THE CONTRIBUTORY VALUE OF TREES TO RESIDENTIAL PROPERTY IN THE AUSTIN, TEXAS METROPOLITAN AREA

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Abstract. Two methods for predicting the value trees contribute to residential property value in the Austin, Texas metropolitan area were tested. The formula method, used by professional plantsmen, and the predictive-modeling method, using regression analysis, were used to predict the value of trees on 120 homesites. The value of the homes ranged from $30,000 to $600,000 and represented homes typical of the Austin, Texas area. Trees on all homesites were evaluated with the ISA formula method and given a dollar value. Independent variables representing the house and lot were used in the predictive modeling method to determine the value that the trees contribute to sales price. The value of the trees derived by the formula method was found to represent 13 percent of the actual sales price of homes while the value of trees derived by the predictive modeling method represented 19 percent.

Résumé. Deux méthodes pour prédire la valuer contributive des arbres à la valeur d'une propriété résidentielle à Austin, région métropolitaine du Texas, furent testées. La méthode avec une formule, utilisée par les arboriculteurs professionnels, et la méthode avec un modèle de prédiction utilisant l'analyse de régression, furent utilisées pour prédire la valeur des arbres sur 120 propriétés. La valeur des maisons variait de $30,000 à 600,000 et représentait des maisons typiques de cette région du Texas. Les arbres sur les propriétés furent évalués avec la formule de l'ISA et une valeur monétaire fut attribuée. Des variables indépendantes représentant la maison et le lot furent utilisées pour la méthode avec un modèle de prédiction afin de déterminer la valeur contributive des arbres au prix de vente. La valeur des arbres selon la méthode basée sur la formule représente 13 pourcent du prix de vente réel des maisons, tandis que la valeur des arbres selon la méthode basée sur le modèle de prédiction représente 19 pourcent.

There is growing awareness of the valuable contributions made by trees to the urban landscape. At the forefront is the contribution of trees to residential property value. A great deal of work has been conducted to quantify this contribution using many methods (1, 2, 4, 8). However, in recent years, the formula and predictive modeling methods have received more attention within the research community.

The formula method is used by professional plantsmen to estimate the value of individual trees. This method is described in the *Valuation of landscape trees, shrubs and other plants* (5) and is supported by arborists, nurserymen, landscape contractors, and the courts. This method is the established norm.

The predictive modeling method uses regression analysis to predict the dollar value of residential property (dependent variable) with independent variables representing the lot and improvements. This method was used by Morales (6, 7) and Anderson and Cordell (1) using different independent variables. The predictive modeling method, using sales prices of homes and corresponding market characteristics in the analysis, would seem to represent what people are actually paying for trees.

The need to ascertain the value that trees contribute to residential property values becomes even more important when the trees are threatened by disease. Oak wilt, caused by *Ceratocystis fagacearum,* has become a serious problem in numerous Texas communities throughout a 35 county area. In order to assess the financial impact of this disease and perform cost/benefit analysis or disease control options, an accurate assessment of the contribution made by trees to the value of residential property must be determined. This assessment is by no means the only requirement for a cost/benefit analysis. Items such as the cost to maintain declining trees and the removal of trees that have been killed by oak wilt are also important, but the dollar value of these and other items have not been documented sufficiently in the Austin area. Therefore, it is the intent of this research to begin the process by quantify-

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ing the contribution of trees to the market value of residential property in Austin, Texas using the two evaluation methods.

The Study Sites

Four neighborhoods were chosen for the analysis; Travis Heights, Rollingwood, Tarrytown, and Eubank Acres (Figure 1). All of the neighborhoods were at least 20 years old at the time of the study. Sales price for every home in the sample were unavailable or out of date due to the stability of these neighborhoods. Therefore, values for the 120 houses (30 from each neighborhood) were obtained from the Travis County Appraisal District. These values, ranging from $30,000 to $600,000, were found to represent 72 percent of the actual selling price of property in the four neighborhoods. This figure was derived by comparing the sales price of the few recently sold homes in the vicinity with their corresponding tax appraised value. It was the tax appraised value that was used in the analysis. This could later be compared with the probable selling price (tax appraisal value/0.72) of each of the properties.

The formula method. All trees on the sample lots were evaluated with the method described in the *ISA guide* (5). This method uses the following formula;

TREE VALUE = BASIC VALUE x SPP x CNP x LCP
Where
BASIC VALUE = a) replacement cost for trees up to 8 inches (20 cm) diameter, or,
b) $\text{Diameter}^2 \times .7854 \times \$22$
SPP, CNP, LCP = species, condition, and location percentages, respectively. These percentages represent the relative favorability of specific tree characteristics.

The species, conditions and location percentages used in the formula were obtained from Dewers and Dreesen (3). Replacement costs were obtained from Austin nurserymen and found to be $150 per diameter inch.

The predominant species found in the four neighborhoods were live oak (*Quercus fusiformis*) and cedar elm (*Ulmus crassifolia*). These species comprise approximately 50% of the total tree population. Other important species included sugarberry/hackberry (*Celtis laevigata/C. occidentalis*), ashe juniper (*Juniperus ashei*), pecan (*Carya illinoensis*), Shumard oak (*Q. shumardii*), Spanish oak (*Q. texana*), Carolina laurelcherry (*Prunus carolinia*), and crepe myrtle (*Lagerstroemia indica*).

Trees on the sample lots were generally small. This is due, in part, to the site which is characterized by thin soils over rock. Other important factors affecting the size of the tree were the high density of stems and age. However, the average size (height and diameter) of the oaks, elms, and pecan increased in some neighborhoods due to better care provided by the homeowner.

Predictive modeling method. The lots in the sample neighborhoods were also evaluated using the predictive modeling method. This method used regression analysis to predict the tax appraised value of residential property with independent variables representing the house and lot. Twelve data items were collected for the regression analysis from the Travis County Appraisal District:

1) tax appraised value of the house and lot
2) square footage of the house and lot
3) age of the house
4) pool (yes or no)
5) number of bathrooms
6) fireplace (yes or no)
7) number of central air conditioning units
8) type of garage or carport
9) storage areas
10) number of driveways
11) fence (yes or no)
12) number of porches

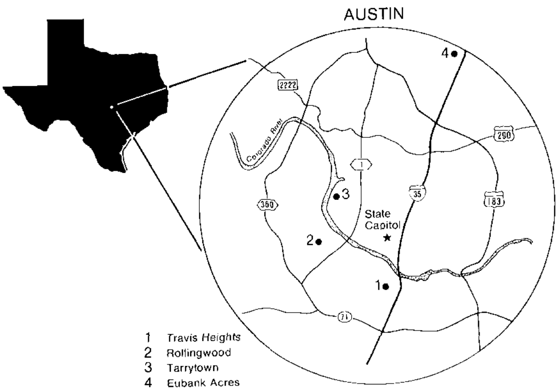

Figure 1. Distribution of sample neighborhoods used to collect data for the assessment of the contributory value of trees to residential property value.

Once the appraisal data were collected, the variables representing the trees on each lot were added to the data set.

Two important differences exist between these data and the data collected by Morales (6, 7). First, tax appraised value was used here instead of sales price because sales price information was unavailable for the sample neighborhoods. Secondly, and most importantly, the variable representing trees has been modified. Rather than simply using a yes or no variable (trees or no trees), the equivalent number of healthy trees (number of trees x average condition) multiplied by the average diameter of the trees on the lot was used to obtain a figure more representative of valuable tree characteristics.

Two preliminary steps limited the number of variables in the regression model. Stepwise analysis was used to identify those variables which contributed most to the predictive capability of the model. In addition, a series of scatter plots were developed to determine if any transformations of variables (log x, 1/x, etc.) would be appropriate. Once these two steps were completed, the regression model was developed using a computer statistical package, Statistical Analysis System (SAS).

In order to test the predictive capability, an independent data set of 20 lots from the same four neighborhoods was collected and applied to the model. The resulting predicted tax appraised value was subtracted from the actual tax appraised value to obtain the residuals. The mean of these residuals should be zero and the standard error small, if the model is predicting well.

Results

The lot value of trees averaged approximately $21,000 for all neighborhoods using the formula method (Table 1), representing 20 percent of the tax appraised value of the property. Since tax appraised value represents only 72 percent of the actual sales price of the property, the percentage that trees represent of the actual value of the property is somewhat less. For the sake of comparison, if the overall mean tax appraised value were divided by 0.72 to determine the expected selling price of the property in the four sample neighborhoods, the formula value of trees would represent 13 percent of the actual property value.

Using the predictive modeling method, it was found that the value of the trees on the lot was approximately $18,000 representing 19 percent of tax appraised value (Table 1). Assuming the model used in this method would remain the same had sales prices been used, this method would provide an accurate reflection of the percentage that trees represent of actual property value. The model used to obtain these results was as follows:

Table 1. Mean value of trees derived by the formula and the predictive modeling methods.

Neighborhood	*Number of lots*	*Mean value of trees/lot (A)*	*Mean predicted appraised value of property (B)*	*Percent (A)/(B)*
The formula method				
Travis Heights	30	$ 7,679.60	$ 61,234.50	12%
Rollingwood	30	33,215.66	118,295.20	28
Tarrytown	30	25,588.20	231,195.83	11
Eubank Acres	30	18,176.96	68,252.40	27
Entire sample	120	21,165.11	119,744.48	20%
The predictive modeling method				
Travis Heights	30	$ 12,845.88	$ 61,234.50	21%
Rollingwood	30	24,916.42	118,295.20	21
Tarrytown	30	21,058.98	231,195.83	10
Eubank Acres	30	14,299.88	68,252.40	22
Entire sample	120	18,280.11	119,744.48	19%

$$TV = 24988.14 + [0.0152 \times SQH2] + [12756.65 \times NP] + [2272929.04 \times DTSQ] + [-15497.47 \times F] + [17285.87 \times AC]$$

Where:

TV = tax appraised value of residential property

SQH2 = (square foot area of the house)^2

NP = total number of porches

$$DTSQ = \frac{\text{(equivalent no. of healthy trees x avg. diameter)}}{\text{square foot area of the lot}}$$

F = fences (1=yes, 0=no)

AC = number of central air conditioning units

The variables in this model all had a positive impact on the tax appraised value of residential property except the presence or absence of fences. For example, the presence of one porch would add $12,756.65 to the tax appraised value, whereas, the presence of a fence would subtract $15,497.47. The variable which had the strongest impact on the model was the square of the square foot area of the house. A 2000 square foot house would contribute $60,800 to the tax appraised value with this model.

This model had an R-square value of 0.82 and all variables used were significant at $p = 0.05$. The test of the model showed it to slightly over-predict the value of property (mean of residuals =$6,000), but the amount was small enough to provide confidence in the model.

Conclusions

The results derived here are similar to those found by Morales (9) in New York. In Austin, Texas the value of trees derived by the formula method was found to represent approximately 13 percent of the actual sales price of homes compared to 11 percent found by Morales, while the value of trees derived by the predictive modeling method represented 19 (Austin) and 17 (New York) percent, respectfully, of the actual sales price of homes.

The formula method has the ability to obtain a value for the trees on a lot regardless of the number, density, health, or maturity of those trees. In the past, it was the only method that could account for subtle differences in group of trees on different lots. In this study, however, the predictive model was developed using many of the tree characteristics found in the formula method. This allows the model to be applied to a variety of lots with mature tree cover and obtain a distinctive value for each group of trees. This ability is important in the predictive modeling method because, as previously stated, it is this method that seems to better reflect what people are paying for trees.

This study confirms that trees contribute value to residential property and indicates that this contribution is between 13 and 19 percent of the value of property in the metropolitan area of Austin, Texas. A consistency in the difference between values derived by the formula and predictive modeling methods was also confirmed. This could mean that the formula method is underestimating the value of trees.

Some insight into the potential impact of oak wilt can be gained from this study. Of the predominate species, live oak makes up approximately 28% of the population, red oaks about 3%. Both species are highly susceptible to oak wilt. Using the figures derived from this research, the potential impact of oak wilt could range from 4 to 8 percent of the value of residential property in the Austin metropolitan area. However, the impact could be greater since these trees are also some of the largest and most valuable trees on some residential sites.

Finally, the methods used here could be applied in other cities, though each new location would require the collection of data to define the parameters used for the variables in the predictive modeling method.

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Abstracts

FERRANDIZ, L.S. 1988. **The ABC's of tree fertilization.** Grounds Maintenance 23(4): 26, 28, 30, 134.

Knowing what makes up a good tree fertilizer is only half the story. To obtain a tree's full potential, you must know how to properly apply the fertilizer. The article concentrates on the methods and equipment for soil-applied tree fertilizers, including surface, drill and liquid fertilizations. Use a spreader, drill or liquid injector, depending on situations like compaction, slope, etc. Fertilize the root-zone area evenly on a grid pattern for drill- and liquid-injection methods. (The root zone refers to the tree canopy plus the area extending one-third beyond the tree canopy.) Avoid the root flare. Fertilize in the fall. Use slow-release nitrogen fertilizers for most trees. Fertilize shade trees at 3 pounds of nitrogen per 1,000 square feet, at balance near 3:1:1 (for annual treatments). Reduce rates for conifers and broadleaf evergreens. Make the proper calculations to insure the correct fertilization rate. Don't place fertilizers more than 8-in below the soil surface. Be careful of electrical lines, sprinklers and other potential underground problems.

KAYA, H.K. 1988. **Princes from todes.** Am. Nurseryman 168(5):63, 65-69.

Not all nematodes are bad. In fact, the possibility of artifically inundating areas with insect-parasitic nematodes to supress pests has tremendous appeal. *Steinernema feltiae* (also known as *Neoaplectana carpocapsae)* and *Heterohabditis heliothidis* are nematodes that possess nearly every desirable attribute of the ideal biological control agent. They are an effective alternative to chemical controls. They are safe to plants and warm-blooded animals. They are easily mass-produced and applied. They actively seek out susceptible hosts. They possess high virulence and infectivity, killing their hosts within 24-48 hours. And they have a wide host range. However, while each of these species is capable of killing more than 250 insect species under laboratory conditions, they are limited to moist situations favorable for their survival in nature. Nematodes by themselves do not kill their host insects. A lethal bacteria inside their bodies, *Xenorhabdus,* is released once the nematodes enter the insect hosts. While the *Xenorhabdus* bacteria kills the insect, it is incapable of entering an insect's body by itself. It needs the nematode to penetrate the insect's body cavity, and the nematode needs the bacteria as a food source. Thus the nematode and bacteria have a symbiotic relationship.