7. Economic Impacts of Urban Forestry

In the aforementioned S290 national nursery industry survey, seventeen plant categories were used to determine the distribution of nursery sales by growers in 2003. Four of these pertained to trees including deciduous shade trees, evergreen trees, Christmas trees, and fruit trees. Of the total product mix portfolio of nurseries in the U.S., these four categories represented 26.8 percent of total nursery sales. The top deciduous shade tree producing states, in terms of the share of their respective states nursery sales, included Kentucky (44% of total nursery sales), New Mexico (43%), Colorado (37%), Tennessee (32%), South Dakota (32%), Indiana (31%), Iowa (31%), and Minnesota (31%). he top evergreen tree producing states, in terms of the share of their respective states nursery sales, included North Dakota (30% of total nursery sales), Indiana (28%), Ohio (27%), Minnesota (22%), Arkansas (21%), and Montana (21%). The states with the highest relative percentage of Christmas trees and fruit trees included West Virginia (44%) and Tennessee (18%), respectively.

In 1997, the American Nursery & Landscape Association (ANLA) and the U.S.D.A. Forest Service teamed up to conduct a landmark study of landscape tree planting in the U.S. The objectives of the ongoing survey were to measure the progress of Community Forestry activities, to provide a database for planning; to confirm the availability of adequate tree supplies; and to help plan and track future care and maintenance efforts. The research study included a survey of the largest private nurseries in the U.S. as identified by the American Nursery & Landscape Association. Utilizing a representative sample of 1,872 nurseries and obtaining a response of 40 percent (749 respondents) provided results that have a margin of error plus or minus four percent. The survey determined that 122,268,000 landscape trees were shipped during 1995-96. That was a 5.1 percent increase over 1994-95 and the fourth year-in-a row that total tree shipments had increased. Tree shipments totaled 116 Mn in 1994-95; 111 Mn 1993-94; 104 Mn in 1992-93, 98 Mn in 1991-92, and 104 Mn in 1990-91. From 1991 to 1996 total tree shipments increased at an average annual rate of 3.3 percent. Of all trees shipped in 1995-96, 43.5 percent (53,144,000) were evergreens, 27.9 percent (34,132,000) were shade trees, 20.9 percent (25,519,000) were flowering trees, and 7.7 percent (9,472,000) were fruit/nut trees. From 1995 to 1996 shipments of evergreen trees increased by 8.3 percent, or 4,085,000 trees; shade trees by 3.2 percent, or 1,066,000 trees; flowering trees by 4.3 percent, or 1,056,000 trees; and fruit/nut trees decreased by 2.3 percent, or 222,000 trees. From 1991 to 1996 shipments of evergreen trees increased at an average annual rate of 6.4 percent; shade trees increased at an average annual rate of 1.3 percent; flowering trees increased at an average annual rate of 0.4 percent; and fruit/nut trees increased at an average annual rate of 3.6 percent.

Regionally, the West produced 32.2 percent of all trees in 1995-96, the South 30.8 percent, the Midwest 28.2 percent, and the East 8.8 percent. States that shipped the most trees in 1995-96 included Oregon (14.9% of total tree shipments), Michigan (13.9%), California (13.3%), Tennessee (7.9%) and Florida (7.1%). These five states accounted for 57.1 percent of all trees shipped in 1995-96. Of all trees shipped in 1995-96, landscape contractors purchased 31.9 percent, retail garden centers 27.1 percent, re-wholesalers 20.4 percent, general merchandisers 14 percent, municipalities 4.5 percent, and other customers 2.1 percent. Total landscape tree production was projected to increase 42.7 percent, with production projected to grow by an estimated 16.6 percent from 1996 to 1997, and 22.4 percent from 1997 to 1998. No other tree planting surveys have been cited in the literature since this landmark study conducted by ANLA. However, assuming that the previously mentioned benchmarks hold [that approximately 26.8 percent of nursery sales are trees that could be used in urban forestry settings and that 4.5 percent of the trees produced by nurseries are sold to municipalities] then several inferences can be drawn when coupled with the Green Industry primary and secondary data included herein.

Economic Impacts of Tree Sales and Tree Care Services

Economic impacts of the portion of urban forestry related to commercial tree production and tree care services are summarized in Table 7-1. The estimates are based on tree production by the nursery and greenhouse sector, and tree care by the landscaping services sector. The total value of tree production suitable for urban forestry, including deciduous, evergreen, fruit, and Christmas trees, was $4.63 Bn. This value represented 27.2 percent of total output by the nursery and greenhouse sector for the U.S. as a whole, but for individual states ranged from as high as 82 percent (Mississippi) to less than one percent (Hawaii). The value of tree care services was $9.92 Bn, which represented 27.1 percent of the output of the landscaping services sector. The total output of tree production and care services was valued at $14.55 Bn. This translated into $21.02 Bn in total output impacts, 259,224 jobs, $14.12 Bn in value added, $9.93 Bn in labor income, and $516 Mn in indirect business tax impacts.

Table 7-1. Economic Impacts of U.S. Urban Forestry Tree Sales and Tree Care Services, 2002

State	Nursery & Greenhouse Sector Tree Sales ($Mn)*	Urban Forestry Tree Sales (%)	Landscaping Services Tree Care Output ($Mn)*	Total Tree Sales and Services Output ($Mn)*	Output Impacts ($Mn)*	Employ-ment Impacts (jobs)	Value Added Impacts ($Mn)*	Labor Income Impacts ($Mn)*	Indirect Business Tax Impacts ($Mn)*
Alabama	71.2	27.2	109	180	281	3,905	203	125	8
Alaska	3.6	27.2	11	15	17	147	11	9	0
Arizona	80.5	27.2	233	313	539	7,243	370	268	16
Arkansas	20.7	42.4	45	66	96	1,387	66	45	2
California	642.6	18.8	1,482	2,125	3,077	37,769	2,105	1,549	75
Colorado	149.9	55.1	245	395	540	5,504	351	259	12
Connecticut	14.9	5.8	193	208	319	3,172	222	172	9
Delaware	21.3	61.5	34	55	90	1,045	65	41	2
Florida	335.3	17.5	698	1,033	1,553	21,946	1,122	768	42
Georgia	44.6	13.6	324	369	527	7,198	368	274	13
Hawaii	0.3	0.3	43	43	75	1,101	51	40	2
Idaho	19.4	28.1	43	62	95	1,179	68	49	2
Illinois	117.4	31.5	508	626	845	7,519	568	436	19
Indiana	121.8	62.4	208	330	469	5,197	290	209	11
Iowa	33.9	42.0	63	97	127	1,396	76	56	3
Kansas	16.3	27.2	72	88	133	1,673	82	63	3
Kentucky	53.1	53.1	70	123	166	2,468	121	79	4
Louisiana	15.1	16.6	59	74	91	1,478	59	45	2
Maine	14.4	36.9	37	52	81	1,048	54	40	2
Maryland	90.0	27.2	285	375	629	7,407	445	321	17
Massachusetts	39.0	24.4	290	329	470	4,798	317	252	11
Michigan	174.0	26.6	339	513	664	6,613	414	13	13
Minnesota	136.5	58.4	152	289	418	3,748	246	177	10
Mississippi	40.2	81.7	31	71	91	1,346	71	41	2
Missouri	17.9	17.0	167	185	207	2,893	135	110	3
Montana	13.6	38.6	13	26	39	425	23	16	1
Nebraska	16.1	45.3	43	59	72	782	43	34	1
Nevada	4.7	44.9	140	144	249	3,314	171	133	7
New Hampshire	1.4	2.4	51	53	83	962	54	43	2
New Jersey	89.6	24.1	383	472	672	7,599	470	352	17
New Mexico	31.3	49.9	37	68	93	1,171	68	48	2
New York	59.8	16.7	424	484	547	5,408	392	316	10
North Carolina	206.2	21.1	279	486	834	10,119	602	367	25
North Dakota	4.5	39.2	7	11	15	166	8	6	0
Ohio	313.4	53.5	445	758	1,013	12,331	633	451	19
Oklahoma	46.8	20.2	74	121	169	2,961	103	74	4
Oregon	343.8	40.9	119	462	856	11,107	537	376	24
Pennsylvania	227.5	29.8	406	633	910	10,427	621	450	22
Rhode Island	5.4	13.7	35	40	70	773	46	35	2
South Carolina	40.9	12.2	135	176	307	4,592	212	128	9
South Dakota	8.1	42.6	9	17	21	222	12	8	0
Tennessee	162.2	55.1	160	323	548	9,408	329	226	15
Texas	207.1	14.4	601	808	1,188	16,438	757	564	30
Utah	26.3	21.2	52	78	116	1,482	80	58	3
Vermont	7.5	31.8	20	27	41	440	27	20	1
Virginia	72.7	31.9	320	393	595	8,282	396	300	15
Washington	149.4	36.6	205	355	527	6,264	374	271	13
West Virginia	16.1	57.5	31	47	61	1,232	32	25	1
Wisconsin	66.4	27.2	177	243	374	3,938	236	178	9
Wyoming	2.4	36.4	12	15	20	202	12	10	0
Total All States	4,631.2	27.2	9,919	14,550	21,020	259,224	14,120	9,931	516

See next page for notes to table.

* Values expressed in 2004 dollars (GDP Implicit Price Deflator).
Note: Missing values for some states were estimated at national average. Percentage of landscape services for tree care: 27.05%.
Sources: Census of Agriculture or ERS Floriculture & Nursery Outlook (nursery output); National Nursery Survey, 2004 (percentage of nursery output for trees); 2002 Economic Census (share of landscape services for tree care).

In the leading states of California and Florida, tree production represented 19 and 18 percent, respectively, of total nursery and greenhouse output. For California, output impacts of urban forestry were in excess of $3 Bn, employment impacts were 37,769 jobs, and value added impacts were $2.11 Bn, while in Florida, output impacts were $1.55 Bn, employment impacts were 21,946 jobs, and value added impacts were $1.12 Bn. Other states with large value added impacts for urban forestry included Texas ($757 Mn), Ohio ($633 Mn), Pennsylvania ($621 Mn), North Carolina ($602 Mn), Illinois ($568 Mn), Oregon ($537 Mn), New Jersey ($470 Mn) and Maryland ($445 Mn).

Other Economic Benefits of Urban Forestry

In addition to these impacts on nursery production and landscape services, trees and landscaping have important effects on residential and commercial property values. Most of the studies reported in the literature have evaluated variation in sales prices for properties in relation to a variety of influencing variables, such as location, building size, neighborhood features, transportation access, etc. These investigations are generally known among professional economists as "hedonic pricing" or "revealed preference" studies. Typically, the studies are conducted within a limited geographic area to control for dominating variables such as income or demographic composition. Payne (1973), who was one of the first researchers in this area, reported a 7 percent premium on average for the market value of a single-family residence due to the presence of "arborescent vegetation" (trees). The premium ranged from 5 to 15 percent. However, there was a ceiling on the positive effect of trees; beyond more than about 30 trees on a residential lot or more than 67 percent wooded cover, values were reduced. A study conducted in Manchester, CT found that good tree cover increased sale prices for homes by 6 to 9 percent (Morales, Boyce and Favretti, 1976). Also, Siela and Anderson (1982) reported that new homes on tree-planted lots commanded 7 percent higher prices than bare lots.

A study of 800 single-family home sales during 1978-80 in Athens GA concluded that the presence of trees in the front yard added 3 to 5 percent to the sales price (Anderson and Cordell, 1985). In a second study by the same authors in a lower-priced neighborhood also found a 3.5 to 4.5 percent premium in sales value for homes with intermediate to large trees (Anderson and Cordell, 1988). It was further reported that each evergreen or broad-leaved tree contributes about $319 to $376, respectively, in value to the home. In a study of 269 single-family house sales with an average price of $93,272, it was found that the presence of mature trees contributed about 2 percent to the home value (Dombrow, Rodriguez and Sirmans, 2000). A study by Henry in 1999 estimated the contribution of the quality of landscaping to house prices for a sample of 218 home sales in Greenville, SC from 1996 to 1997. For homes with the same square footage and other house characteristics, selling prices were six to seven percent higher if landscaping was judged excellent rather than good. The price premium obtained by upgrading landscaping from average to good was approximately four to five percent. Finally, in perhaps the most sophisticated investigation of its kind to date, DeRosiers, Therialut, Kestens and Villeneuve (2002) examined 760 single-family home sales in Quebec, Canada, between 1993 and 2000. It was found that a positive differential of tree cover between a property and its immediate neighborhood raised the property value by about 0.2 percent for each percentage point difference. The higher the proportion of retired people in the neighborhood, the more beneficial was the presence of trees, while it was less so for neighborhoods with a predominance of people aged 45-64. For small homes (bungalows and cottages), a high percentage of ground covers and landscape features such as flower beds contributed more value than did a tree canopy. This investigation also found that an excessive tree cover may negatively impact values, consistent with earlier studies.

Well-maintained trees also increase the "curb appeal" of properties. Research comparing sales prices of residential properties with different tree resources suggests that people are willing to pay 3 to 7 percent more for properties with tree resources versus few or no trees. One of the most comprehensive studies of the influence of trees on residential property values was based on actual sales prices and found that each large front-yard tree was associated with about a 1 percent increase in home sales prices (Anderson and Cordell 1988). A much greater value of 9 percent ($15,000) was determined in a U.S. Tax Court case for the loss of a large black oak on a property valued at $164,500 (Neely 1988). Depending on average home sales prices, the value of this benefit can contribute significantly to cities' property tax revenues.

A study was conducted in 1999 regarding consumer perspectives on the value of the components in a "good" landscape and which attributes of a landscape that consumers valued most (Hardy et al. 2000). Using conjoint design, 1323 volunteer participants in seven states viewed 16 photographs that depicted the front of a landscaped residence. Landscapes were constructed using various levels of three attributes: plant material type, design sophistication, and plant size. Results showed that the relative importance increased from plant material type to plant size to design sophistication. Across all seven markets, study participants perceived that home value increased from 5% to 11% for homes with a good landscape.

Trees sold to municipalities for use in urban forest settings (e.g. parks and other recreational areas) have other economic and environmental benefits beyond those mentioned above. Once they have been installed into the urban landscape, they can result in substantial energy savings; reduction of atmospheric carbon dioxide; improved air quality; reduction of stormwater runoff and hydrology; and enhanced aesthetic benefits.

Street trees modify climate and conserve building energy use in three principal ways: (1) through shading that reduces the amount of radiant energy absorbed and stored by built surfaces; (2) through transpiration that converts moisture to water vapor and thus cools by using solar energy that would otherwise result in heating of the air; and (3) through wind speed reduction that reduces the infiltration of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high such as glass windows (Simpson 1998). Buildings and pavement, along with little canopy and/or soil cover, increase the ambient temperatures within a city. Research shows that even in moderated climates, temperatures in urban centers are steadily increasing by approximately 0.5°F per decade. Winter benefits of this warming do not compensate for the detrimental effects of magnifying summertime temperatures. Because electric demand of cities increases about 1 to 2 percent per 1°F increase in temperature, approximately 3 to 8 percent of current electric demand for cooling is used to compensate for this urban heat island effect of the last four decades (Akbari et al. 1992). Warmer temperatures in cities, compared to surrounding rural areas, have other implications. Increases in CO2 emissions from fossil fuel power plants, municipal water demand, unhealthy ozone levels, and human discomfort and disease are all symptoms associated with urban heat islands. In many areas, there are opportunities to ameliorate these problems through strategic tree planting and stewardship of existing trees allowing for streetscapes that reduce stormwater runoff, conserve energy and water, sequester CO2, attract wildlife, and provide other aesthetic, social, and economic benefits through urban renewal developments.

Tree spacing, crown spread, and vertical distribution of leaf area influence the transport of cool air and pollutants along streets and out of urban canyons. For individual buildings, street trees can increase energy efficiency in the summer and winter, depending on placement. Solar angles are important when the summer sun is low in the east and west for several hours each day. Tree shade to protect east and west walls help keep buildings cool. In the winter, solar access on the southern side of buildings can warm interior spaces. Rates at which outside air infiltrates a building can increase substantially with wind speed. In cold, windy weather, the entire volume of air in a poorly sealed home may change two to three times per hour. Even in newer or tightly sealed homes, the entire volume of air may change every two to three hours. Trees can reduce wind speed and resulting air infiltration by up to 50 percent, translating into potential annual heating savings of 25 percent (Heisler 1986). Reductions in wind speed reduce heat transfer through conductive materials as well. Cool winter winds, blowing against single-pane windows, can contribute significantly to the heating load of homes and buildings by increasing the temperature gradient between inside and outside temperatures. Trees reduce air infiltration and conductive heat loss from buildings.

Urban forests can also reduce atmospheric carbon dioxide (CO2) in the environment. Trees directly sequester CO2 as woody and foliar biomass while trees grow and trees near buildings can reduce the demand for heating and air conditioning, thereby reducing emissions associated with electric power production. On the other hand, vehicles, chain saws, chippers, and other equipment release CO2 during the process of planting and maintaining trees. And eventually, all trees die and most of the CO2 that has accumulated in their woody biomass is released into the atmosphere through decomposition. The combustion of gasoline and diesel fuels by vehicle fleets, and equipment such as chainsaws, chippers, stump removers, and leaf blowers is a relatively minor source of CO_2. Typically, CO_2 released due to tree planting, maintenance, and other program-related activities is about 2 to 8 percent of annual CO_2 reductions obtained through sequestration and avoided power plant emissions (McPherson and Simpson 1999).

Urban trees also provide air quality benefits. They absorb gaseous pollutants (e.g., ozone, nitrogen oxides, and sulfur dioxide) through leaf surfaces; intercept particulate matter (e.g., dust, ash, pollen, and smoke); reduce emissions from power generation by limiting building energy consumption; release oxygen through photosynthesis; and transpire water and shade surfaces, which lowers local air temperatures, thereby reducing ozone levels. In the absence of the cooling effects of trees, higher air temperatures contribute to ozone formation. Most trees emit various biogenic volatile organic compounds (BVOC) such as isoprenes and monoterpenes that can contribute to ozone formation. The ozone-forming potential of different tree species varies considerably. A computer simulation study for the Los Angeles basin found that increased tree planting of low BVOC emitting tree species would reduce ozone concentrations and exposure to ozone, while planting of medium- and high-emitters would increase overall ozone concentrations (Taha 1996).

Studies that have simulated urban forest effects on stormwater report annual runoff reductions of 2 to 7 percent. Annual interception of rainfall by Sacramento's urban forest for the urbanized area was only about 2 percent due to the winter rainfall pattern and predominance of non-evergreen species (Xiao et al. 1998). However, average interception on land with tree canopy cover ranged from 6 to 13 percent (150 gallons per tree on average), close to values reported for rural forests. In Modesto, California, each street and park tree was estimated to reduce stormwater runoff by 845 gallons annually, with a benefit valued at $7 per tree (McPherson et al. 1999b). A typical medium-sized tree in coastal southern California was estimated to intercept 2,380 gallons ($5) annually (McPherson et al. 2000). These studies showed that broadleaf evergreens and conifers intercept more rainfall than deciduous species where winter rainfall patterns prevail.

Trees provide a host of aesthetic, social, economic, and health advantages that should be included in any benefit-cost analysis. One of the most frequently cited reasons that people plant trees is for beautification. Trees add color, texture, line, and form to the landscape. In this way, trees soften the hard geometry that dominates built environments. Research on the aesthetic quality of residential streets has shown that street trees are the single strongest positive influence on scenic quality (Schroeder and Cannon 1983). Consumer surveys have found that preference ratings increase with the presence of trees in the commercial streetscape. In contrast to areas without trees, shoppers indicated that they shop more often and longer in well-landscaped business districts, and were willing to pay more for goods and services (Wolf 1999). Research in public housing complexes found that outdoor spaces with trees were used significantly more often than spaces without trees. By facilitating interactions among residents, trees can contribute to reduced levels of domestic violence, as well as foster safer and more sociable neighborhood environments (Sullivan and Kuo 1996). Scientific studies confirm our intuition that trees in cities provide social and psychological benefits. Humans derive substantial pleasure from trees, whether it is inspiration from their beauty, a spiritual connection, or a sense of meaning (Dwyer et al. 1992; Lewis 1996). Following natural disasters, people often report a sense of loss if the urban forest in their community has been damaged (Hull 1992).

Views of trees and nature from homes and offices provide restorative experiences that ease mental fatigue and help people to concentrate (Kaplan & Kaplan 1989). Desk-workers with a view of nature report lower rates of sickness and greater satisfaction with their jobs compared to those having no visual connection to nature (Kaplan 1992). Trees provide important settings for recreation and relaxation in and near cities. The act of planting trees can have social value, for community bonds between people and local groups often result. The presence of trees in cities provides public health benefits and improves the well-being of those who live, work and recreate in cities. Physical and emotional stress has both short term and long-term effects. Prolonged stress can compromise the human immune system. A series of studies on human stress caused by general urban conditions and city driving show that views of nature reduce stress response of both body and mind (Parsons et al. 1998). City nature also appears to have an "immunization effect," in that people show less stress response if they've had a recent view of trees and vegetation. Hospitalized patients with views of nature and time spent outdoors need less medication, sleep better, and have a better outlook than patients without connections to nature (Ulrich 1985).

Trees reduce exposure to ultraviolet light, thereby lowering the risk of harmful effects from skin cancer and cataracts (Tretheway and Manthe 1999).

Certain environmental benefits from trees are more difficult to quantify than those previously described, but can be just as important. Noise can reach unhealthy levels in cities. Trucks, trains, and planes can produce noise that exceeds 100 decibels, twice the level at which noise becomes a health risk. Thick strips of vegetation in conjunction with landforms or solid barriers can reduce highway noise by 6-15 decibels. Plants absorb more high frequency noise than low frequency, which is advantageous to humans since higher frequencies are most distressing to people (Miller 1997). Although urban forests contain less biological diversity than rural woodlands, numerous types of wildlife inhabit cities and are generally highly valued by residents. For example, older parks, cemeteries, and botanical gardens often contain a rich assemblage of wildlife. Street tree corridors can connect a city to surrounding wetlands, parks, and other greenspace resources that provide habitats that conserve biodiversity (Platt et al. 1994).

Urban forestry also provides jobs for both skilled and unskilled labor. In 2002, there were 262,242 full-time parks and recreation employees across the nation. Public service programs and grassroots-led urban and community forestry programs provide horticultural training to volunteers across the U.S. Also, urban and community forestry provides educational opportunities for residents who want to learn about nature through first-hand experience (McPherson and Mathis 1999). Local nonprofit tree groups, along with municipal volunteer programs, often provide educational materials; work with area schools; and provide hands-on training in the care of trees.