

Evaluation of formulas for the appraisal of
urban trees in municipalities of ChileAvaliação de fórmulas para valoração econômica
de árvores urbanas em municípios do ChileMauricio Ponce-Donoso¹, Leonor Moya² and Oscar Bustos-Letelier³

Resumo

Este trabalho teve como objetivo identificar as similaridades e as diferenças dos resultados e estrutura de sete equações utilizadas para valoração do dano de árvores urbanas, em dez municípios do Chile. O trabalho de campo foi feito na cidade de Talca, Chile durante o ano de 2008. Cada fórmula foi aplicada em duas árvores de 14 espécies representativas da cidade. Um único avaliador mediu a campo todas as variáveis contidas na fórmula. Em relação aos resultados, identificaram-se três grupos de fórmulas: a) as que atualizam o valor do estabelecimento e manutenção das árvores, correspondentes aos municípios de Antofagasta, La Florida, Renca e Talca; b) as que incorporam o dano como principal variável de avaliação, nos municípios de Ñuñoa e Vitacura e c) as equações que incluem variáveis estéticas, situação e estado da árvore, que se aplicam aos municípios de La Pintana, Maipú, Peñalolén e Concepción. As 196 valorações realizadas mostraram uma ampla dispersão do valor monetário obtido, tendo como exemplo um mínimo de US\$118,9 e um máximo de US\$25.663,9 para uma mesma árvore, o que permite encontrar melhores padrões comuns nas fórmulas. Com a amplitude dos resultados apresentados torna-se necessário revisar as fórmulas que se aplicam atualmente no país, através dos Tribunais da Polícia Local, para reduzir as diferenças encontradas. Sugere-se a construção de uma fórmula que represente o verdadeiro valor das árvores urbanas, incluindo variáveis de manutenção, dano, estética, funcionais e situacionais, que possam ser aplicadas para os municípios do país com a finalidade de reduzir as grandes diferenças detectadas e prever a maior igualdade diante da lei.

Palavras-Chave: Municípios Chilenos, Valoração de árvores, Perda de árvores, arborização urbana

Abstract

The work aims to identify the similarities and differences in outcomes and structure of seven formulas that are used to assess damage of urban trees, which are implemented in 10 municipalities in Chile. The field work was conducted by one evaluator during 2008 in the city of Talca, Chile, applying each formula on two trees of 14 typical species of the city. All variables from each formula were measured. Results could identify three sets of formulas: (a) formulas that update the monetary value of establishment and maintenance of trees, which are applied by Antofagasta, La Florida, Renca, and Talca municipalities; b) formulas considered at Ñuñoa and Vitacura municipalities, which incorporate the tree damage as a unique discrimination variable; and c) formulas that included aesthetic, situational and state variables, which are applied by Concepción, La Pintana, Maipú and Peñalolén municipalities. The 196 valuations showed a wide dispersion of the monetary value, from US\$118.9 to US\$25,663.9 for the same tree, which does suggests that better patterns common in the formulas should be found. Local Police Courts do the assessment, however the wide range of results renders it necessary to revise the formulas applied in the country to reduce the differences found among them. The objective is to find a formula that represents the true value of urban trees, which considers maintenance, damage, aesthetic, functional and situational variables. Thus, it may reduce the large differences detected, and may be used by the law in more consistent way, while being applied in the country's municipalities.

Keywords: Chilean Municipalities, Tree loss, Tree taxation, Tree Value, Urban Trees

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INTRODUCTION

The concept of urban trees started to develop in Europe during the 80's, first in the United Kingdom (POLIET *et al.*, 2002) which led to new meanings in the traditional field of forest science. The definition for urban trees is complex when analyzed in different contexts, and when experts can not agree. FAO (2002) and CONAF (w.d.) in Chile have made their own contributions in this area. However, they agree that is a dynamic concept, where the society has identified new ecological, social, environmental, and economic variables. Carter (1993) conceptualizes it as an "integrated approach to planting, care and management of trees in cities to secure multiple environmental and social benefits for urban inhabitants".

The urban forest is a component of different sites, such as greenbelts, parks, tree-lined sidewalks in residential areas, industrial parks or businesses, empty lots, low watershed areas, and other sites (WENGER, 1984). Globally, the management of urban trees is amenable to implement by planning, designing, development, conservation and management; by public and private entities together, as well as by inhabitants (FORREST, 2002; POLIET *et al.*, 2002); contributing to social, environmental, aesthetic and economic aspects (TYRVÄINEN, 2001; PRICE, 2003; TYRVÄINEN *et al.*, 2003; KONIJNENDIJK *et al.*, 2004 and LEAL *et al.*, 2008).

Caballer (1999) mentions that tree appraisal provide some difficulties that differentiate it from the procedures carried out by the evaluation of buildings, streets and squares. Firstly, the same value cannot be assigned to all trees, because there are big and small trees, producing economic returns every year or at the end of a life cycle or production. For example, there are species that are valuable because they produce shade, protect from pollution, adorn the streets, gardens and parks or symbolize ideas and feelings, such as national or historic trees (KONIJNENDIJK *et al.*, 2005).

Tyrväinen, cited by Konijnendijk *et al.*, (2005) comments that different approaches can be used for tree valuation; and environmental benefits valuation to appraise urban trees. In this context, it is possible to apply the Hedonic Prices Method (HPM), Travel Cost Method (TCM), and the Contingent Valuation Method (CVM) (WOLF, 2005).

There is a wide range of application in which there is a need for the valuation or appraisal

of trees. To do that, it is necessary to establish objective, consistent and measurable criteria, in order to assign values to trees depending on their circumstances, for example single tree valuation, property value, lost tree value. For this reason, it is important to find relatively easy to quantify features; such as species and variety, size, age, vegetative state, location, and others (CABALLER, 1999).

Tree valuations try to find a balance between econometric procedures and historic significance, symbolic or landscape components. Chueca (2001) mentions that the objective of valuation methodologies is to reduce the subjectivity of variables, explaining that such subjectivity is not due to the method itself, but whom it is applied.

Valuation methodologies of urban trees have been developed by international organizations. Watson (2002) conducted a review of the main valuation methods applied to six trees by nine appraisers. The methods were CTLA of the United States, STEM New Zealand, Helliwell of England, Norma Granada in Spain, and the Burnley method of Australia. CTLA and Burnley obtained the lowest ratings and the highest standard was obtained by Norma Granada. The latter one was revised in 2006, seeking to reduce the differences and bring their values closer to those obtained by other methods (AEJP, 2007). The Helliwell method (which has only multiplicative factors) resulted in the largest differences among evaluators; therefore it is recommended to reduce the number of multiplier components in order to minimize the variation. In contrast, the formula STEM yielded the lowest variations.

In Chile, the damage valuation on urban trees is done by the municipalities, almost exclusively to determine its loss in order to apply a punishment on whoever caused the damage. Technical staff then proposes the Local Police Court a legal penalty, according to what is stipulated in the Constitutional Organic Law (CHILE, 2004). However, currently the municipal rules have not yet implemented the possibility that the judge, considering the events occurred, requires a compensation for the public goods loss, applying just a fine (PIEDRAHITA and PONCE-DONOSO, 2007). The payment is in UTM (Monthly Tax Unit), corresponding to a monetary expression that is adjusted monthly according to the change in the Consumer Price Index (CPI). In October 2007 it was raised to Ch\$ 33,749, equivalent to US\$ 68.2.

Piedrahita (2007) conducted a study in 28 Chilean municipalities (over 120 thousand inhabitants), the existence of seven formulas that are used as a valuation method of urban trees were identified. The municipalities were: Antofagasta, Concepción, La Florida, La Pintana, Maipú, Ñuñoa, Peñalolén, Renca, Talca and Vitacura. While municipalities apply a formula for the evaluation process, they have no clear objectives in this application. No formulas are used in Calama, Cerro Navia, Conchalí, Coquimbo, Curicó, La Granja, La Serena, Osorno, Punta Arenas, Rancagua, and Temuco municipalities, where fines are applied directly by the Local Police Judge, according to the norm. In Osorno, for each tree damaged, the punishment is the equivalent to planting 10 trees. The municipalities, such as Chillán, Arica, Las Condes, Providencia, Pudahuel, Recoleta and Santiago include variables for evaluating tree damage, or for the application of punishment. The variables more often used in this process are: age, species, degree of damage, plant health, location and different associated costs.

Ponce-Donoso and Piedrahita (2008) indicated that there is a common trend to evaluate at almost all municipalities, but not all of them have a clear evaluation objective. In general, the methodologies do not include damage or amenities; however, it is still possible to evaluate the trees.

In this context, this work evaluates the results from the implementation of the seven appraisal formulas of 10 municipalities surveyed. These were selected among 14 species, two for species, including 196 appraisals applied of different species in Talca city.

MATERIAL AND METHODS

The study area included the trees of Talca city (Maule Region, Chile) located at the streets and the main square. The formulas used by the municipalities and applied in this survey were:

Municipalities of Concepción, La Pintana, and Maipú

$$Value (US\$) = (A * B * C * D) / 10$$

Where:

A = Price of the species at retail market. Species should have between 12 to 14 cm. of perimeter at neck height, a total height of 3.5 to 4 m. for perennial species and 2 to 2.5 m for conifers and palms;

B = Aesthetic tree value and health tree. A ratio between 1 to 10 is considered, depending on the tree beauty, relationship with others, protection, plant health, vigor and dendrologic value;

C = Situation index. Evaluation due to environment and urbanization. It may reach values of 6, 8, and 10;

D = Dimension index, according to tree perimeter at 1.3 meters above the ground. Values are 1, 3, 6, 9, 12, 15, 18, and 20.

Municipality of Ñuñoa

$$Value (UTM) = VA * DO * (1 - DP)$$

Where:

VA: Market price of species expressed in UTM, according to age range and group of species. The trees are classified into three groups;

DO: Caused damage. Value ranging from 0 to 1, and is interpreted as loss of aesthetic, functional and physiological attributes;

DP: Present damage. Value from 0 to 1, represents the deterioration percentage of the structural and physiological present state, caused by physical and biological agents.

Municipality of Peñalolén

$$Value (UTM) = (0.20 UTM * e) + (A * B * VA)$$

Where:

0.20 UTM: Annual maintenance cost of tree;

e: Age of species;

A = Location factor. Tree location in several areas of the city, such as squares, parks, roads, streets or other;

B = State of the tree. Defined as a percentage of tree damage, with damage from 20 to 80%, the factor being 0.8;

VA: Tree value. According to the species and age, it is multiplied by a factor.

Municipality of Renca

$$Value (US\$) = VA + (MA * k) + CE$$

Where:

VA: Market price of the tree;

MA: Cost of annual maintenance;

CE: Cost of removal;

k: factor determined by the age of the tree

Municipality of La Florida

$$Value (US\$) = I * (1 + i)^e + CM \frac{(1 + i)^e - 1}{0.1}$$

Where:

I: Initial market price for species with 2 to 3 years in the nursery, also includes the cost of planting, tutor and ties;

CM: Cost of annual maintenance of tree;

e: Current age of the tree, here the nursery time is not included;

i: Annual interest rate, at value of 4%.

Municipality of Vitacura

$$Value (UTM) = (0.1 * Factor 1 + Factor 2) * \%d$$

Where:

Factor 1: expressed in UTM, depend on tree diameter. The values are between 5 cm over 60 cm;

Factor 2: expressed in UTM, depend on species;

d: percentage of damage present on a tree.

There is a special group for species and diameter.

Municipalities of Antofagasta and Talca

$$Value (US\$) = VA (CM * e)$$

Where:

VA: Present value of the species;

CM: Cost of maintenance;

e: Age

As required by the formulas, it was necessary to determine the species categories that allow applying the formulas from Vitacura, Ñuñoa and Peñalolén. Vitacura uses four species categories and Nuñoa and Peñalolén three groups each. An inter-groups analysis of species to set the frequency for each request was made. Thus the species were selected. As a result of this procedure 42 different species were obtained and 14 were considered for evaluation base it was: a) native or exotic species, especially if it was emblematic species; b) species most frequently found in the city; and c) species age. Those species selected are shown in Table 1.

Two individuals for each species with different age, location and other variable were selected; so the formula was applied twice. Finally, samples of 28 trees were valued by each formula, resulting in 196 appraisals.

The tree selection was two principal criterions: variables presents in used formulas and the meaning of the trees for the city. The selection was performed by using a reference plan of the city central area, provided by the Department of Geographical Information Systems of the Municipality of Talca. Inside of the plan it was

possible to identify location, species and age ranges of most trees. Table 2 summarizes each species selected, location and selection criteria.

The field work had two stages. The first stage included the measurement of dendrometrics variables such as perimeter, bole diameter at breast height, estimation of damage percentage, aesthetic value, health status, and others. The second stage involved data collection of monetary values with a reference price of retail sales in local nurseries, maintenance cost and annual costs of removal; such information being provided by the Department of Cleans and Ornate of the Municipality of Talca. The maintenance cost was calculated based on the annual cost of pruning and other management for a total of 2,000 trees by year; the values are listed in Table 3. The initial investment considered ties and sticks, with prices between US\$0.82 and US\$0.01 per tree; prices obtained between September and October 2007.

Table 1. Species selected.

Tabela 1. Espécies selecionadas.

Scientific name	Common name	Exotic / Native
<i>Quillaja saponaria</i>	Quillay	Native
<i>Cryptocaria alba</i>	Peumo	Native
<i>Jubaea chilensis</i>	Palma chilena	Native
<i>Catalpa bignonioides</i>	Catalpa	Exotic
<i>Ailanthus altissima</i>	Árbol de los cielos	Exotic
<i>Grevillea robusta</i>	Grevillea	Exotic
<i>Jacaranda mimosifolia</i>	Jacarandá	Exotic
<i>Liquidambar styraciflua</i>	Liquidambar	Exotic
<i>Schinus areira</i>	Pimiento boliviano	Exotic
<i>Melia azedarach</i>	Melia	Exotic
<i>Acer negundo</i>	Acer	Exotic
<i>Quercus robur</i>	Encino	Exotic
<i>Ginkgo biloba</i>	Ginkgo	Exotic
<i>Tilia americana</i>	Tilo	Exotic

The annual costs of maintenance for the totality of the trees reached 60 thousand dollars per annum; therefore the value per tree reached 50 dollars a year. However, this varied from one municipality to another, depending on the maintenance needs and management capacity of the municipality.

The cost of removal was determined by using a reference value of 10% UTM per each man/hour demanded by the operation. The Department of Clean and Ornate of Municipality of Talca reported that three men spent two hours to remove a tree, with a removal cost of US\$34.1. This value was similar to one reported from Peñalolén and Ñuñoa municipalities. Table 4 provides a summary of the sale price for each species from local nurseries.

Table 2. Location and criterion selection of species in study.
Tabela 2. Localização e critérios de seleção das espécies em estudo.

Tree N°	Specie	Selection criteria	Location
1	<i>Ailanthus altissima</i>	simpodial trunk	Colín Avenue, between 6 1/2 and 8 South streets
2		Monopodial trunk	
3	<i>Tilia</i> spp.	Similar species	6 Orient, between 2 and 3 North streets
4			
5	<i>Ginkgo biloba</i>	young specie	Colín Avenue, between 19 1/2 and 20 South streets
6		emblematic specie	Main Square
7	<i>Acer negundo</i>	attack of pathogens	2 West, between 2 and 1 North street
8		minor attack of pathogens	5 Orient, between 2 and 3 North street
9	<i>Liquidambar styraciflua</i>	monopodial trunk	19 1/2 South with 3 1/2 west street
10		simpodial trunk	Carlos Schorr Avenue
11	<i>Melia azedarach</i>	good management	Colín Avenue, 14 South street
12		regular management	Circunvalación Avenue with South West street
13	<i>Quercus</i> spp.	old tree	Alameda between 1 and 2 West street
14		Young specie	Colín Avenue between 18 and 19 South street
15	<i>Schinus areira</i>	good management	19 1/2 South street with 4 West
16		regular management	20 South with 5 West street
17	<i>Cryptocaria alba</i>	young specie	Alameda, between 3 and 4 Orient street
18		emblematic specie	Main Square
19	<i>Grevillea robusta</i>	monopodial trunk	Colín Avenue between 19 1/2 and 20 South street
20		simpodial trunk	Colín Avenue between 6 1/2 and 8 South street
21	<i>Jubaea chilensis</i>	similar species	2 North with 2 Orient street
22			
23	<i>Jacaranda mimosifolia</i>	emblematic specie	Main Square
24		young specie	Alameda, between 4 and 5 Orient street
25	<i>Catalpa bignonioides</i>	old tree	2 South with 1 Orient street
26		young specie	19 1/2 South with 4 Wet street
27	<i>Quillaja saponaria</i>	no management	El Arenal with Santa Rosa street
28		with management	El Arenal with 5 1/2 South B street

Table 3. Maintenance costs.
Tabela 3. Custos de manutenção.

Item	Pruning (US\$)	Others (US\$)
Labor (US\$/year)	28,333	27,667
Materials, inputs, reparations (US\$/year)	30,000	15,000

Source: MUNICIPALIDAD DE TALCA, 2006.

Table 4. Retail price of spices in nursery.
Tabela 4. Preço a varejo de espécies em viveiro.

Specie	High average (m)	Retail price average (US\$)
<i>Ailanthus altissima</i>	1.0	5.8
<i>Tilia americana</i>	2.6	5.0
<i>Ginkgo biloba</i>	1.8	25.0
<i>Acer negundo</i>	2.5	4.1
<i>Liquidambar styraciflua</i>	1.8	14.5
<i>Melia azedarach</i>	1.2	5.0
<i>Quercus robur</i>	1.3	6.8
<i>Schinus areira</i>	0.9	3.5
<i>Criptocaria alba</i>	1.3	7.2
<i>Grevillea robusta</i>	1.3	7.9
<i>Jubaea chilensis</i>	0.8	48.9
<i>Jacaranda mimosifolia</i>	1.5	13.0
<i>Catalpa bignonioides</i>	1.5	3.7
<i>Quillaja saponaria</i>	1.7	6.0

RESULTS AND DISCUSSION

The results are presented in the following two tables. The Table 5 shows the variables required for tree appraisal. The variables were measured considering the formula requirements and the approach applied by authors for damage evaluation, health status and the situation of each tree. The Table 6 shows the final valuation results from formulas evaluated, according to variables and other data analysis required.

It is important to keep in mind the goal of formulas evaluated, which are used in the implementation of laws seek to value the trees loss, so that the Local Police Courts can apply a punishment for damage on urban trees. In this context, it is necessary to mention that in the country there is not an initiative to create a formula, unique or adaptable to geographic areas or other criteria, which then represents an appropriate appraisal of the urban tree.

According to the formulas evaluated, it is possible to separate them into three groups. The first is composed of the municipalities of Renca,

Antofagasta, Talca and La Florida, that represents an update on maintenance and plantation costs. In those cases, the higher annual maintenance cost, to bear higher valuations in those municipalities, if management of urban trees is inefficient. In contrast: those who have done an adequate management will find a lower value. As in any method that is based on capitalization, the main problem is the choice of capitalization rate (CABALLER, 1999).

In the second case, there are the formulas of Ñuñoa and Vitacura, which are affected by relevant damage conditions and damage present on the tree; those municipalities do not perform the trees valuation without damage. If it was done, the final value obtained was zero. Sánchez (2003) expresses that it is a difficult task to appraise a damage or death of a tree. These types of valuations are different to that in a usual economic market, where supply and demand, buyer and seller do not establish a price between them, but a value. Therefore, the appraisal methods do not allow to evaluate the whole tree, and these would be applied only to determine the tree loss.

Table 5. Measured variables.
Tabela 5. Variáveis medidas.

Specie	Tree nº	Aged (years)	DAP (cm)	Perimeter (cm)	Sanitary state*	Location Index*	Present damage (%)*	Occasioned damage *	% damage*
<i>Ailanthus altissima</i>	1	28	57.5	179.6	10	8	10	0.50	60
	2	8	9.0	27.3	3	8	80	0.90	90
<i>Tilia spp.</i>	3	5	4.8	14.1	9	8	30	0.60	60
	4	8	7.2	21.2	9	8	3	0.05	4
<i>Ginkgo biloba</i>	5	5	4.5	12.6	8	8	1	0.01	1
	6	105	87.9	274.3	8	10	10	0.10	5
<i>Acer negundo</i>	7	25	44.6	140.1	3	10	60	0.80	70
	8	18	37.0	114.6	5	10	30	0.40	40
<i>Liquidambar styraciflua</i>	9	8	8.3	24.2	5	8	30	0.60	50
	10	16	19.6	60.3	8	8	10	0.15	20
<i>Melia azedarach</i>	11	25	47.0	144.5	8	8	5	0.10	8
	12	35	96.0	299.5	3	8	95	0.90	98
<i>Quercus robur</i>	13	25	57.7	180.3	8	10	5	0.30	20
	14	5	4.5	13.6	6	8	5	0.02	4
<i>Schinus areira</i>	15	25	38.0	118.2	4	8	40	0.60	5
	16	18	25.0	76.1	5	8	30	0.50	40
<i>Criptocaria alba</i>	17	13	18.2	53.0	8	10	3	0.15	10
	18	105	57.3	179.6	6	10	2	0.05	4
<i>Grevillea robusta</i>	19	18	35.9	110.3	8	8	5	0.05	5
	20	25	46.0	143.6	8	8	15	0.40	35
<i>Jubaea chilensis</i>	21	25	67.0	209.2	9	10	0	0.40	5
	22	25	71.0	221.8	9	10	0	0.05	1
<i>Jacaranda mimosifolia</i>	23	105	52.0	162.3	9	10	10	0.10	10
	24	5	3.5	10.0	1	10	40	0.80	70
<i>Catalpa bignonioides</i>	25	25	22.0	67.8	4	8	30	0.01	25
	26	13	18.0	55.3	8	10	25	0.05	20
<i>Quillaja saponaria</i>	27	25	57.3	179.2	9	8	2	0.01	5
	28	15	25.5	79.2	5	8	3	0.20	40

Table 6. Calculated values or prices found according to the different formulas (US\$).**Tabela 6.** Valores calculados ou Preços determinados segundo as diferentes fórmulas (US\$).

Specie	Tree N°	Municipality						
		Concepción, La Pintana, Maipú	Ñuñoa	Peñalolén	Renca	La Florida	Vitacura	Talca, Antofagasta
<i>Ailanthus altissima</i>	1	560.0	300.7	318.5	127.5	877.4	458.9	1,405.8
	2	14.0	15.4	91.0	93.0	128.6	278.9	405.8
<i>Tilia sp.</i>	3	36.0	66.9	56.9	92.1	57.9	158.7	255.0
	4	36.0	7.7	91.0	92.1	127.6	14.4	405.0
<i>Ginkgo biloba</i>	5	160.0	1.6	56.9	112.1	80.0	3.5	275.0
	6	3,600.0	1,023.8	1,194.4	146.6	28,793.0	53.5	5,275.0
<i>Acer negundo</i>	7	206.0	133.6	284.4	109.8	724.3	433.9	1,255.7
	8	257.5	65.0	204.7	109.8	430.3	247.9	905.7
<i>Liquidambar styraciflua</i>	9	57.8	47.8	91.0	101.6	139.3	167.8	414.4
	10	554.7	47.3	182.0	118.6	375.0	89.9	814.4
<i>Melia azedarach</i>	11	384.0	39.7	284.3	109.1	722.5	61.2	1,255.0
	12	216.0	466.0	398.1	126.6	1,309.6	916.8	1,755.0
<i>Quercus robur</i>	13	650.7	245.4	284.4	110.9	726.8	163.2	1,256.8
	14	32.5	3.0	56.9	93.9	59.9	10.6	256.8
<i>Schinus areira</i>	15	99.2	310.0	284.3	107.6	718.8	29.7	1,253.5
	16	82.7	171.6	204.7	107.6	426.2	169.5	903.5
<i>Criptocaria alba</i>	17	173.3	40.6	147.9	101.3	266.9	47.5	657.2
	18	520.0	557.4	1,194.2	128.8	27,802.6	32.6	5,257.2
<i>Grevillea robusta</i>	19	454.4	11.0	204.7	112.0	434.3	29.7	907.9
	20	605.8	141.9	284.4	112.0	729.5	267.7	1,275.9
<i>Jubaea chilensis</i>	21	6,599.9	344.4	284.4	153.0	828.6	53.5	1,298.9
	22	6,599.9	43.1	284.3	153.0	828.6	10.7	1,298.9
<i>Jacaranda mimosifolia</i>	23	1,404.0	658.0	1,194.2	134.6	28,124.5	81.6	5,263.0
	24	13.0	54.6	56.9	100.1	66.8	185.1	263.0
<i>Catalpa bignonioides</i>	25	74.7	2.9	284.4	108.0	719.8	112.3	1,253.9
	26	93.3	5.1	147.9	98.0	261.9	89.9	653.9
<i>Quillaja saponaria</i>	27	513.7	8.4	284.3	110.1	724.8	40.8	1,256.0
	28	142.7	54.2	171.1	100.1	327.4	189.9	756.0

Note: 1 US\$ = 600 Ch\$ Aprox.

In the third group are the municipalities of Concepcion, La Pintana, Maipú and Peñalolén, whose formulas represent a better approach about the whole tree appraisal, incorporating variables related to aesthetics, site, visual influence, health and similar characteristics, which are evaluated in this work; Mooter *et al.* (2004) also mention that tree appraisal is not an exact science. However, methods have been developed, some specific, allowing to assign the trees a market value, considering variables such as size, life expectancy, aesthetic value, location, shape, cost and depreciation, and more (CULLEN, 2002). This type of valuation can be applied to individual species or groups, but it is not suitable for forest areas.

The formulas of the group third have a multiplicative structure, similar to international methods, especially CTLA, STEM, Helliwell or Burnley (WATSON, 2002), which incorporate factors that are difficult to explain, and have strong influence on the final value; as is possible

to see by the result of the use of both formulas for the same tree (Table 6).

The results of the appraisal for a same tree have a wide range for all of the formulas used. In medium and small trees, between 5 to 20 years of age, the maximum and minimum values show a difference of 89.7%, influenced mainly by the costs of maintenance and damage present. In old trees, over 20 years, the differences between municipalities reach 95%, by the impact of variables mentioned. In the case of trees with emblematic characteristics, the differences of valuations reached 99.6%, especially in the formula of Municipality of La Florida, due to the capitalization, as well as due to the initial investment and maintenance of the species.

The application of the formulas shows that, on average, the lowest value reaches US\$113.2, by using the formula of Municipality of Renca, because when the establishment and maintenance cost are updated, the age factor utilized reduces the final value. Other formulas

from the group reached appraisal rating averages of US\$3,457.6 for La Florida and US\$1,364.9 for Antofagasta and Talca municipalities, which include yearly maintenance.

In the formula applied at La Florida, an emblematic species reaches a very high value, over six times for a non-emblematic one, as cited above. For the remaining formulas applied in the municipalities of Concepción, La Pintana, Maipú and Peñalolén, the values obtained for these species incorporated other aspects in the appraisal. The value obtained by both methods differed on average by around 15%, a minor difference in comparison to others formulas used in this study.

CONCLUSIONS

From the results, it is possible to conclude that:

- Evaluating the different methodologies in a common scene, a big variety exists in their application on urban trees appraisal, mostly due to its composition;
- The formulas recommend for appraisal trees are those used by Concepcion, La Pintana and Maipú, less so in Peñalolén. However, it is necessary to develop a unique formula for the municipalities located at Central Chile, which will reduce the value differences;
- The subjectivity and judgments of the evaluator with difficult factors to determine or to compare value; are the more important variables to determine how to evaluate a tree;
- With formulas applied in different contexts, these should not include the effect of substitution; nor that the tree could eventually generate income by its sale, these aspects would influence the final value obtained.

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