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## EVALUATION OF STUDENTS' PERCEPTION OF URBAN GREEN AREAS IN FORTALEZA CITY, CEARÁ STATE, BRAZIL.

Carlos Germano Ferreira Costa<sup>1</sup>, Ricardo Figueiredo Bezerra<sup>2</sup>, George Satander Sa Freire<sup>3 4</sup>

### ABSTRACT

This study evaluated the perception of undergraduate students from the Universidade Federal do Ceará (UFC) at the Pici Campus with respect to urban afforestation in the city of Fortaleza in comparison with afforestation on the university campus (UFC) in terms of benefits and disadvantages that urban trees provide. We applied a questionnaire to 274 students. The analyses are based on the variables of gender, age, college course and neighborhood of residence. The results show that the perception of the level of afforestation in the city of Fortaleza as a whole and in the neighborhood of residence is considered regular; however, the level of afforestation at the Pici campus is considered good to very good. We applied statistical tests (chi-square) to the data and observed some significant findings linking the college course and students' perception of afforestation.

**Keywords:** Urban Green Areas, Environmental Education, Environmental Perception.

## AVALIAÇÃO DA PERCEPÇÃO DA ARBORIZAÇÃO URBANA EM FORTALEZA.

### RESUMO

O presente estudo objetivou avaliar a percepção dos alunos de graduação da Universidade Federal do Ceará (UFC), que frequentam o *campus* do Pici, com relação à Arborização Urbana existente na cidade de Fortaleza em comparação com a área da UFC, bem como os benefícios e prejuízos que esta arborização traz. Para tanto foi aplicado um questionário a 274 estudantes. Os resultados obtidos mostram o perfil da percepção da Arborização Urbana desses alunos, sendo a análise feita a partir das variáveis gênero, idade, curso e bairro de moradia. Os resultados apontam que, na percepção da maioria o nível da arborização de Fortaleza e do local de residência é considerado regular, em contrapartida o nível da arborização do *campus* do Pici é considerado de bom a muito bom. Foram aplicados testes estatísticos (qui-quadrado) aos dados sendo observado alguns resultados significantes entre o curso e o nível percebido da arborização.

**Palavras-chave:** Áreas Verdes Urbanas; Educação Ambiental; Percepção Ambiental.

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## INTRODUCTION

Analyses of the population's perception are used to measure the level of satisfaction of the population in several cities in Brazil and in the world (OKAMOTO, 2002). This assessment is usually carried out through questionnaires, which have been little explored in the city of Fortaleza, a place with few green areas and that is affected by real estate speculation and negligence from the population and the government.

Urban afforestation is considered a set of arboreal individuals of size and shape compatible with the space that do not cause physical or phytosanitary problems (SANTOS; TEIXEIRA, 2001).

Urban afforestation is a set public and private land of a city with predominant arboreal vegetation. It is also defined as a set of natural or cultivated arboreal vegetation in a city. This vegetation is represented in private areas, parks, squares, public roads, and other green areas (SANCHOTENE, 1994).

Trees are fundamental elements in an urban design as they define and structure the space. They play an essential role in the quality of life in cities and therefore in the health of city dwellers. Trees represent cultural values of the historical memory of cities, for example, the famous mango trees of the city of Belém in Pará State, Brazil (SANCHOTENE, 1989).

France greatly influenced the city of Fortaleza, printing its name in the art and culture of the city. France irradiated one of the richest periods of western history: the *Belle Époque*, whose influences were reflected in Fortaleza from the late 19<sup>th</sup> until the early 20<sup>th</sup> century, when Europe was swept by a wind of euphoria and hope for life. It was a time of peace and relative prosperity, which lasted until 1914 when World War I started. While

in Europe, the *Belle Époque* ended with World War I, in Fortaleza, the period lasted until the 1920s (PONTE, 2001).

However, for many years, Fortaleza has faced serious problems in management and implementation of urban afforestation, and is today a little-afforested city. There are few trees and most of them are mutilated by incorrect pruning. The city also faces the problem of little arboreal biodiversity (MARQUES, 2005). Studies show that in some neighborhoods of Fortaleza, more than half of the trees belong to a single species (MORO; WESTERKAMP, 2011).

This type of afforestation is ecologically incorrect, because it limits the variety of food options for the fauna. It also favors the quick spread of diseases and pests among the trees. Thus, the use of a single tree species in urban afforestation should be avoided (GRAZIANO, 1994).

The challenge of planning the urban afforestation in the city of Fortaleza is extensive, and it is necessary to focus on the most serious problems (MORO; WESTERKAMP, 2011).

Primarily, the public and executive environmental bodies must exercise the management and handling of afforestation; however, it becomes necessary the participation of universities, research institutions and contractors for urban services, as well as the participation of the population. Firstly, it is necessary is to evaluate the population's perception of urban afforestation and its importance in the urban context.

In this sense, this study aims to assess the environmental perception of undergraduate students of the Universidade Federal do Ceará (UFC), who attend the Pici Campus, regarding urban afforestation in the city of Fortaleza in comparison

with the afforested area of the Pici Campus. We also investigated the benefits and problems that

urban trees may cause.

## MATERIALS AND METHODS

### Characterization of Fortaleza City

The city of Fortaleza is located on soft coastal undulations at 21 m above sea level, on average, at  $-03^{\circ} 46' 06''$  S and  $38^{\circ} 31' 36''$  W. Fortaleza is on the northern coast of Ceará State, Brazil, covering an area of about 300 km<sup>2</sup> and with a population of about 2,452,185 inhabitants, it is the fifth largest Brazilian city. It shows an urbanization index of 100% with population density around 7,786.52 inhabitants/km<sup>2</sup>, concentrated in an area of 314.927 km<sup>2</sup>.

Administratively, Fortaleza is divided into six regional secretariats. (IPECE; 2012; IBGE, 2013). According to data from the Secretariat of Urbanism and Environment – SEUMA (2013), the results of revitalization programs for urban afforestation in Fortaleza can be defined as insufficient, with the exception of the tree mapping process of Fortaleza and the planting and distribution of 6,500 seedlings

for environmental education actions. Among the challenges faced by the city are the development of a Plan of Urbanism, Environment and Urban Control, emphasizing the importance of creating a plan for strategic monitoring that includes topics such as garbage recycling, environmental education, green policy for the city and creation of parks.

The climate is predominantly equatorial and intertropical, favored by mild and constant breeze of the sea, which provides an annual average temperature of 27°C. The rains are more frequent between the months of January and July, with an annual average of approximately 1,600 mm (FUNCEME, 2013).

### The Universidade Federal do Ceará and the Pici campus

The Universidade Federal do Ceará (UFC) covers an area of 233 hectares, divided into three campuses: Benfica, Porangabussu and Pici. Located in the area of the Regional Secretariat III, in the Pici neighborhood, the Pici campus, the site used in this study, covers 212 hectares and houses

the Science Centers, Agricultural Sciences and Technology Centers; the Pro-Office of Undergraduate Courses and Research and Graduate Studies; the University Library, and various laboratories, as well as the sports sector (UFC, 2013).

### Method

The environmental perception about the current condition of urban afforestation in the city of Fortaleza by undergraduates of the UFC, Pici

campus, was measured through a questionnaire carried out between May 15-17, 2007, with 274 students of the institution. The interviews were

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carried out the Central Library of Sciences and Technology, canteens of departments and at the university cafeteria.

The questionnaire addressed issues concerning the profile of respondents and their perception of the urban afforestation. The first four questions were related to the profile of the respondent: gender, age, university course and neighborhood of residence. The seven following questions addressed the respondents' perception of urban afforestation, and the scales considered the levels of neighborhood,

block of residence and the Pici campus, in particular. The questions were presented on a scale of 0-10, for data computation, transformed into ordinal variable (Table 1). There were two questions, with ten listed options each concerning the advantages and disadvantages of urban afforestation, and the respondent was asked to choose only one option. Finally, respondents were asked about their interest in participating in voluntary actions of planting and maintenance of trees in public areas.

Table 1. Assessment parameters.

Ratings	Grades
0-1	Very bad
2-3	Bad
4-6	Regular
7-8	Good
9-10	Very good

The descriptive statistical treatment of the results was obtained with the software SPSS for Windows release 7.5.1 Standard Version.

The respondents' perception of urban afforestation in this research was measured in different urban scales. Starting from the municipal scale, the questions subsequently delineated the scale of neighborhood, street and finally the block of the respondent's residence, taking into account only the

existing trees in public areas around the houses. Trees planted in private gardens of the houses were disregarded in the study. After, we assessed the perception of afforestation of Pici campus, also following a scale sequence: first the campus as a whole, after the central area and finally the immediate surroundings of the department buildings.

## RESULTS AND DISCUSSION

### Respondents' profile

Of the 274 respondents, 54% (148 people) were male and 46% (126 people) female. The age of the respondents ranged from 17-60 years, with an average of 21.0 years of age. About 50% of the respondents were between 21-25 years old. Approximately eight out of 10 respondents were

between 17-25 years old. We interviewed undergraduate scholars from four courses and most of them attended Agricultural Sciences. A small percentage (2.2% of the total) was students from the College of Pharmacy, Dentistry and Nursing, who attended classes at the Pici campus.

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### Respondents' perception of urban afforestation in Fortaleza

The results showed that, of the 274 respondents, approximately 2/3 (61.7%) consider the urban afforestation in Fortaleza as “regular”, only one in 10 (9.1%) ratings it as “bad” and “very bad” (7.3% and 1.8%, respectively), and less than 1/3 of the respondents rate the urban afforestation in Fortaleza as “good” or “very good” (28.8%, and 0.4%, respectively). We observe a high concentration of ratings at the regular level and proportionally higher percentage of positive than negative reviews

for this item. Therefore, despite the weaknesses observed in the urban afforestation in Fortaleza, there is greater approval of the green areas in the city (Figure 1). Other studies show a tendency of the population to approve local urban forests, for example, Malavasi and Malavasi (2001) state that for 56% of the urban population of the city of Mal. Cândido Rondon (Paraná State, Brazil) approved of the local urban forests, similar to the results in our study.

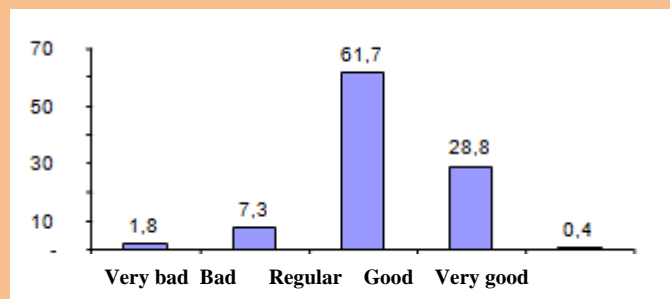


Figure 1. Perception of urban afforestation of the city of Fortaleza in May 2007

### Respondents' perception of urban afforestation in their neighborhoods

Respondents also showed a “regular” rating for the afforestation in the neighborhoods where they live. However, in this case, the distribution of the answers is uniform, showing a decrease in “regular” ratings and an increase in “very bad”, “bad”, and “very good” ratings. Again, the positive evaluations outweighed the negative ones. Four in 10 respondents rated the afforestation in their neighborhoods positively, 28.8% rated it “good” and 8.4%, “very good”. In the evaluation of urban afforestation in the city, three out of 10 respondents rated it as “very good”, while negative assessments (13.9% “bad” and 5.5% “very bad”) were given by two out of every 10 people.

We observe again the tendency for positive ratings for the afforestation in the neighborhoods. However, the negative ratings showed a slight increase compared to the evaluation of urban afforestation in the city. This result highlights the difficulty to accurately assess extensive geographical areas. Individuals' perceptions are possibly affected and undergo limitations due to the large area, since by reducing the area to be evaluated, respondents show a more critical evaluation, with greater identification of flaws, leading to negative responses (Figure 2).

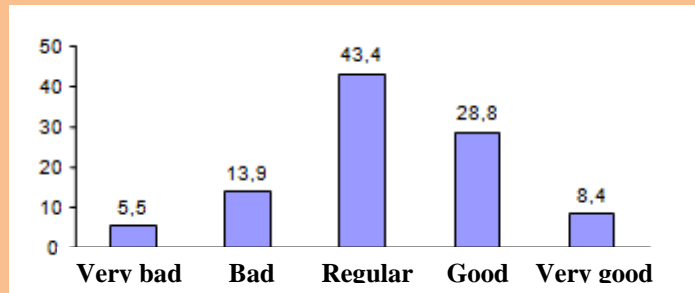


Figure 2. Perception of urban afforestation in neighborhoods in Fortaleza in May 2007.

### Respondents' perception of urban afforestation of the streets where they live

The evaluation of afforestation on the streets where the respondents live showed a balance between positive and negative ratings. Respondents show a more critical evaluation of urban afforestation with the reduction of the area to be assessed, that is, the street. There is an increase of negative ratings and a sharp reduction of "regular" ratings when compared with the assessments of urban afforestation in the city and the neighborhoods of Fortaleza City.

For the streets where they live, respondents assess the afforestation negatively (21.5% "bad" and 12% "very bad"). However, in this respect, there is a similar division of evaluations. About 30% of respondents rate the afforestation on the streets where they live positively (23% "good" and 8% "very good"), similar to the results for the assessments of afforestation in neighborhoods (28.8% "good" and 8.4% "very good"). However,

in relation to the perception of afforestation in the city, there is a significant increase of "very good" rating from 0.4% to 8.0% in the assessment of afforestation in the neighborhood, and to 8.4%, on streets. This situation shows a visible reduction of "regular" ratings, compared with previous evaluations. Possibly, these results assumed that respondents realize flaws and/or specific advantages in afforestation and evaluate urban afforestation more critically in small areas. However, it is not clear the reasons that keep the rating "very good" at the same levels in all assessments, and the increase of positive ratings, once it would be expected a sharper perception of flaws in urban afforestation (Figure 3).

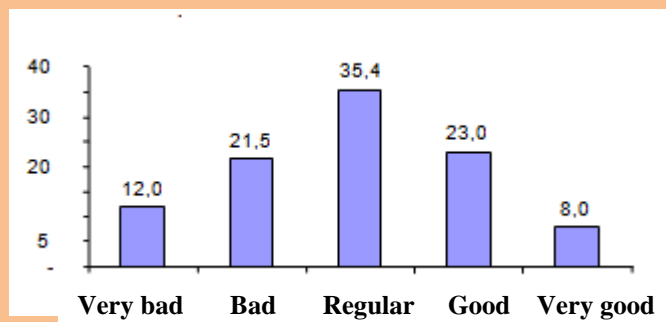


Figure 3. Perception of urban afforestation of streets where the respondents live in the city of Fortaleza in May 2007.

### Respondents' perception of urban afforestation in the neighborhood block where they live

In the evaluations of the afforestation in the blocks where the respondents live, we observed fairly similar results to those found for afforestation on the streets. Again, positive and negative assessments tended to approach, with a reduction of

negative ratings “very bad”, from 21.5% to 16.8% in relation to ratings for afforestation on the streets, and the same ratings 12% “very bad”, 23% “good” and around 8.0% “very good” were observed (Figure 4).

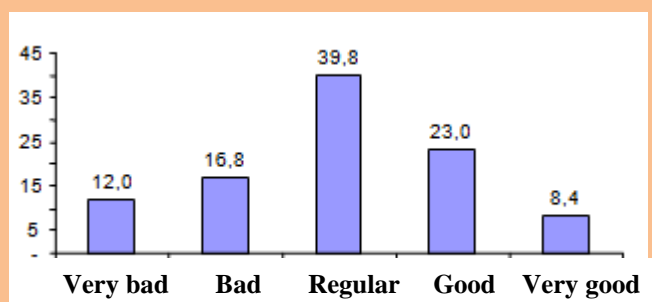


Figure 4. Perception of urban afforestation in the neighborhood blocks where respondents live in the city of Fortaleza in May 2007.

The results described above do not allow to define a trend beyond the “regular” ratings for all cases, varying from 35.4% for the afforestation on the

streets to 61.7% in the city. We observed a certain maintenance of positive reviews about the urban afforestation in the city of Fortaleza, around 30%.

### Respondents' perception of the afforestation on the Pici campus

The evaluation of afforestation on the Pici campus shows a profile very different from that observed for the areas previously assessed, confirming expectations when choosing this area as a reference. We observe a clearly positive rating for the afforestation on Pici campus with almost nine out

of 10 (87.2%) of respondents giving it higher ratings, 36.1% “good” and 51.1% “very good”. The results show a strong approval of the afforestation on Pici campus (Figure 5).

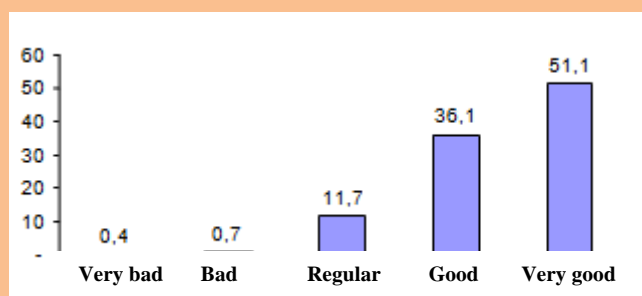


Figure 5. Perception of urban afforestation on Pici campus in May 2007.

### Respondents' perception of the urban afforestation around the departments on the Pici campus

The assessments of afforestation around the departments of the university show, as expected,

the strong approval of 43.4% “good” and 37.2% “very good”, amounting to 82.6% of the total. This

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percentage is slightly lower than the assessment for the campus as a whole. The negative ratings, despite a slight increase, recorded around 5% of the

reviews. As many as 14.6% of the respondents rated the afforestation around the departments as “regular” (Figure 6).

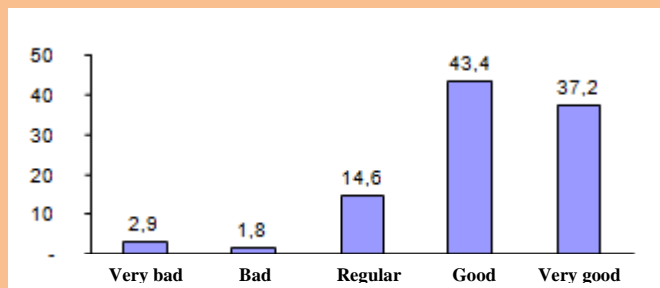


Figure 6. Perception of the afforestation around the departments on Pici campus in May 2007.

Probably the reasons that led respondents to assess afforestation around their departments less positively, in relation to afforestation on the campus as a whole, is the greater familiarity with the afforestation of these areas. We can assume that the hypothesis used to explain the pattern of progressive differences in the assessment made for the previous aspects (city, neighborhood and street)

repeats for the campus as a whole. The smaller the area, the greater the tendency to evaluate it more critically, either positively or negatively. These results reflect temporal differences in the urbanization process and, consequently, in afforestation at the university and the city where older streets have a conspicuous afforestation than the recently urbanized ones.

#### Respondents' perception of environmental comfort in the city of Fortaleza.

As many as 54.7% of the respondents rated the environmental comfort in Fortaleza as “regular”. However, we observed a tendency for the positive reviews (“good” and “very good”). About three out of 10 respondents (27.7% of the total), 26.6% rated

the environmental comfort as “good” and 11% as “very good”, while around two out of 10 (17.5% of the total) evaluated it negatively, that is, 15.3% rated it “bad” and 2.2% “very bad” (Figure 7).

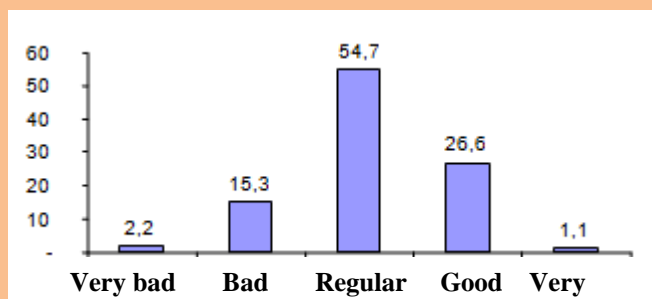


Figure 7. Perception of environmental comfort in Fortaleza in May 2007.

These results contrast with the low quality and low level of urban forestation in Fortaleza, common in

most Brazilian cities that grew up disorderly and without the creation of environments that contribute

to the well-being of citizens, such as squares, urban parks or urban afforestation. Planning afforestation is essential for urban development to avoid harming the environment, given that urban forests are the determining factor of environmental health as they affect the welfare of the population due to the multiple benefits that they provide, besides contributing to climate stabilization (DANTAS, 2004).

The cities display concreted sidewalks, without trees, generating a climate imbalance by increasing

the temperature in urban centers, which results an arid landscape that is harsh for healthy living conditions. Thus, living in the city is becoming more difficult and, in some cases, even unbearable. Urban dwellers are increasingly involved with the problems linked to the progress and development and forget to enjoy the good that nature has to offer. Therefore, they are more and more involved in the environment that they created, generating vascular tension and neuroses that aggravate quickly (SANTIAGO, 1980).

### **Respondents' perception of benefits of urban afforestation**

Most respondents (53.6% of the total) stated that the main benefit of urban afforestation relates to the temperature control, followed in the a long distance by a pleasant urban landscape with roughly two out of 10 (17.9%) respondents, and only about 10% of the respondents mentioned that the main benefit of urban afforestation is air pollution control.

We observe that none of the respondents stated the control of soil erosion (0%), and valuation of assets and real estate (0%) as benefits provided by urban afforestation, and only a negligible fraction related urban afforestation with the control of noise pollution (0.4%) (Figure 8).

Malavasi and Malavasi (2001) found that of the total respondents in their study, 92% recognizes some advantage of urban afforestation and the thermal comfort was mentioned as the greatest benefit and 75% acknowledged as benefit, the maintenance of urban afforestation.

The factors that led respondents to ignore soil erosion control and valuation of assets and real estate as benefits are not perceived in interviews and not possible to be explained. We could attribute this fact to lack of technical knowledge of erosion control; however, this explanation would not sustain, as many respondents are scholars of engineering and biology courses, for example. Another possible explanation can be attributed to the high percentage of soil impermeability in the city and the absence of hills and slopes in Fortaleza. Fortaleza does not face landslide-related problems as cities such as Rio de Janeiro, São Paulo and Salvador do.

The fact that valuation of goods and real estate as a benefit of urban afforestation was not mentioned suggests that this population is unaware of the advantages that the landscaping projects provide to the urban space and architecture of the buildings.

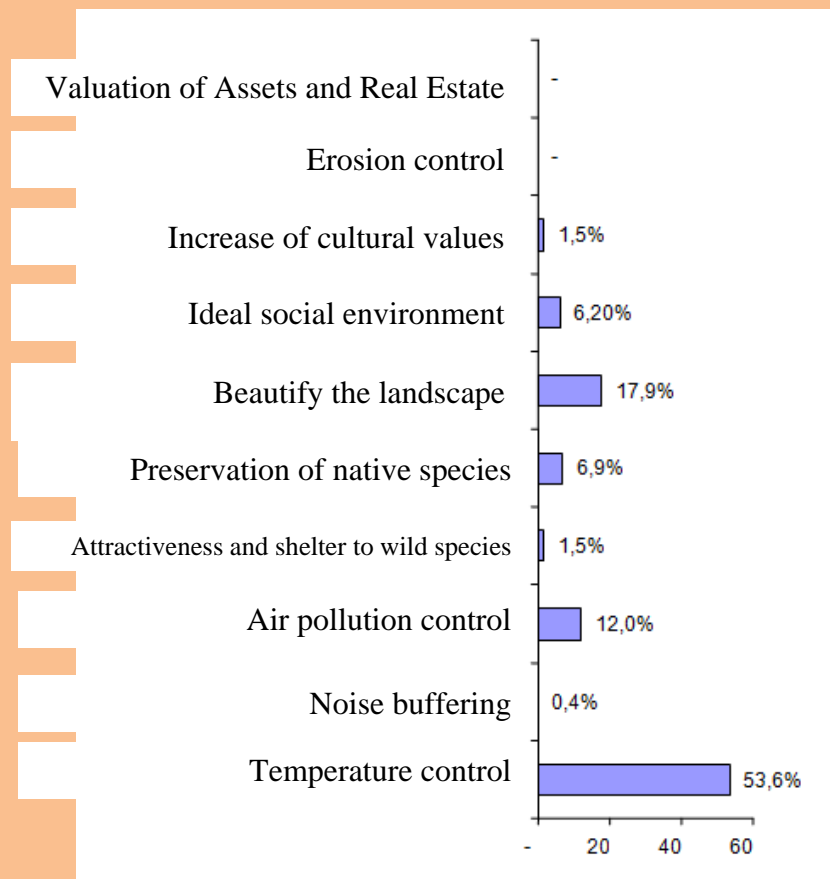


Figure 8. Perception of benefits of urban afforestation in the city of Fortaleza in May 2007.

### Respondents' perception of problems of urban afforestation

The respondents mentioned the fall of trees (16.4%), the risk of fruit drops (16.4%) and damages to sidewalks by roots (16.4%) as the main problems caused by urban trees. These three choices accounted for almost half the responses (49.2%), followed by concerns with damages caused by roots to underground pipes (11.7%) and damages caused by branched to the aerial wiring (11.7%) (Figure 9).

The assessments of the positive aspects of urban afforestation concentrated in an alternative in which 53.6% of the respondents stated that the main benefit of urban afforestation relates to the temperature control. Nevertheless, the negative

aspects are more distributed evenly among the options presented (the fall of trees (16.4%), the risk of fruit drops (16.4%) and damages to sidewalks caused the roots (16.4%)) totaling 49.2% of respondents.

The parameters used by individuals for the evaluation of a perception, in this case, of the urban afforestation, is based not only on the observation and measurement of biological variables, but also on sentimental, psychological and aesthetic factors (OLIVEIRA, 1996), leading to assume that the individuals interviewed associate urban afforestation to negative variables, when the options are presented to them.

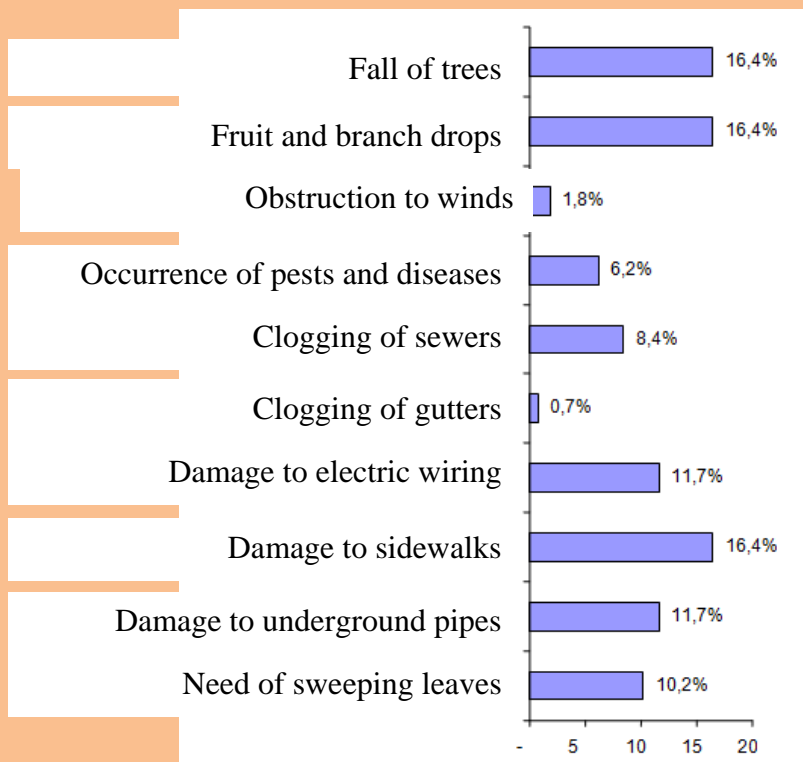


Figure 9. Perception of disadvantages of urban trees in Fortaleza in May 2007.

#### Opinion on the interest in participating in voluntary actions of planting and maintenance of trees in public areas

Respondents were asked about their interest in participating in volunteer activities of planting and maintenance of trees in the city. The data confirm that most of the population interviewed (seven out

of 10 of the respondents) shows interests to participate in activities related to urban forestation (Figure 10).

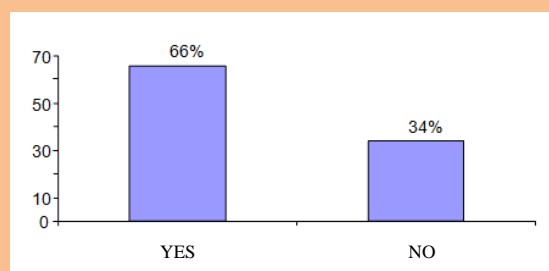


Figure 10. Interest in participating in volunteer activities of planting trees in public areas.

Our results corroborate previous studies that reaffirm the interest of the population to participate in voluntary activities related urban afforestation. In our study, a significant percentage of the respondents (66%) showed interest in participating

in voluntary tree-planting activities in public areas in Fortaleza. Malavasi and Malavasi (2001) interviewed the population from Mal. Candido Rondon (Paraná State, Brazil) and found the 91% of the respondents showed willingness to contribute

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annually with values between R\$1.00 and R\$ 5.00 (circa US\$0.25 to US\$2.00) for the maintenance of

urban afforestation.

## PRELIMINARY ANALYSES OF THE RESULTS

Crossing some variables such as the assessment of the urban afforestation in the city of Fortaleza and the urban afforestation on Pici campus with the environment where the scholars study showed, by

the application of tests of “chi-squared”, some associations. We opted to present the associations graphically rather than in tables for a better visualization of these results.

### Evaluation of urban afforestation in Fortaleza versus the environment where the scholars study

The environment where the respondents study affect their perception of urban forestation. Scholars of agricultural sciences concentrate their ratings as “regular”, while scholars from the Technology Center tend to evaluate the urban afforestation of Fortaleza more positively. In the studied population, only scholars from the Science Center rated the urban afforestation of Fortaleza “very good”. Possibly, because most scholars of agricultural sciences, in their majority of the agronomic engineering course, have more practical

lessons in the field. In addition, disciplines of the course are taught in other centers within the Pici campus; therefore, the students circulate around a larger area on the campus and develop a better perception compared to other academic centers, for example, the Technology Center, which usually has classes in its own building. The test of “chi-squared” shows a significance level of 0.04, demonstrating an association between these variables (Figure 11).

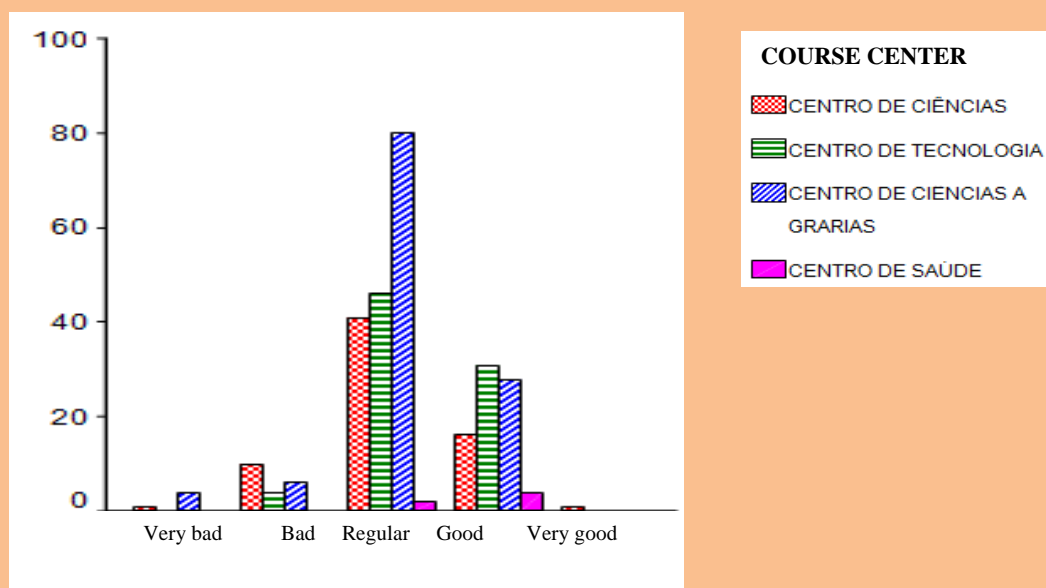


Figure 11. Graphical representation of the statistical analysis of the perception of urban afforestation in Fortaleza versus the study center of UFC in May 2007.

### Afforestation of Pici campus as a whole *versus* afforestation in the departments of the campus

The statistical analysis of the assessment of the relationship between afforestation of the campus and at the departments of study showed that the study centers influence the scholars' perception of the tree planting in the area, and this assessment reflects the change of perception in relation to the size of the area evaluated.

The results show a higher frequency of ratings "very good" for evaluations of afforestation of Pici campus by scholars from the Technology Center (56%). However, this relationship is reversed when we analyze the ratings "good", where a little more than 50% of the scholars of agricultural sciences rated the afforestation on campus "good". This shows a relationship between the course the scholar attends and his/her perception of the afforestation on campus, possibly due to the curricular structure of the course which includes subjects related to afforestation and landscaping, as in the case of agricultural sciences courses, and also due to

greater contact with open spaces as part of practical classes in the field. For the other levels of evaluation, we highlight the fact that only scholars from the center of agricultural sciences rated the campus afforestation "very bad" and "bad" (Figure 12).

Therefore, the results allow to infer the importance of formation of respondents in their perception of urban forestation. The courses that offer training more focused on environmental issues and similar subjects probably provide greater subsidies for these respondents to be more critical and demanding in relation to afforestation. The test of "chi-squared" for this relationship between variables presents a significance level of 0.01.

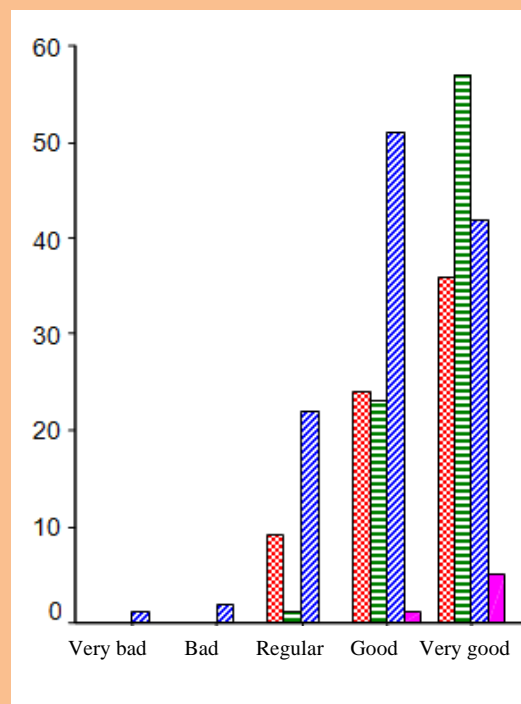
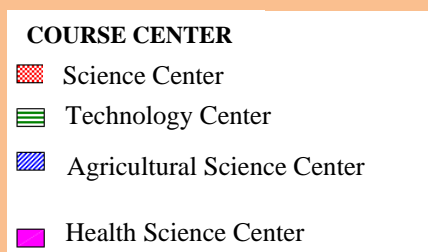


Figure 12. Graphical representation of the statistical analysis of the perception of afforestation on the Pici campus as a whole *versus* afforestation at Study Centers of UFC in May 2007.

## CONCLUSIONS

This study shows that even without technical training, people have an opinion on urban afforestation and the results allow to conclude that:

- The population interviewed rates the urban afforestation of Fortaleza as “regular”;
  - Occasional flaws in afforestation are evaluated more precisely and critically in smaller urban areas;
  - There is strong approval of afforestation on Pici campus
- among the students and the results reflected differences when considered the formation of the scholars interviewed;
  - The respondents are more likely to associate negative than positive aspects to urban afforestation;
  - The majority of respondents showed interest in participating in volunteer activities of planting and maintenance of trees in public areas in Fortaleza.

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