Urban forestry revisited

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Although trees have been an important part of human settlements throughout history, only recently has their full value to urban dwellers been considered. Trees and green spaces play an important role in improving city living conditions. In the past, urban forestry in developed countries was considered almost exclusively on the basis of its aesthetic merits. Now, a closer look is being given to the environmental services and quantifiable economic benefits they provide. In most developing countries, government and international support for urban forestry has been limited The dramatic urban population increase in these countries, together with a corresponding growth in needs for food, fuel and shelter, calls for the design of strategies in which forestry will play a larger role in providing such commodities and in improving the urban living environment (FAO, 1989; Kuchelmeister, 1991; Olembo and de Rham, 1987). This article discusses the changing perceptions of urban forestry, the role of trees in and around densely populated areas and the opportunities and challenges related to their planting, conservation and use. Special attention is paid to developing countries.

The perception of the role of forestry, whose major objective was long seen in many countries as that of supplying industrial wood products, has broadened dramatically over the last two or three decades to include meeting the rural poor's needs for various products and, more recently, to address global environmental problems. "The fuelwood crisis", "social forestry" and, most recently, the conservation of biological diversity as well as the amelioration of global climate change have been headline issues. While its objectives have broadened, however, forestry has remained a rural activity in the eyes of the public.

Street trees form an important part of the landscape in central Nairobi, Kenya

Tree-planting and management of green space in cities until recently were primarily the domain of municipal parks departments, city planners and landscape architects. Foresters were involved in toe management of forests in city peripheries - in Europe, for instance - but not in the management of the urban forest itself. The literature on urban trees is much richer in journals of landscape architects than in those of foresters. Interest in urban forestry among foresters arose only in the 1960s and still remains a "sleeper" issue in terms of international press and public awareness. With a few exceptions, it receives inadequate attention from national governments. The degree of support for urban forestry is certainly not commensurate with its potential contribution to mitigating urban problems.

It is predicted that, by the year 2000, the population in urban areas worldwide will have increased by more than 750 million people. By that time, half the world's population is expected to be living in urban areas.

Urban population expansion is taking place most rapidly in low-income countries. By the year 2000 there will be 66 cities with a population of more than four million; 50 of these will be in developing countries. The rate of population growth is outstripping the planning capacity of municipal governments in developing countries. Environmental degradation in the cities, peri-urban areas and even accessible rural areas is the result of the growing populations' striving to fulfil their needs for food, energy and construction wood. Although the rate of growth in cities of the developed world is much slower, cities in these

countries are experiencing other serious problems: deterioration of air quality, higher air temperatures, increased noise levels, greater psychological stress and a decreased sense of community.

Planned and spontaneous peri-urban development in Brazil. Note the difference in population density and tree cover. (a)

Planned and spontaneous peri-urban development in Brazil. Note the difference in population density and tree cover. (b)

Although more is known today about urban forestry than a decade ago, it must still be considered a fledgling discipline. Many needs remain to be met in the 1990s and beyond: to quantify the benefits that trees can offer to urban dwellers; to incorporate forestry better into urban planning; to develop urban forest ecology as a field of expertise; to develop specialized knowledge about the choice and management of various tree species; to gain a better understanding of the dynamics between urban population growth and the management of forestry resources in urban, peri-urban and rural areas; to improve institutional structures and legal frameworks for urban forestry; to gain a better understanding of public perceptions of and preferences in urban forestry; and to foster citizen stewardship of urban trees. Foresters and municipal officials must work together to determine both how and to what extent they can meet these challenges.

Two views of urban forestry In Yokohama, Japan: aesthetic improvement of the commercial port...

...and a heavily used public green space

Urban forestry defined

Urban forestry is a specialized branch of forestry that has as its objective the cultivation and management of trees for their present and potential contribution to the physiological, sociological and economic wellbeing of urban society.... In its broadest sense, urban forestry embraces a multi-managerial system that includes municipal watersheds, wildlife habitats, outdoor recreation opportunities, landscape design, recycling of municipal wastes, tree care in general and the... production of wood fibre as a raw material.

Urban forestry is a merging of arboriculture, ornamental horticulture and forest management. It is closely related to landscape architecture and park management and must be done in concert with professionals in these fields as well as with city planners.

Urban forestry includes activities carried out in the city centre, suburban areas and the "urban fringe" or interface area with rural lands. Forestry activities can differ significantly according to the zone. In central areas, the potential for significant new urban forestry efforts are relatively limited in most cities. Here, it is mainly an issue of maintaining or replacing trees planted long ago.

In the suburban areas, more scope exists for tree-planting, as the availability of land is greater than in the city centre. The land is more likely to be privately owned than in the peri-urban or fringe area and the people more settled, thereby having a greater vested interest in tree protection and care.

Urban forestry through history

The planting of trees in human settlements and as an integral part of landscape architecture is not new; it has its roots in ancient Chinese, western Asian and Greek civilizations (Jellicoe, 1985). A number of ancient cities had highly developed parks, gardens and other green spaces - the most notable being Babylon, "the mother city of gardens", dating back more than 3000 years. The Assyrian civilization and, much later, the classical Persian and Greek civilizations arising in the fifth century BC, also had such a tradition, based on amenity as well as cultural and religious beliefs In Europe in the seventeenth and eighteenth centuries, municipal and crown forests were managed for recreational hunting. Later, the elite developed urban gardens and parks as visual amenities in many European cities, particularly Italy, France, Austria and England. The practice of urban amenity plantings subsequently spread to colonies in Africa and Asia. Spanish colonization introduced into Latin America the concepts of interior patios in

houses and public plazas in urban centres. Throughout history, the planting and management of trees and forests has been based much more on aesthetic and spiritual values than on utilitarian benefits.

The greatest pressure on natural resources is in the urban fringe or peri-urban area, i.e. the area of every town or city where the old town stops and new districts begin, and where the planned city gives way to spontaneously growing settlements. It is in these areas that the population growth rate is highest and controlled planning by municipal governments lowest.

In developing countries, these are the areas where new migrants from rural areas settle. It is also in these areas that urban forestry has the greatest potential for development and for satisfying needs of the urban population.

Forestry efforts will also depend on where a city is located. Urban forestry can involve planting trees where they never before existed, enhancing natural vegetation and incorporating urban sprawl into existing forested areas.

There are many differences between the management of trees in an urban environment and "traditional" rural forestry. In many cities, trees are a minor part of the landscape, particularly in the centre. Cities present harsh conditions for tree growth. Even in those which have large tree cover in their central urban area and/or suburban areas, management is complicated by the fragmentation of green space. The objectives of tree-planting, the location, the configuration of planting and the management of the trees in urban areas differ from those in rural areas. Socioeconomic conditions and requirements can be quite different and more variable in a city than in the countryside. In addition, the availability of technical information on which management decisions or urban/peri-urban forestry can be based is still limited, particularly in developing countries (Kuchelmeister, 1991).

This street In Mexico City has been rerouted to permit the retention of a large old shade tree

Changing perceptions of urban forestry

The planting of trees in human settlements is not new (see Box). What is new is that, in some places, foresters and urban officials are considering a broader range of benefits from trees and green spaces and are beginning to try and quantify them. An increasing number of papers have been presented at international and national conferences (e.g. the World Forestry Congress and urban forestry conferences, sponsored in part by the American Forestry Association) which have attempted to change the image of urban forestry from one of an elite amenity-oriented activity to one that can provide various goods and services for a broader spectrum of urban dwellers. Urban forestry is being seen both as a means of catalysing community involvement and as an activity dependent on community involvement. Urban forestry is an opportunity to bring principles of forestry ecology into the city: more than just being about planting individual trees, urban forestry is about managing the urban forest as an ecological entity.

A sapling struggles to survive in the concrete jungle of central Bangkok

Street trees help to control pollution on a central thoroughfare

The value of urban forests

The list of goods and services that urban forestry can provide is impressive. Trees and green spaces help keep cities cool, act as natural filters and noise absorbers; improve microclimates and protect and improve the quality of natural resources, including soil, water, vegetation and wildlife. Trees contribute significantly to the aesthetic appeal of cities, thereby helping to maintain the psychological health of their inhabitants. Beyond ecological and aesthetic benefits, urban forestry has a role in helping resource-poor populations meet basic needs, particularly but not exclusively in developing countries.

Improving the aesthetic quality of urban areas

It is the aesthetic and recreational value of trees, forests and parks that is most directly identified by most urban dwellers, in developed and developing countries alike. Trees fulfil certain psychological, social and cultural needs of the urban dweller (Dwyer, Schroeder and Gobster, 1991). They play a very important social role in easing tensions and improving psychological health; people simply feel better living around trees. One study has demonstrated that hospital patients placed in rooms with windows facing trees heal faster and require shorter hospital stays (Ulrich, 1990). When appropriately selected and placed, trees are effective in screening out undesirable views and ensuring privacy while permitting free visual access to the rest of the landscape. Parks provide easily accessible recreational opportunities for people.

Street trees in Prague, the Czech Republic

Ecological maintenance

As a result of the predominance of concrete buildings, asphalt and metal as well as the concentration of transport systems and industrial activities in and around urban areas, the median temperature is higher (the "heat island" effect), the air is drier and often polluted, rainfall is less efficiently absorbed and the environment is generally noisier than in a rural setting.

Cleaning the air. One of the major problems in urban areas is poor air quality. Plants help remove pollutants from the air in three ways: absorption by the leaves or the soil surface; deposition of particulates and aerosols on leaf surfaces; and fallout of particulates on the leeward (downwind) side of the vegetation because of the slowing of air movement.

Research on the removal of airborne pollutants by vegetation shows that plants are effective sinks for pollution. Trees absorb sulphur dioxide very efficiently. Keller (1979) has quantified an 85 percent reduction in lead behind a shelter-belt of trees. Soil effectively absorbs gaseous pollutants, including carbon monoxide, sulphur dioxide, nitrogen oxides, ozone and hydrocarbons. Trees intercept dust: a belt of trees measuring 30 meters in width has been found to intercept almost all dust in the air. Trees also often mask fumes and disagreeable odours by replacing them with more pleasing scents or by actually absorbing them. Trees also help to increase the relative humidity of urban air through evapotranspiration.

Modifying temperature extremes. Trees, shrubs and other vegetation help to control temperature extremes in urban environments by modifying solar radiation. The shade of one large tree may reduce the temperature of a given building to the same extent as would 15 air conditioners at 4000 British thermal units (BTU), i.e. 4220 kJ, in a similar but unshaded building. Energy saving through tree-planting around houses ranges from 10 to 50 percent for cooling and from 4 to 22 percent for heating (NAA/ISA, 1991).

Noise reduction. Noise is often referred to as invisible pollution. Excessive noise levels in most major cities contribute to both physical and psychological damage. Trees can help both by absorbing and refracting or dissipating noise such as that produced by the heavy vehicular traffic which characterizes urban areas.

Meeting resource-poor people's basic needs

Beyond their aesthetic and ecological value, trees can contribute to the satisfaction of energy requirements as well as the daily food requirements of urban dwellers, particularly in the case of the poorest elements of society.

Fuelwood supply. Although "high technology" sources of domestic and industrial energy are available in most cities (electricity and petroleum products such as diesel, kerosene, gas), their relatively high price puts them out of the reach of much of the urban population in the developing world. Therefore, people continue to depend on fuelwood and charcoal for their energy needs which are consequently satisfied by uncontrolled collection, often resulting in the extensive degradation of areas around many urban settlements in developing countries. When "free" wood energy supplies are exhausted or are too difficult for people to tap into, fuelwood markets develop. Even this energy source is relatively expensive; studies report expenditures of 30 to 40 percent of total income by low-income groups to meet domestic energy requirements. Wood-based

building materials - poles, branches and leaves for thatching, for example - are also in high demand in many urban areas (Kuchelmeister 1991; Ducchart, 1989).

Various options for managing urban and peri-urban forest resources for the production of fuelwood and building wood should be developed (Munslow *et al*., 1988). Many attempts to develop plantations in peri-urban areas exclusively for fuelwood have met with limited success. Either sufficient land to fulfil the fuelwood demand was unavailable or the costs of plantation establishment and management were too high. Small-scale production of fuelwood for the market has not been able to compete economically with alternative land-use options such as agriculture. Alternative options tried in various countries include management of existing forests and woodlands, enrichment planting in these forests and agroforestry systems promoted on smallholder plots to offset some of the energy needs. Much more work is needed to analyse the impact of urbanization on natural woodlands adjacent to and in widening circles away from the cities and along main roads feeding cities.

Food production. Urban agriculture is common in many cities in Asia, Latin America and Africa (Yeung, 1987; Sanyal, 1985; Streiffeler, 1987; Ninez, 1985; Skinner, 1981). Who and how many people practice it as well as what form it takes differ greatly from place to place. It is most often practiced in the urban fringe area by low-income families but, in places such as Africa and the Pacific Islands, urban agriculture is widespread within cities. Although in most places the emphasis is not on the production of staple foods, through the production of vegetables, fruits and condiments, urban agriculture can contribute to the improvement of the nutritional value and variety of city dwellers' diets.

Fruit-trees are often an important component of urban home gardens. In some places, trees are planted to help supplement fuelwood and fodder needs and even to provide raw materials for handicrafts. The role of agroforestry in improving productivity and diversying production should be examined - it is a field that should become much more important in the future.

In many developing countries, particularly in Africa and Latin America, about half the low- and moderate-income households moving into cities will be headed by women. Urban agroforestry will not only be important to household nutrition but may offer a source of income while allowing women to stay at home.

Planning

Given the multifaceted potential of urban trees and forests, a decision must be made as to which of these benefits are to be awarded priority attention in a given setting and how such benefits can be obtained on a sustainable and economically viable basis.

Setting priorities - policy goals

Setting priorities or policy goals for urban forestry efforts must be directly linked to the specific conditions of a city. This may seem a truism but past experience has shown that the long-term viability of urban forestry efforts (as indeed those undertaken in rural areas) depends on the appropriateness (i.e. technical and economic suitability) of the undertaking in relation to the surrounding human and geographical situation. Until very recently, nearly all urban forestry efforts in industrialized countries concentrated on aesthetic improvement. It is noteworthy that most of these efforts were undertaken when the costs associated with establishing and maintaining trees in an urban setting were considerably lower than they are today. In fact, the economic burden alone is one major argument against a narrow focus on aesthetics.

The most well-known examples of urban forestry efforts in cities of developing countries have also had a focus on aesthetic improvement. Although labour costs in many of these countries are still relatively low, it can be argued that the resources used benefited only a small segment of the urban population and, in many cases, might have been better employed in a more multipurpose effort.

Therefore, it is normally appropriate for urban forest policy-makers to aim for generation of the broadest range of potential benefits (from those discussed above) suitable for a given city. A purely ornamental or decorative approach should be eschewed in favour of one designed to provide both functional and visual benefits. As Bartenstein (1982)

suggests, urban forestry should not be considered as an "amenity service" but rather included among the "essential services" along with other health and welfare functions.

A view of Dacca, Bangladesh. In the unplanned urban sprawl at the edge of the city, trees are almost entirely absent

The specific mix of goals will depend on local circumstances. For instance, in a city in arid sub-Saharan Africa, the production of fuelwood in peri-urban green belts may be a top priority, while in a South Pacific island city the promotion of fruit-trees in home gardens may be more important. In an industrial city in North America or Europe, air and noise pollution abatement may require most attention.

The planning process

The planning process should be comprehensive, including all trees, forests and potentially available land, whether public or private. Even though municipal authorities may not have direct control over the trees and forests on all lands, they must all be part of a management plan. The technical elements of the planning process will generally include inventory, species selection and planting, maintenance, harvesting and/or removal.

The planning process will differ significantly depending on the structure of the given urban area. As indicated previously, in older urban areas (often the historic centre of a city) the potential for new forestry efforts may be relatively limited - planning may focus on the maintenance of an existing vegetation pattern.

Similarly, in areas that have been urbanized as a result of unplanned expansion, the planning process will need to be inserted in the context of existing constraints. In areas slated for development or expansion, urban forestry holds the greatest potential; planning in these areas should be an integral part of overall land-use decisions.

A key element in the urban forestry planning process (as with forestry in rural areas) is community or people's participation. Directly (through their labour) or indirectly (through their taxes), city dwellers are essential to the success of any urban forestry effort. Therefore, foresters and planners must enlist the support of the citizens as advocates of urban forestry. The planning process should both foster community participation and promote the education of citizens with regard to the values and benefits of urban forestry. People's participation may occur at three basic levels: through participation in official planning bodies; through contacts with community action groups; and through negotiations with the private sector.

Another essential element of the planning process is financial considerations. To be successful and viable in the long term, urban forestry efforts must produce quantifiable benefits. Therefore, the planning process must identify and quantify the expected costs and benefits of proposed efforts.

Constraints and the need for improvement

The preceding sections of this article highlighted the value of urban forestry. A number of important constraints, however, stand in the way of full achievement of this potential. Not all of these constraints can be removed, but they must at least be considered.

Inadequate funding

A lack of funding is a major obstacle to systematic tree management and the promotion of more effective urban forestry programmes. Moreover, the situation is unlikely to improve, as municipal and national budgets continue to suffer economic restrictions, escalating inflation and resource shortages. Urban forestry efforts will therefore increasingly need to demonstrate that their benefits exceed their costs. This places emphasis on the need for quantitative research on the positive results of urban forestry efforts. It will not be acceptable to claim that "trees reduce solar radiation", that "trees can absorb atmospheric pollutants" or that "trees can help alleviate fuelwood shortages"; specific data on costs and benefits will be essential [Ed. note: see article by Nowak and McPherson].

Low priority

Decision-makers (at both national and international levels) have tended to consider urban forestry as a low-priority activity and one more easily deferred than other programmes. This is partly a result of inadequate education, information, awareness and understanding regarding the economic, social and biological benefits of trees in the urban environment. Even today, urban forestry still tends to be regarded as a cosmetic, aesthetic amenity issue or as a luxury activity that is not worthy of support. Without political will, due attention to urban forestry and the realization of its full potential are impossible. The full participation of local people's organizations is another key to the elevation of urban forestry beyond the critical threshold of priority.

Dispersal of tree management responsibilities

Responsibility for the management of urban trees and forests is often shared by various administrative structures that have competing and even conflicting responsibilities. Because of the initial focus on aesthetic values, park and recreation departments are the agencies most commonly delegated primary responsibility but public works agencies, utility companies, environmental protection agencies, national forestry and/or agriculture departments may also be involved. Governments will need to establish lead agencies and ensure intersectoral linkages in order to make the best use of scarce financial and human resources.

Lack of land

The limited availability of land is a key constraint to urban forestry efforts. Urban sites are complex environments in terms of the availability of appropriate land for planting as well as in terms of ownership and tenure. In some cases, for example in extremely densely populated, unplanned urban fringe areas, the lack of land may be an absolute constraint. In others, people's participation may permit an efficient use even of scarce resources.

Environmental stress

The urban environment is generally a harsh habitat for trees. Stress from the environment reduces the vigour of many tree species and increases their susceptibility to disease and pest infestation. Urban trees are subject to poor soils (compacted, low in organic matter, deficient in nutrients and moisture), air and water pollution and vandalism (Beatty and Heckman, 1981). Species selection takes on paramount importance in overcoming these constraints.

Lack of training, extension and communication

There are relatively few opportunities for training and education in urban forestry, particularly in developing countries, while a lack of appropriate instructional material is another constraint.

As opportunities increase in the use of urban forestry as a tool for development, new skills will be required for urban vegetation managers. Foresters must learn to combine a knowledge of trees with an understanding of city government and the needs of society. In addition to training to improve biological knowledge, there is a need for skills in ecological landscape planning, extension, communication and sociology and related subjects.

Generally speaking, extension in urban forestry is very weak. Practical approaches are yet to be worked out in order to reach and involve citizens, especially the poor [*Ed. note*: see article by Burch, Jr and Grove].

Networking has proved an efficient tool in research and development in many sectors, but formal global or regional urban forestry networking activities are extremely limited. One networking structure functioning on a global level is the International Union of Forestry Research Organizations (IUFRO) Project Group on Arboriculture and Urban Forestry. In addition, a small informal network, created by the Forestry Support Program USA to link people who have forestry questions from across the world with people in the United States who may have answers to these questions, has seen an increasing number of requests. Global Relief, the urban forestry programme of the American Forestry Association plays an important role in information sharing and networking within the United States and, more recently, worldwide as well. While there may be similar

organizations in other developed countries, such initiatives in developing countries are very rare.

Other possible approaches to information exchange include: "twinning" arrangements between the urban forestry establishment of a city in an industrialized country and its counterpart in a developing country; and special programmes established by professional organizations through which city planning authorities, companies and individuals may contribute to a fund to subsidize the cost of collecting and disseminating information (O'Rourke, 1990).

Conclusions

In most countries (both developed and developing) as well as in development cooperation agencies, urban forestry is still widely perceived as an activity that is aesthetically oriented and desirable but not necessarily essential. The recognition of multipurpose urban forestry as a potentially effective and economically efficient means of poverty alleviation as well as environmental and aesthetic improvement is overdue.

Particularly but not exclusively in the cities of industrialized countries, the potential benefits of trees and forests in reducing pollution directly and indirectly (through increased energy efficiency in heating and cooling) require a significant increase in attention and resources. In the developing countries, in light of rapid urbanization, the focus should be on the potential of urban forestry to provide direct benefits in terms of goods and services, especially to the urban poor.

Much more study is needed to quantify the benefits of urban and peri-urban forestry, to understand the dynamics of demand and flows of forest and tree resources between the rural and urban areas, and to develop a scientific knowledge base for urban forestry. Institutional and legal changes are needed as well as the application of participatory methods which are being practiced increasingly in rural development efforts. Clearly, much has yet to be done to develop urban/peri-urban forestry as a discipline and activity. Globally, urban trees and forests can and must become an integral part of our efforts to improve the quality of life in our cities - making them places where people can live and work in a more prosperous, healthy and environmentally sound manner.

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