy, aesthetically pleasing and easy to propagate. A disturbing

trend is to replace tough, multi-purpose, native plants with unproved modern ornamentals (for instance in Bangalore; Gadgil & Parthasarathy 1977).

Often low-care wild edible plants are excellent candidates for use as ornamental street tree plantings. Potential candidates (food and amenity) for avenue planting for the Sub-Himalayas and the Andes have been identified (Kuchelmeister 1993).

A survey of avenue trees in Calcutta has documented the multiple use of street trees. The study showed a direct link between high human activities and a high density of trees. Local people protect and care for the trees. If people worshipped a particular tree, its chance of survival rate were almost 100% (Malhotra & Kumar 1987).

In other words, street trees survive and flourish best when people living adjacent to them commit themselves to be responsible for tree care in the one or other form. Too rarely public departments have tapped this potential. It can be anticipated, once the full or partial responsibility of trees by residents is institutionalized, the survival and viability of street trees will be increased dramatically.

In many cities in the region like in Thailand and the Philippines local business people have invested much in potted woody plants, which are sited in front of their shops or on roof gardens. The general perception of the exclusive public responsibility for street tree planting has prevented creative public-private partnership. For instance, street trees are especially desired in business districts because local shop owners can advertise on the tree protectors. Entrepreneurs generally prefer to sponsor trees in high traffic central locations. These sites are the most challenging for good growth conditions, but a good business sponsor can better ensure the survival and vitality of trees.

5.1.4 Trees in farming

Several cities in the region including Ahmendabad in India, or Shanghai in the PR of China aim to be self-sufficient in food security (Smit 1997). Many urban trees suitable for resource poor settlements can provide food, particularly fruits, but also edible leaves, shoots and even flowers.

In many cities in developing countries urban gardening contributes significantly to food supply and green space. Agroforestry gardens in Pacific (Thaman 1987) and elsewhere are the most significant urban green space in the region. Citrus spp, mango, macademia nut, papaya, coconut palm, avocado, pear are some of the useful fruit trees cultivated in urban gardens in tropical developing countries in the region. Some tree species require less space than often assumed. Bananas and papayas can be squeezed into spaces between buildings along the edge of roads and even in containers on rooftops or balconies. Many trees can be manipulated into shape by training, coppicing, lopping, or pollarding. Climbing woody perennials like passion fruits (*Passiflora spp*) are very suitable for small gardens. Some fruit and nut species are also available as dwarf varieties that are perfect for small spaces (Kuchelmeister 1993).

Managing trees and shrubs on the same land as agricultural crops or livestock in some form of spatial arrangement or temporal sequence in poor neighbourhoods is common. Urban forestry programmes should facilitate this trend to plant tree crops and other trees to increase the agricultural land. There are no reasons why different agroforestry techniques developed in

rural area could not be adopted to the context of urban areas. Far instance, Sloping Agricultural Land Technology (SALT) a diversified system of contour hedgerow inter-cropping in which apart from the hedgerow, permanent and non-permanent crops are grown together on the same land can be promoted in low-income settlements to improve farming and stabilize sloping land. The hedgerow component also acts as a barrier against soil erosion and provides mulch to cover the soil.

In arid and semi-arid areas, it is a common urban forestry practice to establish windbreaks to protect agricultural land and enhance the productivity of the land. Properly managed windbreaks can provide significant quantities of fuel and poles and other tree products without jeopardizing their primary function. Often a network of small windbreaks are more efficient and easily to implement than classical shelterbelts (Kuchelmeister 1989).

Concerning urban agroforestry, foresters should take part in the current research and development efforts by agronomists to increase urban agricultural productions (Lanly 1997).

5.1.5 Watershed management

Urban and peri-urban forests play a significant role in water conservation. In Tokyo urban forest management systems have been changed from single-storied forests to multi-storied ones to improve water conservation (Yuji 1995).

Drinking water supply: Perhaps one of the must urgent priorities in large metropolis is providing clean water to its residents and then dispose safely the wastewater. An abundant supply of clean water depends on the health water supply catchment area or the watershed.

In deed, protection of the suburban and rural areas that serve as the source of their water supplies, is one of the more traditional fields of action of urban forestry, as witnessed in the case of Hong Kong, or Nepal (Braatz 1983). Most of the forestry activities to protect watershed in peri-urban areas are typical rural forestry projects, insufficiently integrated into urban planning process. There is still much scope for integrating forestry with other water resource initiatives. The goal of improving the quality of water can be integrated with flood control, recreation and health and education projects.

Wastewater disposal can also be a major component in urban forestry. Wastewater can be filtered through setting ponds and wetland. It can also be used for irrigation in urban agriculture and forestry. Irrigated tree plantations can be a safe and productive means of wastewater disposal, as practised in arid zones in Egypt and Iran (Braatz 1993), to name a few.

The practice of at least partially treated wastewater in stabilization ponds, integrated into park systems and other green areas has to be considered as an economic and ecological alternative for conventional urban wastewater treatment. This was proofed in a study in the city of Battambang in Cambodia.

The practice of treated sewage fisheries along with garbage and sewage farming in peri-urban wetlands play a significant role in waste recycling and urban sanitation in Calcutta. When

using wastewater to irrigate edible crops the potential health risks must be evaluated (IDB 1997, FAO 1989).

Storm water control: Floods cause considerable damage in the region. Since many informal settlements are located in flood prone areas, they are the most hit and often the least assisted after flooding. As more forested areas are replaced by pavement, less storm water is infiltrated into the ground and runoff volume increases.

The quantity of storm water that runs off of Australian cities each year is about equal to the amount consumed from domestic storage. Therefore there is a great potential for expanded collection, storage and re-use of storm water for non-drinking purposes (French & Sharpe 1976).

Trees can thus be deliberately used to help to achieve the objectives of storm water management at optimal costs, which are to prevent the loss of life, to reduce property damage by runoff of severe storms; to prevent land and watercourse erosion, to protect water resources from pollution, to preserve natural watercourses and their ecosystems.

Integrated storm water and pollution control may involve water collection through the following urban greening techniques: (i) using wetland and parks as important components of a city's flood control system; (ii) designing roofs and pavements to distribute water onto grassed/vegetated areas or sumps or bioswales.

5.1.6 Protected areas

Protected areas are natural or reconstructed habitats that receive some level of ecological protection in order to preserve their ecological or biological functions. Protected areas vary in size from one a few hectares of bird nesting habitats to forests of over thousand hectares. Generally they tend to be small in urban areas (IDB 1997).

Greenbelts: One special form of protected areas are greenbelts, which are large parcels of land in and around cities where urban development is totally prohibited through zoning, or public ownership, easement or development restriction. Greenbelts provide such environment benefits as noise and air pollution abatement, climate amelioration biodiversity, watershed protection and wildlife habitats. Greenbelts are basically open space buffer amid the congestion and pollution of most large cities (Miller 1997).

In the region ambitious greenbelt programmes have been designed, for instance for Djakarta in Indonesia (Kuchelmeister 1989), and Seoul in South Korea. Most of these greenbelts are under threat today. The greenbelt of Seoul is challenged by the need for urban housing and business. Revision of the conservation-oriented zoning concept to a harmonious conservation-development zoning approach might be the only solution to retain part of the greenbelt (Lee & Kumata 1998).

Conservation of **biodiversity** and especially wildlife is predominantly served by rural forest and woodland ecosystems rather than urban forests. The urban forest is expected to play its part. Biodiversity is increasingly stressed in urban forestry management in the region, e.g. in Malaysia, where selected forest species in urban area may serve as a form of ex-situ

conservation (Yap 1995). Kuala Lumpur is the only city in the region with primary forest in its centre (Ariffin 1989).

Quite often botanical gardens, located in the urban areas have a richness of biodiversity (Katzir 1996). In North Vietnam, the oldest trees, and also the ones with the largest diameter are conserved in the botanical garden of Hanoi and not in the rural forests (Dan 1998).

Although urban forests may contain less biological diversity than rural woodlands, the animals that occur in the urban forests are still numerous (Moll & Young 1992). For instance, a study in Jakarta found that birds in an urban environment tend to have low species-richness but high density (Indrawan & Wirakusumah 1995).

On a larger scale urban forests can create or restore biological diversity that will reconnect a city to its surrounding bioregion. Suburban wetlands can be some of the most productive natural ecosystems. Greenbelts and greenways can serve as biological corridors (Groome 1990).

Wetlands: Overlooked as swamps, or nuisance for development, wetlands deserve attention as a priority candidate for protected status. Usually they contain high level of biodiversity and offer a range of environmental services. Although they are fragile ecosystems they have considerable pollution abatement properties. They also provide flood protection, groundwater recharge, wildlife habitat. The entrepreneurial opportunities like fishing and tourism should also be not underestimated. Thus rather draining, filling wetland, city planners and investors need to appraise these ecosystems for their value as a protected resource (IDB 1997).

Protected key areas and buffer zone concepts developed in rural forestry can be adapted to the urban context.

5.1.7 Solid waste management and land reclamation

Wealthy cities are vast producers of solid waste, the disposal of which has become a serious problem. Per capita solid waste generation is still low in poor neighbourhood, but as their per capita income increases, the quantity of solid waste is likely to grow.

Recycling of waste from urban forests can play a role in solid waste management, especially in cities in developing countries, and should be encouraged not only to reduce the need to dispose of vast amounts of waste but also to secure new raw materials from extraction for re-use.

In more wealthier cities one main unexploded urban forest resource is the biomes from tree pruning operations, which currently goes to landfills in Singapore and Kuala Lumpur. With at least 800,000 trees being pruned annually in each city, prunings are a significant resource. In Hong Kong, all the pruning from street and park trees, which is around 9,600 cu m per year is applied as mulch for shrub beds in the parks. This is equivalent to an annual saving of $ 576,000, because the park authorities do not have to purchase these mulch materials. Wood chips may also be composted, together with green "urban waste" to produce a horticultural product. They may also be used as a substrate for growing mushrooms. Chips may be fed

directly to a boiler to generate electricity that may be fed back into the city grid as a source of revenue and sustainable power (Webb 1998).

Reclamation: Unused and degraded land and landfill sites can be reclaimed through afforestation (Wong 1995). By regreening landfills or other reclamation sites, a city can effectively cover an eyesore and add more vegetation to its park system. The idea of greening parks on terminated landfills, i.e. where controlled disposal of waste material to land is exercised seems to have become popular in some cities in America. In Southern California an arboretum was developed after the landfill was completed (Boddaert 1998). Afforestation of landfills has also been practised in Hong Kong (Chan et al 1996) and other cities in the region.

Although reforestation at the end of the landfill's operational life is generally regarded as a good idea, permitting agencies may be concerned that the tree roots in a layer of topsoil spreading over the clay cap, may compromise the integrity of the clay cap. With the right tree species, proper site preparation and an appropriate root barrier fabric, there should be no environmental hazards occurring due to reforesting a landfill.

In the region there is much scope that tree specialists and landscape architectures joint solid waste management initiatives by forming landfill-to-park-conservation alliance and converting the "waste" of the urban forest into a valuable resource.

5.2 Policy and institutional framework for management of urban trees and forests

5.2.1 Responsibility for urban trees and forests

The responsibility for urban tree planting takes three main forms in the region (i) the planting of trees on main highways, important roads, along city watercourses and reserves is the responsibility of the government[9]:[10].(ii) Tree planting along mixed-roads, municipal roads, city parks, etc. is the responsibility of the local government authorities. (iii) Home garden tree planting is the responsibility of homeowners.

Tree planting in public areas can be done through permanent work forces of official agencies, hired labour, contractors to government and/or local authorities (as done for all urban tree planting in public areas in New Zealand and Australia), or by a multiplicity of NGOs. In almost all the countries except in China, some contractors are now NGOs, which work for a smaller profit margin. In China, such work is the responsibility of individuals, encouraged by legislative provisions. Tree planting by NGOs and the general public is mainly to commemorate instances such as the World Environment Day, World Food Day, Environment Week, etc. In fact, urban tree planting on such important dates is the predominant activity conducted by NGOs in several cities in the region.

[9] Also called Park Recreation and Administration, Park & Landscape Management Office; Natural Resource Department, Urban Greening Office, Regreening Office, Parks Development, Department of Environmental Services, etc.

[10] Various departments execute the actual work such as the road authorities (along roads), water boards and environmental authorities (along watercourses), relevant government departments in the case of tree planting around buildings, etc.

Maintenance of trees planted in public urban areas is often very confused, with no proper arrangements. As a result, many areas where trees have been planted suffer from inadequate maintenance work (Widanapathirana 1997) especially where budgets are limited. Planting and maintenance through NGOs or contractors appears to give better results.

Box 1. Urban greening integrated into comprehensive environmental protection of Tokyo

1. Ordinances

In 1992 the Tokyo Metropolitan Government adopted the Ordinance for Conservation and restoration of nature, which provides for the designation of conservation areas, the regulation of development and the designation of green areas.

- **Conservation zones:** green areas which incorporate forests, waterside locations, or historical landmarks are designed as natural conservation zones which restrict activities such as development and logging.
- **Development regulations**: Any development that affects 1000 square meters or more of natural land or farmland must be approved by the government of Tokyo. In addition, the approval of the Tokyo Metropolitan Nature Conservation Council must be sought before any development involving 30,000 square meters or more can be undertaken.
- **Green area promotion**: Highly urbanized districts, where the proportion of green area is low, are designated "greenery promotion areas". In those areas, the Tokyo Metropolitan Government, working in conjunction with municipal authorities, implements a variety of urban greening projects.

Establishment of Parks and Other Open Space (1992)

Area	Number of parks	Area (ha)	Per capita park areas (ha)
Ward area	4,646	3,232	3.98
Tama Area	3,147	1,840	4.98
Island Area	28	280	89
Total	7,821	5,352	4.52

2. Metropolitan Plan for doubling the Amount of Urban Green in Tokyo

In 1994 the Government adopted the Tokyo Metropolitan Plan for doubling Greenery. This plan is designed to promote comprehensive, systematic policies with regard urban green areas and bodies of water in Tokyo. Long range goals outlined in the plan include doubling the amount of green space in Tokyo, improving the quality of green space, and promoting activities to achieve these goals. Some primary activities to be achieved by the early 21st century include

- Two hundred million trees in Tokyo urban districts
- Six square meters of parkland for every Tokyo resident
- Conservation of forests and waterside areas in their natural states

The Plan consists of the following four components:

Increasing nearby green space: in parks and greenbelts; private homes and facilities; in pubic facilities, roadsides, watersides, restoring clear streams.
Preserving existing green space: conserving of nearby green space and watersides; conservation and establishment of land for agriculture, forestry and fisheries; preservation and use of natural parks; preservation of valuable wildlife.
Organising a system to increase green areas: cooperation between government and citizens; systems of providing plant materials; information dissemination and awareness-raising and education programmes:

Creating a water and green area network

Source: Tokyo Metropolitan Government 1998

5.2.2 Legal framework

Legal considerations are important determinants of urban tree establishment (planting and maintenance) in the region. There are three aspects to this: tenure, the rights to harvest, and the general legislative framework. With regard to land tenure, governments often own public lands and impose restrictions on planting, with individual public agencies sometimes not being legally able to directly initiate tree planting. Other public areas are given over to public or private agencies for management such as along waterways. Sometimes only the government has the rights to harvest and utilise timber and fuelwood and this can provoke conflicts between the government and those who are expected to plant trees.

People as individuals work for their own benefit and tree planting in public areas may not produce direct benefits to them. In developed cities, this may not be a problem, but in poorer ones this issue could well be relevant. One exception is all the cities in China where by law the people are enabled to obtain direct tree benefits such as fruits, fuelwood and timber from the trees planted in public areas over a thirty-year term.

Box 2. Urban forestry in its infancy - the Pacific

Although urban agroforests are well developed in the Pacific (Thaman 1987), modern urban forestry is virtually non-existent in the developing countries of the Pacific region.

A case in point is the city of Apia in Samoa, where there is no coherent tree greening strategy. An organised plan of street tree planting is non-existent. This is mainly due to the fact that Apia is an agglomeration of autonomous districts; each governed by a local Chief. As such there does not exist a Parks Department of Apia. Whatever planting is done is under the governance of the Department of Conservation, which is chronically under-funded. Along the foreshore and around the government buildings, palm and ficus trees have been planted, but this seems merely part of building development than anything else.

Along the foreshore or boulevards are a number of old ficus trees, dense and big and terribly butchered. Proper pruning practices are non-existent but merely a hacking and whacking job.

Whilst Samoa tries to attract tourism, the idea of beautification and planting of amenity trees is in a stage of infancy. There are some well kept gardens that belong to the larger hotels.

In the outskirts of Apia, where the more affluent people live, one can find nice gardens, often enriched with larger trees. Decent maintenance is lacking however. In the gardens of the less well endowed, one can find often cropping trees and further out in the villages there are merely small farmers with crops such as pineapples, breadfruit, papayas etc.

Amenity planting programmes may be able to be developed in some sort of a tourism development initiative, rather than through the 'local council' (Buddingh 1998).

Box 3. Urban forestry integrated in urban planning in Chandigarh, India, a model and planned city

Chandigarh, a model and planned city of India, is characterised by a rich and well-developed urban forestry component. Besides having clusters of trees on the outskirts, trees have been planted all along roadsides, roundabouts, parks, and gardens and within the premises of institutions and religious places. At present, 66 types of trees planted along road sides have been listed along with their common and English names, taxonomic family, flowering time, and uses (Singh et al NN).

5.2.3 Research and training

There is a scarcity of trained professionals and other stakeholders in urban forestry, a distinct lack of regional exchange of information, and little technology development and transfer from other parts of the world, the international forestry community is conspicuously absent in urban forestry efforts but if involved, could facilitate greater awareness and actions on the local, regional and national level. Urban forestry is young in the region but encouraging examples nevertheless exist:

- In Australia arboriculture is progressing, but not well organised and does not have a research base (Moore 93).
- In China, institutionalised urban forestry research began in the 90s. There are urban forestry research agencies in the Chinese Academy of Forestry, as well as in some other provincial forestry research institutions. The Branch of Urban Forestry of the Chinese Association of Forestry was established in 1994. Beijing Agriculture College set up its Urban Forestry Department in 1995 (Li 1997).
- In Malaysia, the Forest Research Institute is actively involved in urban forestry, a top priority programme (Philip 1997).
- In Korea, the Forestry Research Institute has focused on (i) reclamation of damaged and disturbed urban forest ecosystems; (ii) ecological-landscape management of urban forests; (iii) investigation of Seoul's urban forest ecosystem. Planned related activities include assessment and functional classification of urban forests and optimal arrangement of urban forests (Park 1997).
- In the Philippines, The College of Forestry at the University in Los Banos has developed technical guidelines, manuals and extension aids, conducted studies on economic and socio-economic aspects of urban forestry and provided training on various levels (Palijon 1997).

Multipurpose urban forestry is even more in its infancy. Existing information is incomplete, widely scattered and not easily accessible including on the relationship of urban dwellers (particularly the poor) in developing countries to urban green areas. Concerning urban agroforestry, foresters are insufficiently active in the current research and development efforts by agronomists to increase urban agricultural production (Lanly 1997). Forestry is also under-represented in multiple resource inventories.

Very few training and extension programmes exist for urban forestry and none has a special focus on low-income citizens.

5.3 Issues and challenges facing urban tree and forest management and development

Urban forests are under threat in the region. In addition to ecological constraints of planting and managing forest in an urban environment, the most common obstacles are (a) insufficient awareness and appreciation of the economic value of urban trees and forests; (b) rural bias of forestry development policies; and (c) policy and institutional deficiencies. There is a multitude of policy and institutional barriers, of which the following can be highlighted: (i) inappropriate tree and land tenure and outdated laws and customs; (ii) unsustained financial resources; (iii) insufficient local participation; (iv) deficiencies in integrating urban greening into urban planning practices under rapid urban growth conditions, especially in poor cities; and (v) lack of multi-disciplinary approaches to urban forestry.

5.3.1 Ecological constraints

While limited information suggests great species richness (the total number of species), in practice species diversity is very limited. A large portion of the urban forest is comprised of relatively few species and in some cases, unjustified preference for a few exotics. Genetic characteristics that could confer resistance in a stressful environment, although critically important, appear to have received little attention.

Urban vegetation managers face a number of practical challenges in planting and maintaining urban forests: conditions of urban sites for greening are often harsh, and although new technologies have been developed in wealthy countries to match vegetation to sites, many practices are only suitable for wealthier cities and regional technology transfer is slow. Partly this reflects lack of urban forestry expertise in the less affluent countries of the region where there are only few opportunities for urban forestry training and education. Weak or non-existent urban forestry extension services also constrain technology adoption although some Forest Departments, such as in Fiji and Thailand, are involved in urban areas.

Urban growing conditions (Table 2) differ markedly from rural conditions in that the urban paving and buildings modify the urban mesoclimate in a way which decreases wind speed, raises temperature and precipitation, lowers the relative humidity and increases the quantity of contaminants by a significant factor (Nilsson & Randrup 1997). Technical constraints identified as affecting urban forests in the Philippines are presented in Table 3.

Table 2. Basic challenges to trees in an urban environment

Items	Problems
Soils	Compacted, contaminated, poor drainage
Sunlight	Blocked by tall buildings
Air supply	Polluted trees may die
Above-ground space	Reduced by buildings and utility lines
Below-ground space	Underground wires, building foundations, compacted soils, etc.
Damage by humans	Vandalism, accidents, etc.

Many woody plants are suitable for urban planting; for instance, 6,000 tree and 2,000 shrub varieties have been identified as urban plants in China (Li 1997). Nevertheless, out of more than 90 different tree species in Beijing, 70% of trees are either *Populis* or *Sophira japonica* (Profous NN). Only a limited number of *species* are planted as urban trees in the region due to lack of systematic trial of species and poor access to planting material even though trials have shown some urban trees to be most hardy, aesthetically pleasing and easy to propagate. One of the major causes of the death of newly planted urban trees all over the world is drought (Bradshaw et al. 1995). Tree species tolerant to drought and other urban stresses[11] are often not appreciated by the elite (Chandrakanth et al. 1990). This makes design of urban beautification programmes difficult in India and elsewhere. A disturbing trend is to replace tough, multi-purpose, native plants with unproved modern ornamentals (for instance in Bangalore; Gadgil & Parthasarathy 1977). The preference for exotic plants in the tropics is not surprising because there has been little serious investigation into indigenous plants apart from the more decorative species (Jim 1991). Today relying more on native species is advocated by some urban foresters in the region, e.g. in Malaysia (Yap 1995).

Table 3. Technical constraints of urban greening in the Philippines

1.	Limited open spaces	5.	Soil conditions: very thin top soil, hard pan, saline soils, and improper soil mix
2.	Very narrow street corridors	6.	Prevalent vandalism
3.	Too much above and below ground utilities. Some utilities are even wrongly mapped	7.	Lack of technical expertise (arborist, landscape horticulturists)
4.	Too polluted and harsh an environment for trees	8.	Dearth of technical information

Source: Palijon 1997

5.3.2 Limited awareness and appreciation of the importance of urban trees and forests

Even though imperfect, valuation techniques exist for urban forest resources, used so far in the wealthier countries in the region; they have to be adjusted and tested for poor cities. When urban forestry activities are included as components of larger urban improvement programmes, it is important that they also be subjected to financial, economic and social-economic analysis. Beyond valuation, the challenge is getting value of urban trees and urban forests accepted by policy makers so that they are "given a chance" alongside more lucrative uses of scarce urban land.

Demonstrating the worth of urban forests and trees could help to secure policy support for programmes; placing a value on urban green resources is thus one of the most significant challenges in urban greening programmes (IDB 1997). The monetary value of urban trees is not easy to estimate, and very little hard data are available for cities in developing countries (Kuchelmeister 1997). Even where value can be demonstrated and communicated, many urban forests take years to provide their full benefits, often making it difficult to gain popular support. Without immediate tangible benefits, the time horizon for poor people to invest might simply be too long. In this aspect, urban forests share a common problem with rural ones.

[11] These can be ideally suited for avenue trees, examples being some temple trees in India - *Ficus glomerata, Ficus infectoria, Terminalia ariuna, Melia azedarach*, and *Bassia latifolia*.

Valuation of forestry's many non-material and non-marketed benefits is never easy. The problems faced in their valuation have recently been reviewed in some depth and many observations already made will apply equally to urban as to rural forests.[12] Efforts have been made to adapt valuation techniques specifically to urban forestry. An example is "Green City", a user friendly management tool to quantify the environmental benefits of urban trees, developed by the American Forest Association (Box 4).

Economic analysis of urban forest resources is particularly relevant when sizeable tracts of urban land are involved. Such land has high alternative value in private use, because it can yield commercial and residential buildings that are precluded when the land is set aside for urban greening. Valuation is in such cases needed to help support justification for greening rather than lucrative real estate functions of the land.

Box 4. Costs and benefits analysis of urban forests as a tool for local communities

The American Forests' Urban Ecosystem Analysis (Green City) offers a means of quantification of the environmental benefits of urban trees. American Forests has transferred Urban Ecological Analysis methods to local communities so that they can recognise, measure, and advocate better natural resource policies in their communities. Benefits include energy conservation, urban heat island reduction, storm water runoff, air pollution reduction, noise and glare control, and carbon sequestering. The analysis has been developed to help local people demonstrate the value of trees in their community to its leaders, putting tools into the hands of local people, so that they can make community-based decisions that affect long-term planning, management, and funding (Kollin 1997). The method will also be tested in several countries in the Asian region (Falconer 1996).

One approach is to put land up for bid with the restriction that it can only be used for urban greening purposes. The highest bid might be seen as the economic value of a given green space. If benefits are difficult or expensive to quantify, a simple cost-effectiveness analysis could be used. Moving to a social cost-benefit analysis complicates matters but answers the question of whether an urban forestry project is worth doing, when all benefits and costs (private and social, tangible and intangible) are included.

The replacement cost method is a rough and ready means of assessment that provides an upper bound for non-market benefits (e.g. replacement cost of wastewater systems of wetland and ponds). The recreation benefit of public parks that attract visitors can be approximated using the travel cost model, an exercise that favours small urban parks without an existing close substitute for comparison.[13]

The value as perceived by the people themselves is the ultimate indicator of acceptance or rejection of an urban forestry initiative.

[12] See Kengen 1997

[13] Results of such analysis usually show that small urban parks in the vicinity of residential areas are economically more attractive than are larger parks further away.

5.3.3 Rural bias of development policy

There is widespread recognition that urbanization generates many unintended impacts on rural areas and that rural development policy frameworks should be broadened to take into account negative and positive aspects of urbanization. Forestry needs to strengthen mutually beneficial complementary rural-urban linkages, thus supporting a sustainable and socially just development process. Urban forestry with a clear focus must be put on the development cooperation agenda.

Many development professionals have assumed that by supporting for rural development initiatives aimed at achieving rural prosperity, they could reduce migration to cities. Historically, the decision to direct most international assistance to rural rather than urban areas is related to the traditionally negative image (Box 5) of the city and its impact on rural areas. This image has only recently been under reconsideration.

It is now recognised that the growth of urban populations has an internal dynamic independent from rural migration. Nevertheless, development thinking is still dominated by a rural bias (Hall et al 1996) both in individual countries and in their external aid partner agencies.

Box 5. Three development myths about urbanization

The image of cities among rural development specialists tends to depict the city alternatively as:

- the perverse result of unequal and unbalanced development - which leads to conflicts of interest between the urban elite and rural masses;
- the result of the spread of development models formulated in industrialized countries - a thesis which encourages the interpretation of the relationship between city and outlying areas in terms of conflict between urban and rural economies;
- the effect of the assimilation of exogenous cultural models by non-western societies - focusing on social and cultural aspects - in which the rural/urban relationship is seen as a conflict between the culture of modernization and consumerism and traditional, wholesome culture.

Source UNCHS 1997

This rural bias is particularly marked in forestry[14], which has focused almost exclusively on rural areas (Kuchelmeister 1996), despite the fact that foresters have highlighted the significance of urban needs more than two decades ago in the Jakarta World Forestry Congress (e.g. Andresen 1978). A probable major reason for this is that most contacts for development assistance in forestry are forestry ministries, which are not responsible for urban and peri-urban areas. Furthermore, foresters tend to have less influence in cities than do landscape designers and gardeners (Lanly 1997). It seems that some foresters are mentally

[14] For instance, at present ADB has no forestry and agroforestry projects which involve urban forestry (Kenneth Macdicken 1997); also the European Commission has not a single urban forestry project in their budget line on tropical forestry (Roby 1998). CIFOR has no programme to work on any aspects of Urban Forestry (Byron 1997); urban forestry was not on the work programme of the IPF, and is not on that of the IFF (Intergovernmental Forum on Forests) which is the follow-up to the IPF (Michaelsen 1997). ICRAF is not engaged in work related to urban forestry. The major research and development thrusts in Southeast Asia are to develop alternatives to slash and burn, and to help rehabilitate degraded lands, through improved agroforestry systems. Thus, ICRAF are focusing on the rural smallholder sector, particularly those living in the more remote parts of Asian watersheds (Garrity 1998).

blocked, concerning their negative image of the city, instead of facing the urban challenges and opportunities for the forestry profession.

Most current urban greening activities in development cooperation are initiated by the agricultural community[15], which does not yet sufficiently support urban forestry.

While today many officers in bi- and multilateral development agencies agree that there is no policy reason for not including urban forestry into the development agenda, little action has followed. FAO has a modest urban forestry programme (Braatz 1993). USAID is in the process of launching an urban forestry initiative. Because in Latin America urbanization has already reached 75%[16], it is not surprising that the Inter-American Development Bank has taken the lead among development agencies in urban greening.

Growing urban poverty has resulted in a more positive attitude by development cooperation agencies towards aiding urban areas and has also increased recognition that urbanization generates many unintended impacts on rural areas and that rural development policy frameworks should be broadened to respond to both the negative and positive aspects of urbanization. However, the relationship between urban and rural areas seems to have been left to either the market or to destiny; there are few specific sound policies in this fundamentally important field. The overriding policy question is therefore how to strengthen mutually beneficial complementary rural-urban linkages, thus supporting a sustainable and socially just development process.

5.3.4 Policy and institutional deficiencies

5.3.4.1 Legislation, tenure and custom

Land tenure could conceivably be the most significant obstacle to urban greening in many cities. People who do not have a piece of land, or do not feel even partly responsible for one, are not likely to care for trees or other vegetation planted where they live. Traditional laws and customs can impede or facilitate urban greening. Especially where urban sprawl invades traditional villages there are conflicts between developers and customary rights. Informal local tree laws in Beijing (Profound NN) are now ignored by investors in Beijing. Different cultural backgrounds are often ignored in the planning of open space[17]. Cultural values can lead to diametrically opposed impressions of the urban environment in the region. For example, in Japan urban green space has traditionally been in the form of Shinto or Buddhist shrines that were, and continue to be highly maintained areas adorned with ornamental gardens, buildings, etc. The purpose of these places is both religious and social, so vegetation is kept to a minimum, and there seems to be no tradition of "creating a natural ecosystem" (Shun-Ichi Watanabe 1992).

[15]For example, UNDP 1986, People Feeding Program IDRC 1996.

[16]A historical milestone event was the Seminar on Urban Greening in Latin America and the Caribbean, Dec. 1996, cosponsored by the IDB, where more than 300 professionals from 23 countries participated (IDB 1997).

[17]Germeraad (1990) discussed the lessons learned for the design of open space including green areas in Arab-Muslin settlements.

In unauthorised settlements people grow food crops (for which tenure is less critical as they are seasonal) but do not care for urban forests, where their tenure is in doubt. 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, harvest or otherwise use an area.

At the time many laws were enacted, many ordinances did not deal with urban forests; law is often slow to adapt to new situations and remains behind the times in many countries. For instance, in the Philippines, national policies, laws and regulations and local ordinances need to be revised and formulated (Paladin 1997).

5.3.4.2 Inadequate Financial Provisions

Table 4 makes it evident that there is a wide range of per capita spending on urban forestry. Data on expenditures for urban forestry are only available for those few cities with ambitious programmes. In most cases only information about public urban forest sector spending is known and often there is no separate calculation showing urban forestry expenditure, as is the case of Hong Kong (Chan 1998, Jim 1998).

Table 4. Municipal forestry budget (1997)

Municipality	Inhabitants	US $/ Capita *	% of Annual Budget	Reference
Bangkok Metropolitan Area, Thailand	10,000,000	0.37	0.80%	Charmniern 1998
Hanoi, Vietnam	3.000.000	0.01	n.d.	Dam 1998
Seoul , Korea	10,465,000	13.66	2.50%	Park 1997
Singapore	3.300000	2.00	0.05%	Yuen 1998
Melbourne, Australia	40,000	16.20	6.00%	Stokie 1998
Melbourne (day-time pop.)	400,000	2.00	6.00%	Stokie 1998
Christchurch, New Zealand	309,028	31.10	7.70%	O'Reilly 1998
Comparison USA				
Cincinnati, Ohio	365,000	3.60	0.22%	Gulick 1998
Milwaukee	625,000	12.80		Quennell 1998
North York	560,000	3.20	0.66%	Quennell 1998
* Exchange rate February-March 1998				

In urban forestry programmes it is often overlooked that funds are required for regular maintenance and protection and therefore much urban forest management is a sort of crisis management (Kuchelmeister 1991). Without a budgetary commitment to upkeep, a city's investments in this public amenity can become a waste of money.

Ideally, most funds for urban forestry must come from local sources. However, in most cases urban forestry programmes compete poorly with other services, especially in times of financial crisis and in developing countries. The challenge is to find ways of securing general tax revenue and to encourage private investments in urban forestry (Morgan 1996).

Although the list of benefits obtained from urban forests is lengthy, the resources spent on urban forestry research in the region seems to be low. For instance, the Forest Research

Institute of Korea spends only one per cent of its annual budget on urban forestry research (Park 1997).

5.3.4.3 Poor local participation

Historically, participation in urban forestry at the local level has been limited to management tasks assigned by the project administration without any prior input by the stakeholders in establishing priorities. In particular, although women bear a disproportionate share in the responsibilities of "the green elements" of family welfare, they are the least consulted in urban forestry projects (IDB 1997).

Quite commonly national and international priorities do not coincide with local priorities. Urban forestry projects that did not take the priorities and perceptions of local value into account often failed. In the past, top-down approaches to urban forestry programmes, as in China, have prevailed throughout the region, although this seems to be changing greatly in recent years.

A study in Bangalore showed a distinct preference of trees by social groups, e.g. the westernised, upper-class localities highly preferred exotic ornamental trees while the less affluent localities with a stronger element of indigenous cultures had an overwhelming preference for traditional trees (Gadgil & Parthasarathy 1977). The traditional preferences have been totally overlooked in planning urban forests. People who have grown up in a violent inner-city neighbourhood also have different expectations of green space.[18]

5.3.4.4 Limited Integration of Urban Forestry in Urban Planning and Development

The challenge in poorer countries is to make trees compatible and functional under the pressure of rapid urban growth and urban sprawl. Knowing the driving forces behind urban growth facilitates assessment of future development of urban areas and makes possible realistic planning for urban forest resource development. Given that the major challenge posed by the current rapid urbanization in poor countries of the region is to mitigate the "urbanization of poverty" there are many competing demands on tight city budgets which must be considered alongside environmental impacts on poor communities and on fragile natural resources. For example, unauthorised settlements frequently lack basic services such as potable water and sewers that may tend to take precedence over urban greening. Yet lack of attention can result in unmanageable environmental pressure on urban green space, including the cutting of trees for firewood.

It may be recognised that in future, urban trees and forests should assume an ever increasing role as a necessary component of the urban landscape. However, the challenge to city planners is (i) to anticipate the direction and magnitude of the growth; (ii) to secure resources for urban forestry for local needs (iii) to evaluate the probable uses of urban forests so that they can

[18]Low-income residents in downtown Detroit showed that although residents placed a great deal of importance on the out-of-doors, the features of parks that they prefer are well-maintained areas that include built features. Citing fear of attack and the potential for crime as the main reasons, these people did not want naturalized or rugged areas in their neighbourhood as this would represent a loss of security and increase the possibility for crime (Talbot & Kaplan 1984).

provide the best combination of services and goods (IDB 1997). Above all, how to convince decision-makers to allocate resources for trees and forests alongside apparently more "pressing" problems will be a continuing challenge.

5.3.4.5 Lack of institutional coordination

Urban forestry is by definition an integrated discipline that requires a high level of institutional capability to plan, plant, and care for and renovate urban forests. Lack of coordination between national, provincial and local levels can jeopardise urban greening. Comprehensive management of urban forest is handicapped by fragmentation of government agencies, e.g. in Bangkok (Pleumarom 1988). The City of Manila has two offices in charge of trees and associated vegetation: the Parks Development Office and the Parks and Recreation Bureau; They respectively handle development and maintenance (Palijon 1997). In Apia, Samoa, there is no coherent tree greening strategy, mainly because the city is an agglomerate of autonomous districts, each governed by a local chief (Buddingh 1998).

Local governments carry out most urban forestry programmes in the region. Many municipalities do not coordinate with local and/or community organizations that could assist them in managing the urban forest. Lack of well-organised local groups to participate or the lack of strong administrative or managerial skills among existing groups is another constraint.

Poor coordination among disciplines is also a problem: for example, the staff of most of the greening offices in Metro Manila are civil engineers. Whenever there are foresters, agriculturists and botanists, their roles are only secondary or on a consultancy basis (Palijon 1997).

6. ACTIONS REQUIRED TO IMPROVE URBAN FORESTRY IN THE REGION

A sustainable urban forest can provide a high level of net benefits over time. The tree resource must include age-, size-, and species-diversity that allows a continuity of benefits for both individual trees and forest stands. Creating such a forest involves three components: (i) the tree resource; (ii) the community framework and (iii) a comprehensive management programme. This section discusses the support needed to design and implement a successful urban forest programme. The basic framework - socio-political, technical, legal, financial, etc. - is required to facilitate project design and implementation and to sustain investment.

Since a large proportion of urban trees and forests fall under private ownership, sustainability is the responsibility of a broad community framework of public and private agencies and landowners[19].

6.1 Securing social and political support - building partnerships

[19]Specific criteria and indicators that can be used to assess each of these components is presented by Clark 1997.

Social and political support is paramount for success and requires involvement at the national, regional and local level. International assistance is also warranted.

6.1.1 Social support from stakeholders

By involving the affected citizens and community groups in programme design, planners can assure public support at the outset and greatly increase the change for success. There should be citizen involvement in deciding which problems to tackle and how they should be tackled.

Urban forestry must begin with an initial assessment of management needs and opportunities. People support what they believe to be valuable, especially if they receive direct benefits from projects (IDB 1997). For example, urban trees survive best when people have begged for them (Kuchelmeister 1991) and trees that are actually worshipped have a nearly 100% survival rate. Neighbourhood associations and others local NGOs are among the most common groups to work with; public involvement requires looking beyond the normal city park boundaries to the communities that surround urban open spaces (JAENIKE 1997). The region's own examples of efforts to work with diverse interest groups include:

- In **Yokohama**, Japan, the city's Board of Parks and several citizens' associations operate an ecological park. The responsibility of each association in terms of park maintenance is clearly defined, and citizen's associations offer a number of yearly recreation programmes. Two types of associations are distinguished according to participant members: (i) specialists interested in one aspect of nature (e.g. bird-watchers) and (ii) generalists interested in social activity during their leisure time (Kaneko & Nanbu 1997).
- In **Delhi** efforts of citizens and volunteer groups have achieved nature reserve status for the Delhi Ridge Forest, a tropical thorn forest type (Asgish & Rao 1997).
- In **the Philippines**, foundations and other NGOs manage vast areas of green space, e.g. Rizal Park, Quezon Circle, Ninoy Aquino Park (Palijon 1997).

Outside the region, business owners in Brazil care for street trees or sponsor tree planting in front of their stores in exchange for advertising on the tree protectors. In Chile some companies even manage entire public parks (IDB 1997). The Parks Department of Brookley, USA, has informally turned over management of neighbourhood parks in low income areas to Philadelphia Green (PG), a volunteer initiative. This effort offsets budget cuts within the Parks Department.

Environmental education is an investment that can generate high ecological dividends[20] in urban greening projects, especially over the medium and long term (Zulauf 1996). Cultivation of an appreciation for trees can build upon traditional values and can facilitate the transfer of state-of-the-art urban forestry technology and investing in enhancing an understanding of the benefits from urban forests.

Currently, various opportunities for environmental education are evolving in the region, for example, the integration of urban forestry into school curricula, city sponsored events such as festivals, tree planting days, community group involvement, and contests. The Hong Kong Urban Council runs a "King of Urban Hong Kong Trees" competition. From a list selected by a panel of experts, citizens nominate trees for the title of king and vote for "Most Popular

[20]For instance, in one suburb of Melbourne tree vandalism was reduced from 84% to 25 % due to a community awareness campaign (French & Sharpe 1976).

Trees". People who correctly guess the king enter a lucky draw for a variety of green prizes. In Mysore, India more than 100 schools have been included in an urban forestry programme (Gowda & Sridhara 1987). In the Philippines, an awareness campaign and promotion of "Clean and Green" and also an "Adopt a Street/Park" programme are well installed. Some commercial establishments support awareness campaigns by providing posters bearing their company's logo (Palijon 1997).

6.1.2 Political support

Urban forestry requires high political support. For instance, the former President of the Philippines is the leading promoter of the programme "The Clean and Green Programme for Metro Manila" (Palijon 1997). Because of the direct concern of Premier Zhou Enlai, the design of the subway in Beijing was changed to protect two ancient Gingkoes (Garden Administration Bureau NN). Successful urban forestry projects are often the result of mayors' efforts (Lanly 1997), witness ambitious urban forestry projects in Bangkok (Charmniern 1998), in Colombo (Wickramasinghe 1998), and Puerto Princesa, Philippines to name a few.

In an attempt to institutionalise urban forestry, the Philippine government through the Department of Environment and Natural Resources (DENR) incorporated urban forestry as one of the major components of its Master Plan for Forestry Development. The Urban Forestry Division of the DENR provides technical expertise and materials such as seedlings (Palijon 1997).

6.2 Strengthening local capacities

6.2.1 General

The shift in paradigm in urban planning will shape the future of urban forestry in the region. Increasingly, current management policy advocates a decentralization of responsibilities from central to local government and to communities. A redistribution of responsibilities is emerging with evolving new roles for many actors and the creation of partnerships between the different actors in urban development. Key decentralization-related issues which forestry, whether rural or urban, will have to face are presented in Box 6.

Box 6. Key forestry related issues with regard to decentralization trends

1. How will national and departmental government agencies treat municipal involvement in forest-related issues? Why?
2. What factors influence whether or not specific municipalities develop competent, honest municipal forestry units?
3. To what extent do municipal forestry activities incorporate the participation of local forest users and respond to their concerns?
4. Can national government agencies, NGOs, municipal governments, and forest users overcome their current weakness with respect to sustainable forest management?
5. Do negotiations between national government agencies, environmental NGOs, municipal governments, and local community groups develop protected area management that preserves ecological functions and also benefits local communities?
6. Will municipal land use planning alter landowners' use of their resources? Why?
7. How much does decentralization increase road construction and maintenance in forested areas, and what impact does that have on forests?
8. What political, economic, and ecological factors lead some municipalities to promote more sustainable natural resource management than others?

Source: Kaimowitz et al 1997

In the Bantay Puerto Programme of Puerto Princesa, Philippines (Box 9), the national government devolved certain powers to the local government to manage the urban forestry programme. Further, the city government decentralised certain functions and responsibilities to village level bodies for effective administration and implementation of schemes. Encouraged by the city leadership's success in preserving its rich natural resources, the Department of Environment and Natural Resources (DENR) turned over the management of the world-renowned St. Paul Subterranean River National Park, together with the Irawan Watershed, to the Puerto Princesa city government.

Urban capacity building is a relevant 'buzzword' for urban forestry. To sustain urban forestry efforts, communities need technical, logistical, and infrastructure inputs as well as access to research and development information.

Numerous fields of action exist where development assistance in local capacity building is needed, including training, education extension services, and technical assistance. Many of these requirements can be shared among communities in the region, e.g. provision of information material, urban forestry training guidelines, etc. Local, national and regional urban forestry capacity building networks are required to synthesise, further document, and disseminate experiences in urban forestry and to provide wider active support to urban forestry capacity building efforts.

There is great potential for South-South cooperation. For instance, the Singapore government provided assistance in the preparation of Landscape Guidelines for the urban forestry programme of Manila (Palijon 1997). Another good technique is the sister-sister partnership concept between cities of the North and South (O'Rourke 1990).

6.2.2 Appropriating training and education

Training opportunities for urban forestry should be increased dramatically with regard to environmental and professional education. Education and training opportunities, which are relevant to developing countries, have to be identified and curricula developed.

Training and education in urban forestry is needed for growing demand for multi-functional urban forest resources. Reorientation of staff in park and recreation management so as to better deal with the challenges of poor people will be required as well as training for urban greening stakeholders. It can be assumed that urban forestry will experience the same radical shift that occurred in rural development forestry (community and social forestry) some two decades ago. There is need for formal and informal **environmental education** and **professional training**.

New **professional skills** will be required which are necessarily different from those for traditional foresters or production horticulturists. In most cases a new kind of urban green manager has to be trained - one who in addition to being able to deal with the multiple technical dimensions of urban forests can also handle the different stakeholders' interests and can mediate trade-offs. Foresters will have to combine knowledge of trees with an understanding of city government, society and its needs. Arboriculturists also need skills in ecological landscape planning, extension, communications, sociology, municipal, commercial, and utility arboriculture; landscape management and contracting; supervision of parks and recreation lands; curation of arboreta and botanical gardens; habitat restoration (especially disturbed areas and/or wetlands); horticulture education; and research in plant stress physiology.

Steps to improve professional training in the region would be: (i) to assess the demand for training in the region using different scenarios of development; (ii) to identify and list existing education and training opportunities relevant to developing countries; (iii) to evaluate the content of urban greening related curricula in sample institutions; (iv) to identify and advise institutions on opportunities for strengthening the content and delivery of urban greening; (v) to share experience through regional networks, with a strong subregional approach.

6.2.3 Improving information and research

Urban forestry is a young and growing science, so far largely tailored to the specific needs of wealthier countries or of wealthy cities. It is of paramount importance to progress quickly in multipurpose urban forestry with a clear focus on the local needs of vulnerable groups without jeopardizing other important objectives such as watershed or ecosystem protection.

An obvious need is to synthesise available information and to improve the exchange of experience. Areas needing further investigation include: (i) approaches and methodologies for planning urban forestry programmes; (ii) the relative importance of the environmental and productive functions of urban forests; (iii) appropriate technical knowledge and institutional frameworks to support urban forestry programmes. Such tasks will necessarily be a joint effort by a variety of actors and development agencies, especially international research centres such as CIFOR and ICRAF, can play a significant role in this endeavour.

A specific research priority agenda for multipurpose urban forestry in developing countries must be created[21]. Establishing a working group should be considered, e.g. under the Forest Research Support Programme for Asia and the Pacific (FORSPA) and Asia Pacific Association for Forestry Research Institutions (APAFRI). Guidelines for steps for setting research priorities for urban forestry to be considered are listed in Box 7.

Box 7. Setting research priorities for urban forestry for multiple local needs

Step 1: Understand urban problems in developing countries by consulting with urban greening related resource persons, as documented, articulated and prioritised by urban initiatives.

Step 2: Identify urgent and important areas of urban greening research agenda which can assist in mitigation these urban problems by dialogue with presentations from community groups/landowners, municipal planners, urban forestry professionals, the development industry and practitioners.

Step 3: Compile the state-of-knowledge all of the potential functions of urban forests, and challenges confronting urban forest development.

Step 4: Identify gaps in major urban forestry research and prioritise an urban forestry research programme by national, regional and global panel discussions/workshops, with appropriate inputs from end users and clients of research results.

Step 5: Explore pilot research projects through collaborative efforts between community groups, intermediate groups and representatives of informal settlements and researchers (adopted from Kuchelmeister 1998).

6.3 Selecting appropriate types of project

The following three basic types of urban forestry projects can be distinguished: (i) stand-alone projects for specific sites; (ii) component projects; and (iii) "global projects". Other projects only provide technical assistance and training. Component projects involve incorporating urban forestry into water and sewer projects requiring additional forestland around settling ponds and reservoirs to serve as a catchment or greenways along areas to protect flood plains, etc. [22] There is much scope for forestry development projects to be integrated into urban infrastructure projects.

Individual projects are very suitable for major urban areas that require enough funding to merit consideration as individual investment projects. Large amounts of required infrastructure development, technical assistance and mobilization of resources make it

[21] A Regional Forestry Research Project could facilitate this by: (i) identifying and listing urban forestry research resources in the region; (ii) reviewing the experience of urban forestry related research undertaken by the private sector, NGOs, universities and other collaborative arrangements; (iii) analyzing the ways research institutions set research priorities, define clients, and transfer knowledge; and (iv) mobilizing resources to accomplish the above objectives.

[22] One example is the Australian-Indonesian Centre for Sustainable Urban and Regional Development (SURD) in Jakarta. The project is concerned with increasing the environmental and economic sustainability of urban and regional development in Indonesia and the wider region, of which increased planting and retainment of the natural environment, including vegetation, is an integral part. Integrating the natural and built environment is another key element of the strategy (Sharpe 1997).

economical to approach a city-wide greening effort as a single project. Global or multiple work projects resources, experience and approaches on urban forestry among several cities for which projects that would be costly on an individual basis.

Box 8. Urban Forestry Programme in the Philippines

The Clean and Green Programme is a national programme aimed at keeping and maintaining a clean, healthy and beautiful environment in Metropolitan Manila and other cities in the Philippines. Rehabilitating the environment in urban centres is envisioned to be achieved through various strategies: (i) Establishment of mini-forest and nature parks; (ii) greening of main thoroughfares, avenues, side streets and islands, greenbelt areas; (iii) establishment of city/town/school nurseries; (iv) enlistment of participation of as many sectors as possible in urban greening, initiation of an intensive information campaign promoting urban forestry and others. Expected output is the achievement of a tree-to-person ratio of 1:4 and considerable reduction in air, noise and sight pollution, improvement in micro-climate, provision of more green areas for recreation and relaxation, and notable contribution to the physiological and psychological well-being of urban residents (Palijon 1997).

6.4 Ensuring a suitable legal framework

For the effective, planned and systematic management of urban forest, a legal framework is necessary. Laws and regulations attempting to control the removal and conservation of trees and other vegetation in cities vary throughout the region (Table 5). In assessing the appropriateness of the legal framework of urban forestry, the following issues have to be evaluated: (i) how well does it protect trees? (ii) How well does it protect the structure and function of the urban forest? (iii) How well does it address the needs of the general public? (iv) How well does it protect private property rights? (v) With respect to all of the questions above, are the penalties appropriate? (vi) What are the enforcement challenges? (vii) What are various parties' recommendations for improving the bylaws?

Box 9. Integrated municipal environmental initiative and decentralization of urban forest of national interest - the case of Bantay Puerto Programme of Puerto Princesa, Philippines

Puerto Princesa, a relatively young city of 120,000 people, is famous for its forest and marine ecology. The city's vast land area and its rich seawaters have attracted great in-migration from all over the country. This uncontrolled population influx has brought havoc to its ecological system through illegal logging, slash-and-burn farming, blast and cyanide fishing. Such horrors have become a new mode of production among a few people greedy for quick money.

Consequently, the forest cover of Palawan, including Puerto Princesa City, has been reduced tremendously, from 75% in 1976 to 50% in 1992. Some parts of the city began to experience flash floods during heavy monsoon rains. The marine ecology is also under degradation. Furthermore, the government did not take any action for a long time as a result of which the rate of environment destruction accelerated at an unprecedented pace.

The Bantay Puerto Programme: The Bantay Puerto Programme promoted by Mayor Edward S. Hagedorn aims to protect, conserve, and rehabilitate the city's forest and marine resources so as to improve the quality of life of the people, and increase the city's economic contribution to the country by utilising its resources in a manner that is ecologically sustainable, socially equitable, and economically viable. The programme's key management concept is simple: **protect what is there, rehabilitate what has been destroyed, and plan for the judicious utilization of resources for sustainable development**.

One of the major components of the Bantay Puerto Programme is the Bantay Gubat or the Forest Watch whose major tasks are protection, conservation and rehabilitation of the city's forest areas. The Forest Watch has the power to confiscate illegal forest and marine produce, apprehend poachers and even file cases against them. A massive reforestation scheme (Pista Y Ang Kageban) was launched with the help of the local population. This scheme has mobilised about 80,000 people from all walks of life to plant and conserve trees.

The national government devolved certain powers to the local government to manage the programme. Further, the city government decentralised certain functions and responsibilities to village level bodies for effective administration and implementation of schemes.

The government also established a Cyanide Detection Test Laboratory in order to check the illegal catching of fish from the sea. This programme also provided a basis to formulate a national law banning slash and burn farming. Farmers engaged in this type of cultivation were provided with viable incentives for alternative occupations.

Approximately 700,000 trees were planted with a survival rate of 80% with the participation of the local population, thereby creating an environment for conservation. Encouraged by the city leadership's success in preserving its rich natural resources, the Department of Environment and Natural Resources (DENR) turned over the management of the world-renowned St. Paul Subterranean River National Park, together with the Irawan Watershed, to the Puerto Princesa City Government.

Source: PUERTO PRINCESA CITY 1998

Table 5. Urban tree protection in the Asia-Pacific region

Protection of trees mandated by	Australia	Hong Kong, China	Japan	South Korea, Seoul	New Zealand, Manukau	PR China, Nangjing	Philippines	Singapore
Designated special sites	●		●	●	●	●	●	●
Parks			●		●			
Historical areas/cultural sites			●		●			
Rare or large specimens			●	●	●	●		●
Beautiful or scenic views			●	●	●		●	
Scientific sites				●	●			
Districts designated by government including private land	●		●	●	●			
Species designated by government				●	●		●	
Listing of protected specimens required for regulation			●	●	●			
Good public acceptance of tree protection identified	●		●		●			
Government subsidises urban tree plantings			●					
Mapping/inventory of urban trees by government (public & private land)								
Permits or licenses required for activities altering or impacting trees (except for public safety)								
All trees (no minimum diameter) – public land	●	●	●		●	●		
All trees (no minimum diameter) – private land	●	●	●		●	●		
Minimum diameter of trees set – public land					●			●
Minimum diameter of trees set – private land			●		●			●
Fines for illegal removals of trees	●			●	●	●	●	●
Replanting required with diameter specified				●	●	●		●
Protection of growing environment directly affecting chosen trees	●		●		●	●		
New developments must submit site plans with standing trees/new plantings identified		●						
Strong government policy to minimise tree removals, maximise green space	●	●			●			
New, more comprehensive laws under study or recently enacted					●			

Source: PROFOUS/LOEB 1990

The wealthier cities in the region including Singapore and Hong Kong and Seoul[23] have created urban greening related laws and regulations. Some illustrative provisions follow:

- In New Zealand and Australia the law stipulates that 65% of the land in housing compounds be devoted to trees and grasses. Land use laws specify the areas in the cities where trees only are allowed and other important regulations exist, such as the motor traffic act which bars vehicles from parking in parks and areas under grass.
- In India, Sri Lanka, Nepal, China and many others, the law specifies the minimum reservation along roads, paths, waterways, etc.
- For instance, in Sri Lanka the law sets aside a minimum of 1 m on both sides of a public pathway as a reserve where only tree planting is permitted (Widanapathirana 1997).
- In the Philippines the "greening act" of 1994 (The House Bill 13376) states that residential, commercial and industrial estates should allocate at 30% of their gross area for open spaces for parks, playgrounds and recreational use (Palijon 1997).
- In Malaysia a new law requires real estate developers to allocate 20% of the land to green space (Philip, 1998).
- In Republic of Korea deregulation of greenbelt system is a political issue. Revising from conservation-oriented zoning into a harmonious conservation-development zoning to supply land for urban housing and business is advocated (Lee & Kumata 1998).

Tree ordinances are important and are best if they are not prescriptive but goal and outcome driven, setting flexible performance standards, a process that allows innovation within the constraints of local conditions.

Sometimes land use in general is regulated through informal agreements (UNDP 1996). Some regulations allow for flexibility. For instance, in some cities of Brazil, developers can exceed zoning limits on building height, by "trading" vertical space for green space. Thus, a developer limited to a two-story building may be given permission to built a four-story structure by providing additional open space in exchange (Zulauf 1996).

Using international conventions to promote economic development is a strategy deserving of attention in urban forestry. International laws relevant to urban forestry development include the UN Framework Conversion on Climate Change (CCC), Convention on Biological Diversity, Convention to Combat Desertification.[24] Such conventions could serve as tools for enhancing urban forest development in the region.

[23] *Regulatory law:* Most countries protect historic, rare and large or culturally significantly trees and forests. Religious motivation is often attached to trees in Asia (Profous & Loeb 1990). In metro Manila, a presidential degree obliged owners, or entitled others with owners' permission, to cultivate unused private lands and some public lands adjoining streets or highways. A summary of urban greening related laws see Department Of Local Administration 1994

In Sao Paulo, Brazil, a law dictates that for any new development in the city, 15 % of the land must be left as general area and another 5 % must be set aside for public use (Zulauf 1996). In India legal cases can be brought against public authorities and against tree violators.. In many cities, like in Delhi there are many laws, so that even government officers were not aware about the different rules and regulations (Singhal 1994, Asgish & Rao 1997).

[24] Example of an assessment with regard to agriculture and rural development (see LEUTNER 1997).

6.5 Facilitating institutional flexibility and public-private partnerships

Every urban forestry programme requires someone to hold responsibility and authority for implementation. This function is often discharged by a city department (e.g. responsible fore parks and recreation, natural resources, urban green), but it could be otherwise; bylaws and institutional ordinances should allow the institution to cooperage. For example, existing land use or zoning policies may discourage urban agriculture or other new green areas, or conversely, may permit unused municipal land for urban greening, as is the case in Manila and Papua New Guinea.

Tree boards may, in smaller cities, assume the operational role of the city forest department (Grey 1996) but could also be advisory, policy making or administrative.

Institutional arrangements should facilitate rather than inhibit urban forestry. For example, waste management institutions could consider changing their bylaws so that treated wastewater could be used for irrigation of tree plantations.

There is increasing participation by the private sector in urban forestry, either by private companies contracting for the execution of services previously executed by civil servants or by taking concessions in which they have the responsibility to obtain funds for the investments, a structure which saves the public sector the trouble of seeking funding for investments (Zulauf 1996).

Box 10. Public tree planting programme through public-private partnerships in Sao Paolo, Brazil

Permittee companies have been contracted, always through public bids, for planting trees along the roadways. The contract assigns a quota of trees that should be planted on a monthly basis and sets the technical specifications that should be complied with. The permittee company sells small advertising spots placed on the seedling-protection rails.

Prices are variable and float according to market demand. If the charges of the permittee are very high, he will not sell much and consequently will not be able to plant the number of trees he should. If, on the other hand, the charges are very low, the company may go bankrupt. This is the most advanced system of partnership, where the businessman bears the risks and the Municipality appropriates the product of the contract, the trees planted along the roadways, no additional cost except contract inspection (Zulauf 1996).

6.6 Ensuring viability and sustainability

6.6.1 Technical viability and environmental sustainability

Technical viability of an urban forestry programme depends on the capacity of the stakeholders to establish and maintain a programme and its intended benefit.

Environment suitability means that outside factors do not interfere with biological and ecological processes of a green space or reduce the benefits provided by the area. To sustain the benefits of the urban forest, managers must be adept at (i) evaluating and rating the ecological sensitivity of components of the urban forest, both within and outside the control of managers; (ii) setting up a monitoring systems on the priorities established in evaluation; (iii) allocating the majority of resources in critical areas for desired urban forest benefits; (iv) assuring continued flow of environmental benefits when the need to change land use occurs; (v) identifying potential negative impacts that might result from the green space itself and counteracting them (IDB 97).

6.6.2 Financial and economic viability

Assuring investors of a project's financial viability is crucial since the project would not be possible without their capital. Economic viability of an urban forestry project depends mostly on: (i) a reasonable financial rate of return to investors so as to guarantee their continued support and (ii) the socio-economic benefits to the public assuring wide public support.

Assessing the **socio-economic viability** of green space is a two-step process. Step one would consist of participatory consultation about publicly perceived benefits. Step two would be a comprehensive evaluation of the costs and benefits and how these accrue to different groups.

6.7 Sustaining funds for urban forestry

Regardless of the funding mechanism, urban forestry needs a sustainable source of revenues to achieve urban greening goals. At least two sources of funds should be sought; a creative mix of sources is required in most cases. Development assistance can provide initial financial contributions.

With proper planning, implementing urban forestry programmes does not need to be a big burden on the public budget. Unrecognised by forestry circles, many cities in the region already have some form of urban forestry activities through existing governmental and non-governmental initiatives to which private households contribute significantly.

Funding strategies might attempt a mix of public funding; cost avoidance, reduction and recovery; and trust and private funds. Securing at least two investment sources is essential to counteract the risk of unstable financial support. Strategies can entail a wide variety of public fund strategies, including general taxes, greening-specific taxes, permit and fee revenues, municipal bonds, and fines.

Planners can also solicit funding from parties that stand to gain the most although not necessary in financial terms. For instance, companies that have caused air pollution may want to improve their image by financing the establishment of green space. Similarly, residents whose property value will increase as a result of increased urban green may prove willing to contribute to a related municipal bond, beautification tax or other revenue-generating mechanism (Morgan 1996). Another key strategy for securing funding for green spaces is to incorporate their establishment into larger infrastructure projects. Reasons for this approach are: (i) urban tree planting is a minimal cost compared to other components; (ii) the benefit can be directly related to the infrastructure project (e.g. pollution control, noise abatement, watershed projects). For example, in Milwaukee, USA, trees are regarded as an integrated part of the urban infrastructure and the city includes trees into road building budgets, a minor part (2,2% of total project costs) (Miller 1997).

Box 11. Using a creative mix of public and private funds – the case of the Philippines

The Metropolitan Manila Development Authority (MMDA) and local government units (LGUs) such as the city and or municipal governments provide budget for urban forestry.

Some LGUs have their own budget allocation, while others have to draw from special funds, savings and donations/adoptions from several sectors like civic organizations (Rotary, Lions, Jaycees, Zeta Beta Rho Fraternity), and environmental (Haribon, World Ecologists, etc.), business, hotels, politicians and other concerned individuals and groups. Adopt-A-Street/Park programme is one of the strategies that provide additional management support to Urban Forestry (Palijon 1997).

In Santiago, Chile, citizens must pay a vehicle tax and can indicate how they would like that money to be spent, e.g. on parks or crime prevention (IDB 1997). Entrance fees for parks, permit fees for felling, and fines are common in China and other countries in the region.

Box 12. Funding parks through revenues in China

In many parks in China fruit species and bamboo for building are harvested; and lakes are stocked with crabs and fishes. Some park departments process the material grown, producing furniture, wine, and cured tea for sale. All these commodities contribute revenues towards the cost of park management: by combining recreation with utility the park department can meet 70% of its costs. If the park is of sufficient size there may be space to allow selected applicants to rent a plot for gardening (Cranes 1979, Kuchelmeister 1991).

Nowadays parks gain revenues from concessions for karaoke entertainment, aerobic and other dance performances, restaurants, etc. Traditional uses like Tai-ji and modern entertainment seem to happily coexist in many parks of China (personal observation).

It is anticipated that **private funding** will be the most essential component of public financing; it includes a very diverse menu including advertising, entrance fees, philanthropic donations, contribution in kind, etc. In Thailand donations in cash and kind are popular for urban green improvement in temple sites. In China, citizens are obliged to plant several trees

per year (Proufous NN). Corporate donations in exchange for publicity are another way to garner private funds, for example a condominium complex sponsoring a nearby city park or private sector companies assuming complete responsibility for managing entire parks.

Cost avoidance reductions and sharing mechanisms provide a means of accounting to show the public that urban forests can lessen municipal budgets. For instance, economic modelling in Australia shows that millions of dollars can be saved annually by reductions in engineering infrastructure costs for water supply, drainage, and cooling of buildings (Box 13).

Box 13. Cost avoidance: Savings of urban engineering infrastructure costs in Melbourne

Urbanization dramatically changes the water balance: (i) Average surface porosity is reduced by paving (30% impervious rooftops, paths and roads). (ii) Drains with high average flow velocity replace natural watercourses, thus speeding storm water to discharge points.

The net effect of these changes is an increase of run-off at the property level by a factor of 2 or more, and an increase of flood peaking at downstream point by a factor of 10 or more. Hence, engineering infrastructure costs are imposed on the urban environment as a result of: (i) Disturbing the natural environment initially by the removal of natural vegetation, construction of paths and roads and water supply dams in distant catchment. (ii) Correcting the adverse effects of this disturbance, by having to construct drains and sewers, treatment plants and flood control downstream.

It was calculated that millions of dollars in engineering infrastructure could be saved through the development and management of urban forests.

Source: French & Sharpe 1976

Debt-for-nature swaps and the establishment of innovative trust funds with the private sector may provide communities with financing for urban forests without making additional claims on capital-scarce public accounts (IDB 1997).

International Conventions like the UN Framework Convention on Climate Change (CCC), the Convention on Biological Diversity, and the Convention to Combat Desertification can also be further explored as new mechanisms to fund urban forestry development projects.

7. FUTURE DIRECTIONS AND RECOMMENDATIONS

7.1 Future directions and urban forestry vision 2010

In the next decade, the Asia-Pacific region will become predominantly urbanized. Urban concentration can produce growth and break the cycle of poverty and deterioration, provided that the problems generated by dense concentration of population and activities are rectified or limited within the context of the dynamic of urbanization. Forestry and related professionals can actively facilitate local initiatives to mitigate these urban problems or risking to become a marginal professional group in development cooperation in the region in the next century.

7.1.1 Urban areas - the test case for development

In the Asia-Pacific region for the first time in its history, rapid growth of population and its concentration in cities around, constitutes the crucial element affecting the long-term outlook for the people in the region and beyond. For better or for worse, the development of contemporary societies in the region will largely depend on understanding and managing the growth of cities. Urban areas will increasingly become the test beds for

- the adequacy of political institutions,
- the performance of government agencies, and
- the effectiveness of programmes to combat social exclusion and to promote economic development.

Historically, the decision to direct most international development assistance to rural rather than urban areas has also much to do with the traditionally negative image of the city and its impact on rural areas. This image has only recently been under reconsideration in international cooperation policies and those adopted by many governments in the region.

In this context urban greening is increasingly acknowledged as one development tool. In current urban greening initiatives professional foresters still play a minor role.

7.1.2 Options for development of urban forestry

The question how, where and at what pace urban forestry is developing in the region will depend on the degree of the pressure to change the professional forestry profile and the speed forestry professionals are willing to react and adapt to this new demand.

To better understand the direction forestry might evolve, imagine that it is the year 2010 and one would observe a presentation of a case study of a successful urban forestry development in a poor neighbourhood (Box 14) in a lecture on forest history of the last century. Students would probably not question if it was the right decision at the late 90's to reallocate resources from rural to urban forestry. Students in 2010 studying forest history of the last century, would not only learn the insight in the 70s clarified that forestry is about people, and only about trees

as long as they are serving the needs of the people. Serving the requirements of an increasingly urbanizing world would be regarded as a logical further step, in a people-centred forestry approach.

As increasingly more people are living in urban concentrations in the region, the demand of local initiatives and urban planners to improve the quality of life by applying ecological principles is growing. Technical options, which are a win-win situation for both ecology and economy are increasingly acknowledged. In this context multi-functional urban vegetation resource management and conservation is increasingly becoming one key element in the search of designing cities by nature.

Box 14. An urban forestry success story of a poor neighbourhood seen from the year 2010

A poor neighbourhood, somewhere in Asia, was a typical Settlement of Despair in the early 90s. People were struggling for survival and basic needs, living in a nearly treeless hot environment, faced with problems of floods, unclean drinking water contaminated by waste, and no recreation facilities. Also living conditions were very harsh local people and their leaders had a vision to improve the neighbourhood. Tree planting was more than a symbol of hope to invest in the future.

Most of the residents of this unauthorized settlement came from rural areas nearby. In the area they migrated from, a million-dollar social forestry project was implemented, with the aim to stop migration. However, migration still continued. Realizing this, it was a wise decision to re-allocate part of resources of the rural project to an urban greening project in the neighbourhood. This project provided the state-of-art on urban greening, thus helping the neighbourhood to avoid costly mistakes in urban greening. Residents proud of their achievements called their neighbourhood Tree City.

Children living in this neighbourhood of hope in the year 2010 cannot imagine a life without basic infrastructure, including trees. For this kids multi-functional neighbourhood parks used for treatment of waste water and its reuse, flood control, gardening and recreation, are as "natural" as greenways connected with this parks and all streets were aligned with trees.

This trend of a search for design towns and cities by nature has basically two implications for foresters working in the region:

(i) ignoring this trend, thus risking to become a marginal professional group in development cooperation in the medium-term
(ii) or actively formulating an extended mandate and vision, and lobbying, communicating and allocating resources for this implementation of this vision, thus becoming significant actors in modelling the human settlements for the new millennium.

7.1.3 Urban Forestry Vision 2010

Forestry history has shown that lobbying by non-foresters committed to forestry and people, cooperating with far-sighted internationally reputed foresters, could facilitate the radical change required in the forestry education, training and work in the 70s. At this period it was clearly recognized in development cooperation that forestry is about people, and only about forests and trees, as long as serving the people's need. Since at that time most people in

developing countries were living in the rural areas, the rural focus was appropriate. As a result of this shift of perspective in forestry is that the basket of technical options (agroforestry land use, multipurpose species, etc.) has increased dramatically and our understanding about the relationship and dependency between rural people and forests has improved very much, too. With the trend of urbanization, again it is overdue, to make the next radical shift in the professional education, training and work by a strong focus of the needs and values of urban societies in the region.

Once an agreement of an urban forestry vision (Example see Box 15) have been reached in development cooperation, i.e. what to do and where to set priories in forestry, many options exist how to adopt this vision to the local situation.

Diverse ongoing urban forestry initiatives and practices clearly demonstrate the urban forestry concept in action. These diverse approaches provide an appropriate framework about the benefits, challenges and actions required to facilitate the implementation of an urban forestry vision 2010. Once, urban forestry is on the top agenda of urban development, a new forestry boom similar like the one when tropical forests were identified as a top priority, is likely to occur.

Box 15. Urban Forestry Vision 2010 for greener towns and cities in the region

In the Asia-Pacific region towns and cities establish trees as one vital component of the basic urban infrastructure and manage urban forests like any other part of infrastructure by the year 2010.

7.2 Recommendations

Experience from other parts of the world on good urban forest practices and successful programme approaches can help planners and urban greening initiatives to avoid costly trials and optimise use of scare resources. Region-wide training courses and shared research facilities could greatly benefit all the regional cities.

Well-planned urban forests are essential for cities offering a high quality of life. Equally important is to integrate urban forestry into a wide variety of urban development projects including sanitation, drainage, housing, and infrastructure. Such large urban projects hold much promise for quickly expanding urban greening in the region. Forestry projects must encourage the strengthening of local rural-urban linkages in a complementary manner that benefits both sides.

The following are basic recommendations in order to boost the development, management and conservation of urban forests. They require local action by the countries of the region as well as reliable assistance and support from their international partners from outside the region:

1. Encourage the strengthening of rural-urban linkages in a complementary manner that benefits both rural as well as urban populations, thus supporting a sustainable and more socially just development process; overcoming the negative attitude towards the urbanization process, and actively assist in solving urban problems.

2. Support and strengthen local initiatives in design, conservation and management of urban forests through interactive participation of all stakeholders. In more affluent cities the focus must be on poor neighbourhoods, focusing on vulnerable groups with a sensitive gender perspective.
3. Allocate significant resources to multipurpose urban forestry with the aim of making trees compatible and functional for urban design and meeting the basic needs and values of local communities;
4. Protect existing urban trees, rehabilitate what has been destroyed, and plan for the judicious utilization of resources for sustainable development.
5. Quantify urban forestry related targets, integrate monitoring and evaluation systems in healthy cities to assess urban greening related indicators; include urban forest resources in (global) forest resource assessments;
6. Integrate urban forestry into urban development projects, e.g. sanitation, housing, transportation and infrastructure;
7. Facilitate sustainability of urban forestry investment for long periods of time (programme approach, financing in phases);
8. Encourage the use of a wide variety of multipurpose species with focus on native plants for biodiversity objectives;
9. Include a priority research agenda for urban forestry: participatory urban forestry, in-depth investigation of the relative importance of the environmental and productive functions of urban forests for different social groups and ecozones; validate urban forests through the identification, selection and trials of multipurpose trees and shrubs;
10. Increase dramatically training opportunities and develop curricula for multipurpose urban forestry with regard to environmental and professional education.
11. Develop guidelines, manuals and state-of the art fact sheets of good urban forestry practices; and then disseminate materials to urban decision-makers and donor agencies.
12. Provide multiple sources of finance with strong participation of the private and non-governmental sector; secure at least two sources of sustained finance, and where appropriate incorporate tree budgets into regular municipal budget lines (e.g. street trees);
13. Promote the creation of urban greening research and development networks (at both national and regional levels) and facilitate exchange with other urban initiatives.

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ANNEX 1. URBANIZATION IN THE ASIA-PACIFIC REGION

	Urban Population (000)			Percent Urban			Growth Rate		CITIES	Absolute poverty		
	1975	1995	2025	1975	1995	2025	Urban	Rural	(<0.75mill.	Total	Urban	Rural
World	1,538,346	2,584,454	5,065,334	38	45	61	2.5	0.8	369	x	x	x
Africa	104,123	250,276	804,239	25	34	54	4.4	2.0	35	x	x	x
South America	137,578	249,331	406,679	64	78	88	2.5	-0.8	31	x	x	x
Asia	592,282	1,197,970	2,718,435	25	35	55	3.3	0.8	154	x	x	x
Study Area	506,316	1,010,873	2,303,904									
Bangladesh	7,108	22,034	78,430	9	18	40	5.3	1.5	3	78	x	86
Bhutan	39	105	597	3	6	19	4.8	1.0	0	x	x	90
Cambodia	731	2,123	8,567	10	21	44	6.2	2.2	0	x	x	x
China	160,047	369,492	831,880	17	30	55	4.0	0.0	51	9	x	13
India	132,272	250,681	629,757	21	27	45	2.9	1.6	34	40	33	42
Indonesia	26,259	69,992	167,393	19	35	61	4.5	0.1	9	25	20	27
Japan	84,409	97,120	103,190	76	78	85	0.4	-0.2	8	x	x	x
Korea DPR	9,356	14,650	25,094	56	61	75	2.4	1.2	1	x	x	20
Korea Rep.	16,947	36,572	50,987	48	81	94	2.9	-5.7	6	5	5	4
Lao PDR	344	1,060	4,316	11	22	45	6.1	2.2	0	x	x	85
Malaysia	4,616	10,814	22,942	38	54	73	3.9	0.8	1	16	8	22
Mongolia	704	1,468	2,926	49	61	76	3.0	0.6	0	x	x	x
Myanmar	7,282	12,188	35,759	24	26	47	3.3	1.8	1	35	x	40
Nepal	649	2,996	13,959	5	14	34	7.1	2.0	0	60	51	61
Pakistan	19,733	48,742	161,579	26	35	57	4.4	2.0	8	28	26	29
Philippines	15,294	36,614	77,622	36	54	74	4.2	-0.1	2	54	40	64
Singapore	2,263	2,848	3,355	100	100	100	1.0	0	1	x	x	x
Sri Lanka	2,998	4,108	10,660	22	22	43	2.2	1.0	0	39	15	46
Thailand	6,244	11,787	28,756	15	20	39	2.5	0.8	1	30	17	34
Vietnam	9,021	15,479	46,135	19	21	39	3.1	2.0	2	54	x	60
Oceania	15,389	20,063	30,712	72	70	75	1.5	1.7	6	x	x	x
Australia	11,943	15,318	21,852	86	85	89	1.3	1.9	5	x	x	x
Fiji	212	319	692	37	41	60	2.2	1.1	0	x	x	20
New Zealand	2,552	3,077	4,011	83	86	92	1.5	-0.4	1	x	x	x
Papua New Guinea	326	690	2,431	12	16	32	3.6	2.0	0	73	10	75
Solomon Island	17	65	323	9	17	38	6.5	2.7	0	x	x	60

Source: compiled from WRI 1996

ANNEX 2. ROLES AND IMPORTANCE OF URBAN TREES AND FORESTS

A2.1 A canopy of benefits

Urban forests and trees provide both tangible and less tangible benefits important for a good quality of life. The consumable products include fuelwood, food, fodder, and poles. They improve air, water and land resources, provide habitats for wildlife, control erosion, protect watersheds for urban water supply and can be an outlet for safe disposal of urban wastes. Additional benefits to society, including it low-income citizens are significant and relate to improvement of health, recreation, environmental education, aesthetics, and enhancement of landscape.

Depending on urban forest management objectives, the focus is quite different in wealthier cities and poorer settlements. Multiple purpose urban forests are required for both rich and poor cities. Examples of multi-functional parks can demonstrate how many benefits can be combined in urban improvement projects working with the poor (Table A1). Appropriate urban forestry has to focus on those benefits, which are desired for local value first.

Table A1. Major benefits of the urban forest in conventional and development-oriented forestry

Multipurpose Urban Development Forestry = Urban Trees for Local Values	
Conventional urban forestry focuses on amenity value in "developed countries"	**Development forestry focuses on economic benefits, employment and support of agriculture in low income cities, mostly in "developing countries"**
• reduces noise • reduces air pollution • reduces climatic extremes • cools cities and planet • conserves energy • provides beauty and shade • improves water quality • controls water runoff • provides habitat for wildlife • increases recreation value • increases health/well being	• provides food • provides fuel • provides fodder • provides fencing material • provides timber • provides medicine, oil • provides raw material, fibre • increases cash/subsistence income • provides employment • improves gardening conditions • plus all benefits of conventional forestry

Source: modified from Kuchelmeister 1991

A2.2 Meeting basic needs

The majority of the people in the region are poor and have an urgent need for necessities for a reasonable quality of life: adequate food, shelter, potable water and jobs. Urban forests can provide a significant portion of these needs. Urban forests can be set aside for food production, timber for shelter and fodder for livestock. Urban green space also provides recreation and employment opportunities. Diverse basic human needs can be satisfied with products from trees and shrubs; food and fuel are among the most pressing needs in

developing countries. Tree products, if sold, provide direct cash benefits; if used within the household they provide indirect cash benefits by freeing cash income for other uses. Trees themselves can improve existing savings/investments, secure tenure or increase property value.

A2.2.1 Fuel

In many smaller urban centres in Asia and Africa, between 50 and 90% of domestic energy supply comes from biomass fuel (WRI 1996). Poor people use small twigs and leaves for firewood. Most fuelwood is bought from peri-urban areas or beyond (Carter 1993) but it seems that a considerable proportion is collected within the city (Kuchelmeister 1991). Aware of this demand, landless and marginal farmers have resorted to collecting fuelwood, especially in open-access forest. As a result forests around urban centres are being degraded.[25] Poor people often have to spend a large proportion of their meagre income on fuelwood and thus have no choice but to over-exploit any trees within reach. Urban forests can alleviate this pressure (Kuchelmeister & Braatz 1993).

Recognising that deforestation in and around arid urban areas is closely related to fuel (energy) requirements, it must be assumed that fuelwood plantations adjacent to or in close proximity to population centres can make an important contribution to meeting urban demands. However, such urban related plantations (usually of exotic species) with few notable exceptions, such as Ethiopia, have not improved fuelwood supply. Often, instead of fuelwood more lucrative poles were produced or poor people did not have sufficient income to buy fuelwood. In order that this paradox can be resolved, less formal "softer" methods involving a mixture of agriculture, agroforestry and plantations (established and managed by small holders) or natural forest management should be adopted (Cline-Cole 1991, Leach & Mearns 1989).

Fuelwood related activities such as urban energy surveys and peri-urban fuelwood production are fields of action in which forestry projects in the region have been engaged for a long time in activities.

A2.2.2 Timber and poles

Building with organic materials in urban areas is less common than in the countryside. Nevertheless, organic materials are still very widely used in the urban areas of the poorest countries. In Bangladesh 53% of walls and 40% of roofs of urban houses are made of bamboo or straw. Availability of an adequate supply of organic materials of the right quality for building is a problem for a significant and growing number of households. The problem is most severe in arid areas and in the vicinity of cities (Wells 1995).

Building materials like poles, branches, leaves for thatching, shade trees for human livestock and crops; windbreaks and shelterbelts for protection of settlements against sand and wind;

[25]Examples about India (Bowonder et al 1987), Nepal (Poudyal 1996, Thapa & Weber 1994), Malaysia (Hadikusamah & Karyono 1991). Pakistan (FAO 1993), Philippines (Cruz et al 1991, Remedio & Bensel 1992), Thailand (Polthanee et al 1991), Vietnam (Bailey 1990) and other countries in the Region are well documented.

and living fences to protect and screen living sites are other appreciated values of urban trees. Progress has been made in incorporating timber harvesting and related forest products with intensive outdoor recreation activities in urban forest (Kuchelmeister 1991).

A2.2.3 Fodder

In the low-income cities of many countries urban green space provides grazing for livestock belonging to urban residents. Trees are an important source of animal fodder, particularly during dry seasons. In some countries like Pakistan the need for fodder is so great that even amenity trees are lopped (Carter 1993).

A2.2.4 Food

Many urban trees suitable for resource-poor settlements can provide food, particularly fruit, but also edible leaves, shoots and even flowers. Urban tree crops have been overlooked in nutrition surveys, but they can significantly contribute to food security in poor areas (UNDP 1996, Smit 1997). Often low-care wild edible plants are excellent candidates for use as ornamental roadside plantings (Kuchelmeister 1993). In Queensland, Australia, a park has been turned into an 'edible' public park to provide fruit, herbs, flowers and vegetables to anyone walking by. Local residents and schools carry out any necessary work and maintenance. Research for the Himalayan region showed that wild fruit trees and other multi-purpose trees are excellent candidates for urban forestry because they are both ornamentals and bear fruit and other valuable products (Parmar 1989).

Food from agroforestry gardens in the Pacific region (Thaman 1987) and elsewhere is significant.

A2.3 Environmental Services

A2.3.1 Climate improvement

Urban areas tend to be much warmer than the surrounding countryside. Urban vegetation can moderate the heat island effect of urban areas by (i) direct effect on human comfort and (ii) effect on the energy budget of urban buildings, where air conditioning is used. Effects can be either significant or negligible, depending on the size, spacing and design of the urban forests.

Trees modify climate in three ways: by acting as a windbreak, by providing shade and through evapotranspiration. It is reported that tree shade can reduce the average air temperature in buildings by as much as 5°C (Akbari et al 1992). Studies in Malaysia showed that under trees air temperature could be 4°C lower than in exposed spaces (Yap 199). For Nangjing, China, it is claimed that the average summer temperature has decreased from 32.2° to 29.4° between 1949 and 1991 by the cooling effect of the trees extensively planted during this period (CARTER 1993). Scientists in Beijing calculated that with every 10% increase of green space the temperature decreases by 1°C. Since the heat island intensity of Beijing has been

calculated at 4 to 5 °C, it may be possible (at least in theory) to control the heat island by increasing of green space by over 50% (Profous NN).

The urban poor appreciate trees for the shelter they provide in lieu of permanent structures; many small business people use the shade of street trees. In Calcutta, avenue trees provide space to a large number of poor people who cannot afford to pay the high rent needed to rent space in the city market (Malhotra & Kumar 1987).

A2.3.2 Air quality improvement

While air pollution in many cities in the more developed countries in the region has dropped over the years, air pollution level has been rising in other cities. Planting vegetation to reduce air pollution is increasingly utilised as an effective approach (IDB 1997). An increasing number of urban forestry projects address pollution control, e.g. Kuala Lumpur (Abedullah 1990), Bangkok, Manila, Hong Kong, and Seoul. As an example from outside the region, Stuttgart, an industrial city in south-west Germany, used the "smog-busting" ability of trees to literally change its urban climate. The arrangement of buildings in the city centre blocks the wind, allowing air pollution to build up. Changes in overall city planning were instituted; some buildings were removed and tree cover was re-established, creating corridors that significantly improved the city's air quality (Whiston Spirn 1984).

Box A1. Multipurpose values of avenue trees in Calcutta

A survey of avenue trees growing along a 4.6-km stretch of a trunk road in Calcutta was undertaken in 1996. Out of 400 trees, 142 were associated with some kind of human activities. Since the total number of mature trees was 138, more than half (64%) were in use.

A number of trees were associated with more than one activity. Religious activities occurred in the form of places of worship like temples. Open or covered structures. Public utilities include places for parking cycle rickshas and carts, bus stop shelters, rest and recreation, advertisements and notice boards, clothes drying, etc. Economic activities relate to selling of food, repair of cycles, barbershops, teashops, etc.

The most heavily used trees are large Banyans (*Ficus benganensis*). The most important shade trees are fast growing native evergreens that provide shade throughout the year. Other trees withstand storms with a high probability of survival, while still others are fruit bearing, or nesting habitat for birds.

The avenue trees provide space to a large number of poor who cannot afford to pay the exorbitant rates to rent a place to operate in the organised city market.

The study showed a direct link between high human activities and a high density of trees. Local peoples protect and care for the trees. If people worshipped a particular tree, its chance of survival was almost 100%.

Source: Malhotra & Kumar 1987

Urban trees interact with the atmosphere and surrounding urban surfaces. It has been suggested that they affect air quality in the following ways. (i) conversion of carbon dioxide to oxygen through photosynthesis;(ii) Trees intercept particulate pollutants (dust, ash, pollen and smoke) and absorb toxic gases such as ozone, sulphur dioxide, and nitrogen dioxide, thus

removing them from the atmosphere. (iii) Trees emit various volatile organic compounds, such as isoprene and monoterpenes, that can contribute to ozone formation in cities. (iv) By transpiring water and shading surfaces, trees lower local air temperatures. This cooling can reduce emission of volatile organic compounds from both biogenic and anthropogenic sources, and can alter ozone-forming processes, thereby reducing local ozone levels. In the absence of the cooling effect of trees, high temperatures would tend to contribute to the formation of photochemical smog, since as much as one-third of smog is directly related to the heat island effect (greater warmth compared to rural environment). (v) by reducing building temperature extremes in both summer and winter, trees can reduce energy use in buildings and consequently reduce pollution emissions from power-generating facilities.

Box A2. Air quality improvement: Results from the Chicago Urban Forest Climate Project

Results from a research project indicate that trees (11-percent tree cover) in the city of Chicago, Illinois (USA), removed 591 metric tons (t) of air pollution in 1991. The greatest removal was of particulate matter less than 10 microns (212 t), followed by ozone (191 t), nitrogen dioxide (89 t), sulphur dioxide (84 t), and carbon monoxide (15 t). Average hourly improvement in air quality (in-leaf season) due to pollution removal from trees in the Chicago area was less than 0.4%. Maximum hourly improvement was estimated at 1.3% for sulphur dioxide, through local improvements in air quality can reach 5 to 10% or greater in areas of high tree cover (Nowak 1995).

Conversely, it must be stressed that air pollutants injure trees by damaging their foliage and impairing the process of photosynthesis. Research on trees which are relatively resistant to pollutants has been conducted in China (Kuchelmeister 1991), in India, Republic of Korea, India (Khan et al 1989), Malaysia and Thailand (Kaitpraneet et al 1978), to name a few.

A2.3.3 Energy savings, global warming and carbon dioxide reduction

By lowering air temperature and shading buildings, trees can reduce the use of energy for air conditioning in the summer, and through blocking winter winds, they can reduce the consumption of energy for heating (Mcpherson & Rowntree 1993).

In the tropics and subtropics the shade of a tree at the southern side of a house can reduce the absorption of temperature of a building of 50 watt/m^2 to one fifth. A tree with a 10-m wide canopy saves 50 m^2 energy. 250,000 trees can save as much energy as is produced by a modern nuclear plant of 12,000 megawatts. A tree can be a natural air conditioner. The evaporation from a single large tree can produce the cooling effect of 10 room-sized air conditioners operating 20 hours a day.

Energy saving through tree planting around houses ranges from 10 to 50% for cooling and from 4 to 22% for heating.

Trees and related urban vegetation can significantly contribute to improving the air quality by cooling and cleaning the air. Energy conserving landscaping by strategically planting trees can maintain comfort without air conditioning and thus needs to be systematically incorporated in housing projects in resource-poor settlements. Since urban trees reduce the need to burn fossil energy, they are a more important investment for green house mitigation than rural trees.

Use of renewable energy sources at a local level conserves fossil fuels and the land or waters from which they are recovered, reduces the transport of fuels, reduces need for the building of transport routes (power lines, roads and rails), and reduces processing (refineries, power stations, etc.). While the role of urban forests in carbon sequestration is limited compared to forests in rural areas, urban trees do play a role in controlling global climate change through indirectly decreasing the use of fossil fuels for building heating and cooling.

Carbon dioxide is a most important component of air pollution and smog, and is a principal contributor to the greenhouse effect. Any action that lowers fuel consumption also lowers the amount of carbon injected into the atmosphere and global warming is thereby slowed down. Tree type, planting location and its intensity, and climate variations are just a few of the factors that determine the extent of saving (Akbari et al 1992).

The major carbon impact of urban trees is through energy conservation. Since this value is directly related to canopy cover, it follows that average tree size, health and age are critical factors in determining the urban forest's ability to offset carbon emissions. Investment in tree care is thereby critical to maximising the urban forest's effect on global warming (Kuchelmeister/Braatz 1993). When added to the ability of urban trees to store carbon, the energy saving potential (from lower air condition requirements) of an urban tree is up to fifteen times higher than the benefit of a rural tree (Moll & Young 1992).

Nonetheless, energy conservation through strategic planting of trees is very seldom deliberately included in urban housing projects in low-income settlements.[26] Research on landscape planning for energy conservation including tree planting has been conducted in South Korea (Kim 1986).

A2.3.4 Noise abatement

Noise often reaches unhealthy levels in large cities. Typically, noise from cars, trains and planes can exceed 100 decibels, twice the level at which noise becomes troublesome. The health risk is high, as shown by research in developed countries. Poor people living close to heavy industry, commercial and traffic corridors often get exposed to the highest levels of noise particularly since all too often the building materials used in low-income settlements do not insulate residents from noise pollution.

Trees and vegetation can help to abate noise through transferring sound to other objects, altering the direction of sound, bouncing the sound back to its source, bending sound waves around an object, and mixing unwanted sound with more pleasing sounds. Trees and other

[26] A good example is a slum-upgrading project in Florida (Parker 1997).

vegetation in conjunction with land forms reduce highway noise by 6-15 decibels while trees in combination with solid barriers reduce noise by 5-8 decibels; by comparison, a typical masonry wall sound barrier reduces noise levels by 15 decibels. Especially advantageous to humans is the fact that plants absorb more high frequency noise than low, since higher frequency noises are most distressing to people (Miller 1997).

A2.3.5 Water use, reuse and conservation

Deterioration of watersheds in and around cities has alarming consequences in terms of insufficient quantity and quality of water for urban dwellers. Trees and other vegetation can help in protection of urban water supply, wastewater treatment systems and storm water management.

Water supply: Protection of the suburban and rural areas that serve as the source of cities' water supplies is one of the more traditional fields of action of urban forestry, as witnessed in the case of Hong Kong, or Nepal (Braatz 1983). There is still much scope for integrating forestry with other water resource initiatives.[27]

Storm water control: High rainfall areas are subject to flooding along streams and rivers. Floods cause considerable damage in the region. Since many informal settlements are located in flood prone areas, they are the most hit and often the least assisted after flooding. As more forested areas are replaced by pavement, less storm water is infiltrated into the ground and runoff volume increases.

Trees can thus be purposefully used to help achieve the objectives of storm water management at optimal costs, which are to prevent the loss of life, to reduce property damage by runoff of severe storms; to prevent land and watercourse erosion, to protect water resources from pollution, to preserve natural watercourses and their ecosystems and to achieve objectives. The traditional engineering approach accepts higher flow rates and reinforces the watercourse with concrete to prevent damage by flooding. This is effective, but expensive and has no ecological value (Parks Department 1994).

Integrated storm water and pollution control may involve water collection through the following urban greening techniques: (i) using wetland and parks as important components of a city's flood control system; (ii) designing roofs and pavements to distribute water onto grassed/vegetated areas or sumps or bioswales. They also recharge aquifers and reduce runoff, flash flooding and pollution of the natural drainage system. Further they also provide or augment water supply from natural aquifers.

Parks can be designed for flood control. Interference with other park uses (such as recreation), occurs only in the short periods when the parks' wetland and flood plains are actually flooded. Tree species can be selected which can withstand water for up to a week or more. In Tokyo urban forest management systems have changed to multi-storied forests from single-storied to improve water conservation (Yuji 95).

[27] E.g. water supply catchment should be an important input to the deliberations on water resources of the UN Commission on Sustainable Development during its 6th session in April 1998 (Michaelsen 1997).

It may be noted that storm water runoff has become the major source of pollutants entering many urban waterways and is a major cause of reduction in the quality of waters in rivers and the coastal environment; runoff can also pollute groundwater, in some cases irreversibly (for an example from Australia, see Box 15). The quantity of storm water that runs off of Australian cities each year is about equal to the amount consumed from domestic storage. Therefore there is a great potential for expanded collection, storage and re-use of storm water for non-drinking purposes (French & Sharpe 1976).

A2.3.6 Soil conservation

With steep terrain and where there is little vegetation and harsh seasonal rains, landslides can be common and can be a constant threat to people's lives and homes. Trees and forests can through water (run-off) management contribute to achieving the best soil erosion control.

A2.3.7 Waste Management

Urban forestry is an opportunity to enhance water services in an integrated and system-wide manner. Most poor cities in the region face significant wastewater treatment challenges and could integrate stabilization ponds into park systems and could reuse wastewater for urban forestry. Tree planting can also offer a beneficial use for solid waste landfill sites.

Solid waste and land reclamation: Wealthy cities are vast producers of solid waste, the disposal of which has become a serious problem. Per capita solid waste generation is still low in cities such as Calcutta, India but as their per capita income increases, the quantity of solid waste is likely to grow. Urban greening offers some solutions, such as composting. Recycling of waste from urban forest can play a large role in solid waste management, especially in cities in developing countries, and should be encouraged not only to reduce the need to dispose of vast amounts of waste but also to secure new raw materials from extraction for re-use.

Unused and degraded land and landfill sites can be reclaimed through afforestation (Wong 1995). It is a practice applied in Hong Kong (Chan et al 1996). The idea of greening parks on terminated landfills, i.e. where controlled disposal of waste material to land is exercised seems to have become popular (IDB 1997).

Waste water: In the developing world, it is estimated that more than 90% of sewage is discharged directly into rivers, lakes, and coastal waters without treatment of any kind. Disposal of domestic wastewater remains a problem in wealthier regions, although by no means as severe as in poor areas (WRI 1996).

Irrigated tree plantations can be a safe and productive means of wastewater disposal; not surprisingly, this has been a tradition in many arid zones like Egypt and Iran (Braatz 1993). Reused waste city water not only recharges aquifers but also reduces the demand exerted on scarce water reserves. The practice of at least partially treating wastewater in stabilization ponds integrated into park systems and other green areas must be considered as an economic and ecological alternative to conventional urban wastewater treatment. Recycling wastewater into green areas is more economical than finding ways to dispose of it somewhere else (IDB

1997). A study in the city of Battambang (the second largest city in Cambodia) confirmed that engineered ponds and wetlands are a less costly alternative to conventional waste treatment.

The major disadvantage of treated wastewater is the large land requirement for treatment. Making the open space economically attractive through multiple use can counteract this. The practice of treated sewage fisheries along with garbage and sewage farming in peri-urban wetlands play a significant role in waste recycling and urban sanitation in Calcutta. When using wastewater to irrigate edible crops the potential health risks must be evaluated (IDB 1997, FAO 1989). A slum upgrading in Durban, South Africa demonstrated that wastewater treatment and recreation are compatible and are accepted (IUCN 1994, ICLEI NN)). In order for the treatment plant to be self-sustaining, revenue must be generated through fish production, user fees and other means.

A2.3.8 Natural conservation - wildlife habitat and biodiversity

Conservation of biodiversity and especially wildlife does not come to mind as a general function of city trees and forests; these roles are predominantly served by rural forest and woodland ecosystems rather than urban forests. Nevertheless, given that increased diversity is now considered to be paramount in the field of nature conservation, the urban forest is expected to play its part, even if limited. Thus, although generally highly valued in urban areas, wildlife receives relatively little consideration in day-to-day urban forest management (Grey 1996). Biodiversity is increasingly stressed in urban forestry management in the region, e.g. in Malaysia, where selected forest species in urban area may serve as a form of ex-situ conservation (Yap 1995). Kuala Lumpur is the only city in the region with primary forest in its centre (Ariffin 1989).

Although urban forests may contain less biological diversity than rural woodlands, the animals that occur in the urban forests are still numerous (Moll & Young 1992). For instance, a study in Jakarta found that birds in an urban environment tend to have low species-richness but high density (Indrawan & Wirakusumah 1995.). Quite often botanical gardens, located in the vicinity of urban centres have a richness of biodiversity (Katzir 1996).

Older gardens and parks, not to mention churchyards, often contain noticeably rich biodiversity; these are the main habitats of urban plants and animals. Older, well-established installations attract, for instance, birds and mammals, the natural habitat of which is the forest (Nilsson & Rundup 1997).

On a larger scale urban forests can create or restore biological diversity that will reconnect a city to its surrounding bioregion. Suburban wetlands can be some of the most productive natural ecosystems and can provide important habitat for fauna. Incorporating green areas through networks will improve biological conservation and biodiversity; e.g. greenbelts and greenways (linear parks) can serve as biological corridors (Groome 1990, IDB 1997).

A2.4 Social benefits

A2.4.1 Health

Research indicates that vegetation and nature reinforce spontaneous attention by people, allowing sensory apparatus to relax and infusing viewers with fresh energy. Visits to green areas bring relaxation and sharpen concentration, since people only need to use their spontaneous attention. Also, fresh air and sunlight are essential for diurnal and annual rhythms.

There are some reports that hospitalised patients recovered faster when they had a view through a window, allowing them to see trees (Ulrich 1984) and that periods spent outdoors in parks have an actual medicinal value for patients and residents of hospitals, old people's homes and homes for the sick. People became happier, slept better, needed less medication, were less restless and far more talkative (Ulrich et al. 1991).

Certainly, improving air quality through planting vegetation has passive impact on health with such obvious benefits as decreased incidence of respiratory illnesses. Shade trees reduce ultraviolet light exposure, thereby lowering the risks of harmful health effects such as skin cancer and cataracts. For that reason urban forests are increasingly recognised as a component to mitigate ground-level ozone and to reduce air pollution (IDB 1997).

A2.4.2 Employment

Urban forestry can provide jobs for the poor as both skilled and unskilled labourers. Tree planting and especially urban agroforestry systems can be labour-intensive and provide both initial start up jobs as well as more permanent employment in tree care (IDB 1997).

In wealthier countries the arboricultural industry is a significant business, often using heavy machinery like cranes for tree pruning. There is also considerable income in growing and selling flowers and ornamental plant seedlings. In less prosperous cities urban forest management is labour intensive. There are also opportunities for all kinds of formal and informal enterprises related to recreation.

A2.4.3 Education

Urban forests provide many educational opportunities. A number of cities in the region have botanical gardens, zoos, natural trails and even visitor information centres that can inform people about flora and fauna. In Singapore a remnant rainforest park at Bukit Tenara and other parks have been established (Carter 1993).

Education opportunities for urban residents are rare opportunities to learn about nature through first-hand experience. For example, the Mahim Nature Park in Mumbai was a treeless garbage dump, with sprawling slums to one side and a polluted creek to the other. Today it

provides a rare oasis of green and an important educational resource, not just for the urban poor, but for school children and college students throughout Mumbai. At the heart of the Park, a garden with over 105 species of ayurvedic plants is used to teach traditional medicine (Pye-Smith 96).

A2.4.4 Recreation and Aesthetic

The urban poor normally have few affordable options for recreation and thus place a high value on green areas. Lower income residents tend to frequent city parks more than wealthier citizens do because they lack the financial constraints and leisure time to reach distant recreation sites. For instance, in Bangkok on Sundays and holidays 10,000 people visit Lumphini Park, most of them from low-income families in nearby residential areas (Pleumaron 1988). Green space for the children of low-income families is very important in Bangkok (Chalermchai 1980) and elsewhere in the region. In Malaysia recreation areas that are developed and managed by government agencies have mainly satisfied the outdoor recreation needs of the urban lower income groups; commercial outdoor recreation areas have mainly catered for the middle and higher income groups (Wan & Wan 1993).

To be useful to low-income people, forests and green areas must be within an affordable travelling distance and have the amenities which people prefer (IDB 1997).

While not considered as important as meeting basic needs, the aesthetics of green areas can also be very meaningful for urban dwellers. Vegetation reduces sun glare and reflection, complements architectural features and lessens the harshness of dense buildings (Miller 1997). Garden cities with enough greenery to be aesthetically appealing are attractive to residents and investors alike. The beautification of Singapore and Kuala Lumpur was one of the factors that have attracted significant foreign investors who assist rapid economic growth in those cities (Braatz 1993, Ariffin 1989).

Through landscape enhancement, urban forests and trees add to the property values in the vicinity. In the USA, in one city the average house with five trees in its front yard was sold for up to 4.5% more than houses without trees. In Connecticut, urban trees account for 6% of total property value (Moll 1992).

ANNEX 3. GLOSSARY

Agroforestry	Land use system in which trees and shrubs are used on the same land as agricultural crops or livestock in some form of spatial arrangement or temporal sequence.
Arboriculture	The planting and care of trees, with a focus on small grouping of woody plants.
City proper	The single political jurisdiction that contains the historical city centre.
Community	A group of people, with a sense of belonging together, and shared interests and similar values. In the context of urban low-income settlements, people who reside in a geographically defined area, identify themselves with that area, and share an interest in its betterment form a community. Face-to-face contact is another feature of such communities.
Deforestation	The clearing of the forest for other land uses: agriculture, grazing, new settlements, infrastructure, etc.
Desertification	Land degradation in dry climates.
Environmental suitability	In the case of urban forestry this means that outside factors do not interfere with biological and ecological processes of an urban forest or reduce the benefits provided by the area.
Greenbelt	Large parcels of land in and around cities where urban development is totally prohibited through zoning, or public ownership, easement, or development restriction.
Greenhouse effect	The warming of the earth surface due to pollutants that form an insulating layer that creates a heating effect similar to being inside a greenhouse.
Greenway	Narrow vegetated corridors that can have multipurpose uses and functions; they are also called linear parks.
Heat island effect	The tendency for cities to be warmer than the surrounding areas due to automobiles, factories, pavements, and people.
Human settlement	Place where human activities take place.
Informal settlement	Migrant community where the residents settle without title to their land. They are in most cases planned, but unauthorized.
Landfill	The controlled disposal of waste material to land; differentiated from waste dumping in which no control is exercised.
Metropolitan area	The set of formal local government areas which are normally taken to comprise the city as a whole and its primary commuter areas.
Natural resources	They include vegetation, soil, air, water, and wildlife.

Open Space	Land in its natural state or altered for natural resources-based uses (farming, parks. etc.).
Protected areas:	Natural or reconstructed habitats that receive some level of ecological protection with the aim to preserve their ecological or biological functions.
Riparian reforestation	Riverside tree planting.
Suburban	Area of mostly - residential urban sprawl on the perimeter of urban centres, also referred as peri-urban.
Urban area	The built-up or densely populated area containing the city proper; suburbs, and continuously settled commuter areas; definitions of urban areas vary by countries.
Urban forest	All trees and other vegetation in and around dense human settlements.
Urban forestry	The broadest definitions regard urban forests as the entire area influenced and/or utilized by the urban population. For the purpose of this study urban forestry is defined as the planning and managing of trees, forests and related vegetation to create or add value to the local community in an urban area.
Urban green	see urban vegetation
Urban greening	A comprehensive term comprising all urban vegetation management (green spaces or urban vegetated areas) including farming and forestry.
Urban vegetation	Trees, shrubs and ground cover in an urban area.

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