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# Residents' attitudes on environmental benefits of Street Trees in Visakhapatnam City, Andhra Pradesh, India.

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## Abstract

Trees play a significant role in cityscapes because they provide a wide range of benefits to people living in cities. Vegetation in urban areas has several positive effects on the environment, including preserving biodiversity, improving the health of residents, protecting against flooding and other water damage, reducing air and noise pollution, and making cities more pleasant places to live. Residents' attitudes and perception towards environmental aspects of municipal streets could be a strategy for making the city more responsive of its inhabitants. In this paper examines the residents' opinions of street trees, perceptions of the Environmental benefits and preferences in six neighborhoods of Greater Visakhapatnam Municipal Corporation (GVMC). A one-way ANOVA test is performed to see any significant difference on the importance of each environmental factor given by the local neighborhood residents from different study areas in Visakhapatnam city. According to the Residents' opinion gathered through the Questionnaire surveys data, the street trees are very important to provide shelter for birds and other city fauna is the most important of the other factors included in the selection of tree species for Visakhapatnam City. This study helps city planners, foresters, and landscape architects evaluate both the benefits and disadvantages of urban tree planting from an environmental perspective.

**Key words**: street trees, urban, perceptions, preferences, Residents, and neighborhoods.

## Introduction

Growing urbanization is a threat to both the environment and wellbeing of citizens and action is needed to reduce future risks to both people and nature. World population living in urban areas is increasing rapidly and it is predicted that by 2030 almost more than half of the population will reside in cities ( United Nations Department for Economic and Social Affairs, 2003). Simply described, street trees are those that are maintained by municipal or local governments and are situated in the right-of-way of public highways. Street usage by people of all ages includes walking, sitting, cycling, and doing business (Jin et al., 2019). Evaluating the environmental advantages of street trees and performing even the most fundamental street tree management need an appreciation for, and an inventory of, the urban forest's structure (Nowak et al., 2015). When it comes to human health, air quality, and other environmental concerns, trees in metropolitan settings may make a huge difference. Trees may reduce the amount of harmful air pollutants exposed to either by eliminating them directly or by blocking their emissions and preventing them from becoming secondary pollutants. The elimination of various gaseous pollutants, the interception of storm water runoff, the improvement of air quality, the storage of carbon, the provision of shade, thermal comfort, and the reduction of urban heat-island effects are just a few of the ways in which street trees enhance the livability of cities and towns. They can also enhance biodiversity by providing food,

habitat and landscape connectivity for urban fauna (Amorim et al., 2013), Burden (2006), Logan (1989), Rhodes et al. (2011), Selmi et al., 2016) all point to the benefits of urban forests.

The problem is that city streets are so unforgiving that trees have a hard time surviving and thriving there. That's why choosing the right species of street trees is so important (Chen et al., 2017; Jim, 2003; Sjöman & Busse Nielsen, 2010). In this analysis, we look at how residents' tastes vary depending on their socioeconomic status. This allows for a more comprehensive analysis of public opinion. The relative relevance of each demographic characteristic as reported by locals in the various research regions is compared using a one-way analysis of variance test. After analyzing the data, recommendations are provided to policymakers on novel methods for urban arboriculture and street vegetation planning.

**Review of literature**

The scientific literature contains statistical evidence that tree shade helps regulate microclimates. The results of the distributed questionnaires supported our analysis. According to Heisler (1986), the shelter provided by urban trees can reduce the cost of air conditioning by 20 to 25 percent. Urban trees can decrease the average urban temperature by 5 degrees Celsius, according to research by Akbari et al., (2001). This finding is comparable to how transpiration cooling lowers solar radiation on dark surfaces. Research by McPherson et al. (1997) is in favor of the claim that trees reduce the need for air conditioning. The inhabitants will also benefit financially, not just a favorable influence on the environment. In fact, having 100 million trees in a city may save annual energy costs by $2 billion, as reported by (Akbari et al., 1992). Haughton and Hunter, 1994 state that urban trees may block 20-25% of the sun's irradiance. Heisler (1986) agreed with this assessment, claiming that savings of up to 25% are feasible. There is consensus among researchers' trees influences the weather (Haughton and Hunter, 1994).

Heisler claims that tree cover alone may significantly alter wind velocity and direction. According to research (Haughton, G., and Hunter, 1994), urban trees may lower wind speeds by 10-30%. According to Sanders (1986), the presence of trees reduces the amount of money spent on enhancing groundwater recharge, and canopy coverage reduces water outflow by 7 to 12 percent. Municipalities may spend less on grey infrastructure by reducing this discharge. This includes constructions like groundwater filtration systems and flood-prevention dams. Haughton, G., and Hunter (1994), who found that trees assist in integrating rainfall into the soil and hence reduce outflow. This environmental benefit has financial repercussions.

Another important benefit is the ability of urban trees to lower city noise levels. According to research by Cook (1978), a 30 m wide stand of tall trees next to permeable ground may cut pollution by as much as 50%. A row of shrubs surrounded by a series of trees may reduce noise levels by 3 to 5 decibels, according to (Reethof, G., 1978), who also agreed. According to (Bolund & Hunhammar, 1999), evergreen trees are the most effective trees for reducing noise, but maples, oaks, and other types of vegetation can also reduce noise levels.

The majority of specialists agreed that all types of urban wildlife may find a home in trees. In a similar vein, Johnson (1988) showed that trees provide habitat that increases ecosystem biodiversity. According to Van Druff (1995), urban wildlife has been shown to be a biological indication of the overall health of an urban region. According to Brown (1983), attracting flora and wildlife helps individuals feel good about themselves. According to many stories, locals have seen a major reduction in squirrel, rabbit, and bird numbers in recent years. Many of the study's participants also saw a large decline in these species in their own neighbourhoods. Quite a number of locals also highlighted how the environment is abruptly altered by the loss of trees over a short period of time. For instance, the absence of a forest canopy made it easier for raptors to migrate in pursuit of squirrels and other susceptible animals. Others said that because there were no trees, squirrels turned to building their nests in buildings and roof areas.

The ideas and attitudes of individuals about tree values have been highlighted by earlier research. Given the limited number of studies that have looked at street tree preferences outside of the United States, concerns regarding the generalizability of research on attitudes towards street trees are well-founded. The United States has conducted the majority of the research on attitudes and perceptions, followed by the United Kingdom, Australia, and China. In general, these studies have sought to understand inhabitants' preferences for urban green spaces, related values, and species preferences. Orland et al., 1992; Rae et al., 2011; Flannigan, 2005; Gorman, 2004; Heimlich et al., 2008; Hitchmough & Bonugli, 1997; Kirkpatrick J.B. et al., 2012). Residents' views towards tree planting and upkeep have also been examined (Summit & Mcpherson, 1998), as have people's perceptions of certain tree species (Schroeder & Ruffolo, 1996; Sommer et al., 1990). The impact of residents' attitudes towards the planting and removal of different types of trees in eastern Australian cities was examined in Australia (Kirkpatrick et al., 2012). It is found that attitudes towards trees had a direct

impact on planting and removal behavior for both general and specific types of trees. It is found that attitudes towards trees had a direct impact on planting and removal behaviour for both trees in general and specific types of trees (Kirkpatrick et al., 2012). Residents in Australia have a strong influence on the presence and species of trees on public land between their property boundary lines.

As an outcome of this, the emphasis of this study is on environmental factors in order to comprehend the taxonomy of meanings connected with trees and to find a solution to the complicated interactions, advantages, and feelings linked with them. To put it simply, the first thing that comes to mind when we think of the importance of trees is the potential, they have to preserve the environment and enhance the quality of life in urban areas. They are also remarkable in urban environments for their aesthetic value and the visual appeal that they provide.

**Materials and Methodology**

The Methodology for data collection of this study is based on qualitative and quantitative data collection from physical environment of the site, local community, and official authorities. The major data collection is through the primary survey and field survey. Six sample neighborhood units are selected within six different administrative zones of Greater Visakhapatnam Municipal Corporation (GVMC**)**. For this study, only street trees are used in the analysis. Data is gathered by self-administered questionnaire. The survey-type questionnaire method is chosen instead of interviews to reach a greater number of respondents. The questionnaire is designed as an online survey at Google Forms. The first part of the questionnaire had a quantitative base. Respondents are asked to supply some basic demographic data as to their age, sex, level of education, Domicile status and whether how long have they been resident in that neighborhood area or city. The second part of the survey dealt with the satisfaction and residents' attitude. In this part of the questionnaire included a series of questions regarding the knowledge of street trees, their benefits and visual aspects. Using simple checkmarks, benefits were to be rated: Very important, somewhat important, not very important, Not at all important, No opinion. After the quantification of data, various statistical measures such as Means, Standard Deviations,'t' – Value and Analysis of Variance (ANOVA) test have been calculated with the help of Statistical Package for Social Sciences (SPSS). A one-way ANOVA is conducted to analyse the factors affecting importance and satisfaction. T-test and one-way ANOVA are employed to analyze the differences among group means. This is done to see if there are differences in the perception and attitude of respondents coming from an urban neighborhood area of Visakhapatnam city. Analysis of Variance (ANOVA) - Results on the perceptions of respondents according to their area, gender, stay at place, age, qualification, occupation, owner of the house with respect to environmental factors with street trees in Visakhapatnam City.

## Study Area

Visakhapatnam a fast growing urban area in India is a small town transforming itself into a metropolitan, VMRDA (Visakhapatnam metropolitan regional development authority is situated on 17°41'18" North latitude, 83°13'07" East longitude, and 900 meters above sea level on the eastern coast of Andhra Pradesh, India (Figure 1).This area is covered with hills of range between 30 m to 594 m above mean sea level. Administratively, the city of Visakhapatnam (GVMC) is divided into six zones, each of which is further divided into 72 wards. There are 6 wards in zone 1, 12 wards in zone 2, 12 wards in zone 3, 19 wards in zone 4, 15 wards in zone 5, and 7 wards in zone 6. According to the 2011 census, Visakhapatnam City (GVMC) has a population of approximately 17, 28,128 people, with a density of 3,191 persons / sq. km. The total Geographical area of the reconstituted Greater Visakhapatnam Municipal Corporation is 539.95 sq.Km. The study areas are located in the Visakhapatnam district, a backward region in terms of both economic growth and social development, and it is a component of North Coastal Andhra Pradesh and is a developing region in terms of both economic development and social development. Due to the port and several large and medium-sized industries in and around the city of Visakhapatnam, which is located in the study region, many people migrated there for a variety of reasons from the districts of Srikakulam, Vizianagaram, and East Godavari as well as from Northern India.

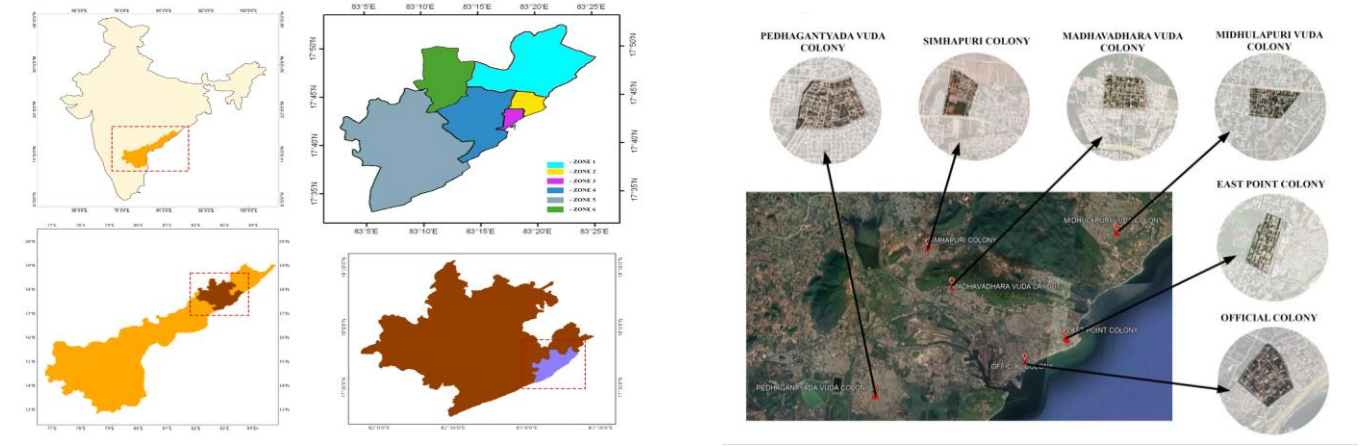


**Fig. 1:** Location of Study Area within the GVMC Limits and Location of selected Neighborhoods, Source: Author, 2022.

Six sample neighborhood areas are selected from each representative zone as highlighted in Figure 1. We obtained inventories of urban trees in the neighborhood sample units mostly plotted developments executed by the urban development authority, Visakhapatnam - Midhilapuri Colony, (zone 1); East Point Colony (zone 2); Official Colony (zone 3); Madhavadhara (zone 4); Pedhagentyada (zone 5); Simhapuri Colony (zone 6) and the areas of these colonies ranged from15- 20 Acres.

## Results and discussion

### Sociodemographic Features of the Respondents

A total of 600 respondents had responded to the questionnaires distributed to six selected neighborhood areas. Out of the figure, 308 (51%) are males and 292 (49%) are female. Most of the respondents are between 18 - 35 years old (44 %). other respondents are between above 60 years and below 18 years comprised of (8 %) and (17 %) respectively. The remaining percent (31 %) is the age group between 35 - 60 years. majority 220 (36%) of the respondents attained bachelor's degrees. About 150 (25%) of the respondents had their secondary education, 130 (8 %) of the respondents had their primary education and another 52 (22 %) of the respondents attained intermediate, only 48 (8%) of the respondents had above degree (master's degree). About 139 (23%) of the respondents are students whereas another 131 (22%) of the respondents were grouped under businesspeople, self-employed 88 (15 %), housewife 75 (13%), unemployed 91 (15%) and other occupation 25 (4%). The initial results show that 42% of the respondents live in rented houses while only 39% lives in own houses, 10% respondents lives in the house provided by the employer and 9 % respondents lives in the others house but paying the rent. The purpose of including accommodation type as the background element is to see whether there are some correlations and regularity to the topic answers. This may give a hint to distinguish the needs and preferences of the different dwellers separately and take that into consideration during the planning process. We found a statistically significant difference in responses to most questions concerning public opinion and attitudes towards street trees, suggesting that locals are aware of the environmental benefits that trees provide. Our knowledge of the value of street trees in urban environments and residential landscapes is deepened and expanded by the results. The majority of those who responded said that they liked the trees on their street, but the findings show that people have quite different preferences depending on where they live. The survey also evaluated residents' opinions on street tree density and general street appearance.

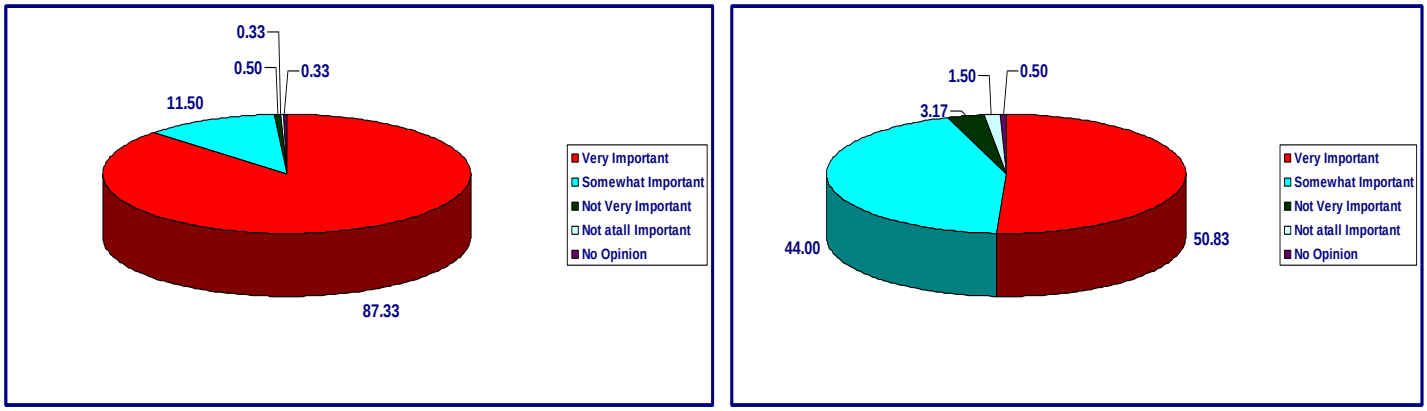


**Fig 2**: Residents' opinion towards provide shelter for birds and other city fauna 2(a) and temperature reduction 2(B) , Source: Author, 2023.

From the above figure 2(A), it is noticed that, 524 (87.33%) of the respondents expressed that, street trees are very important to provide shelter for birds and other city fauna, whereas 69 (11.50%) are somewhat important, 3(0.50) are not very important and 2(0.33%) are not at all important and they are not given any opinion. It is concluded that, majority 524 (87.33%) of the respondents expressed that, street trees are very important to provide shelter for birds and other city fauna. asper Figure 2(B), it is noticed that, 305 (50.83%) of the respondents expressed that, street trees are very important to reduction of temperature, whereas 264 (44.00%) are somewhat important, 19(3.17%) are not very important, 9(1.50%) are not at all important and 3(0.50%) are not given any opinion. It is concluded that, majority 305 (50.83%) of the respondents expressed that, street trees are very important to reduction of temperature.

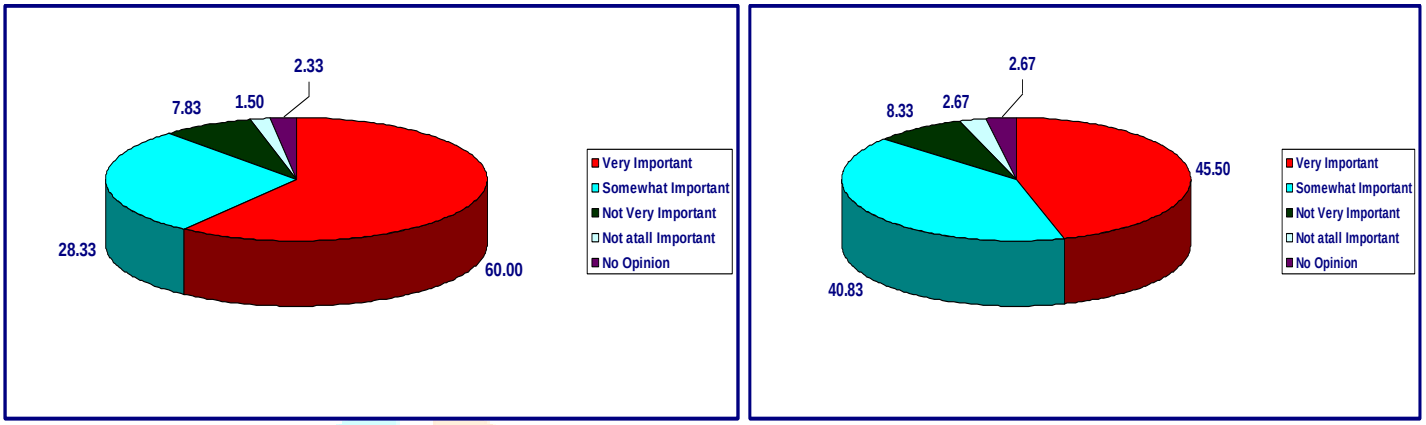


**Fig 3:** Residents' opinion towards noise reduction 3(A) and reducing wind velocity3(B), Source: Author, 2023.

According to Figure 3(A), it is noticed that, 360(60.00%) of the respondents expressed that, street trees are very important for reducing noise, whereas 170 (28.33%) are somewhat important, 47(7.83%) are not very important, 9 (1.50%) are not at all important and 14(2.33%) are not given any opinion. It is conclude that, majority 360 (60.00%) of the respondents expressed that, street trees are very important for reducing noise.

As Per Figure 3(B), it is noticed that, 273(45.50%) of the respondents expressed that, street trees are very important for reducing the wind velocity, whereas 245 (40.83%) are some what important, 50(8.33%) are not very important, 16 (2.67%) are not at all important and are not given any opinion. It was conclude that, majority 273 (45.50%) of the respondents expressed that, street trees are very important for wind velocity.

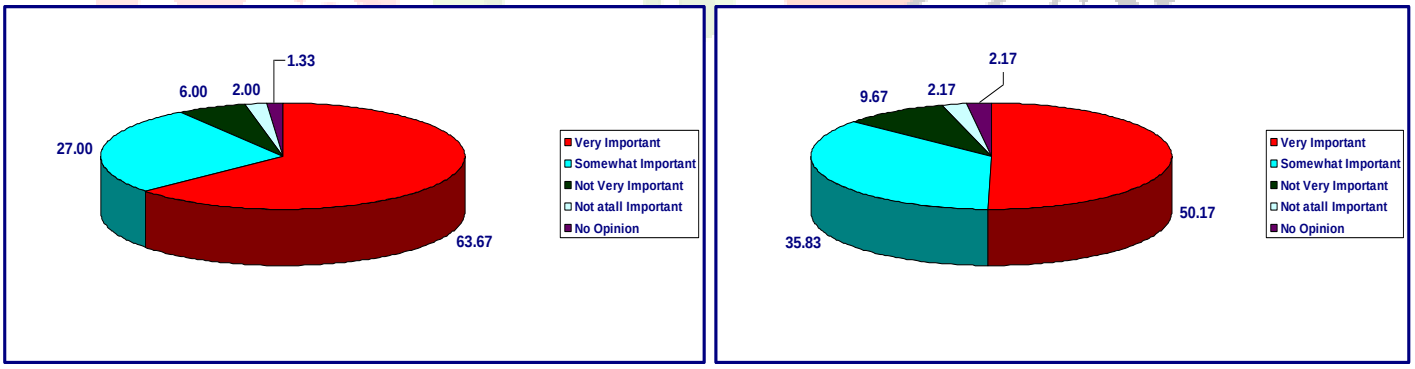


**Fig 4:** Residents' opinion towards Air Pollution reduction 4(A) and minimize the rain water in the streets4(B), Source: Author, 2023.

According to Figure 4(A), it is noticed that, 382 (63.67%) of the respondents expressed that, street trees are very important for Reducing Air Pollution, whereas 162 (27.00%) are somewhat important, 36(6.00%) are not very important, 12(2.00%) are not at all important and 8(1.33%) are not given any opinion. It is conclude that, majority 382 (63.67%) of the respondents expressed that, street trees are very important for Reducing Air Pollution. According to Figure 4(B), it is noticed that, 301(50.17%) of the respondents expressed that, street trees are very important for minimize the rain water in the streets, whereas 215 (35.83%) are somewhat important, 58(9.67%) are not very important, 13(2.17%) are not at all important and are not given any opinion. It is conclude that, majority 360 (60.00%) of the respondents expressed that, street trees are very important for minimize the rain water in the streets.

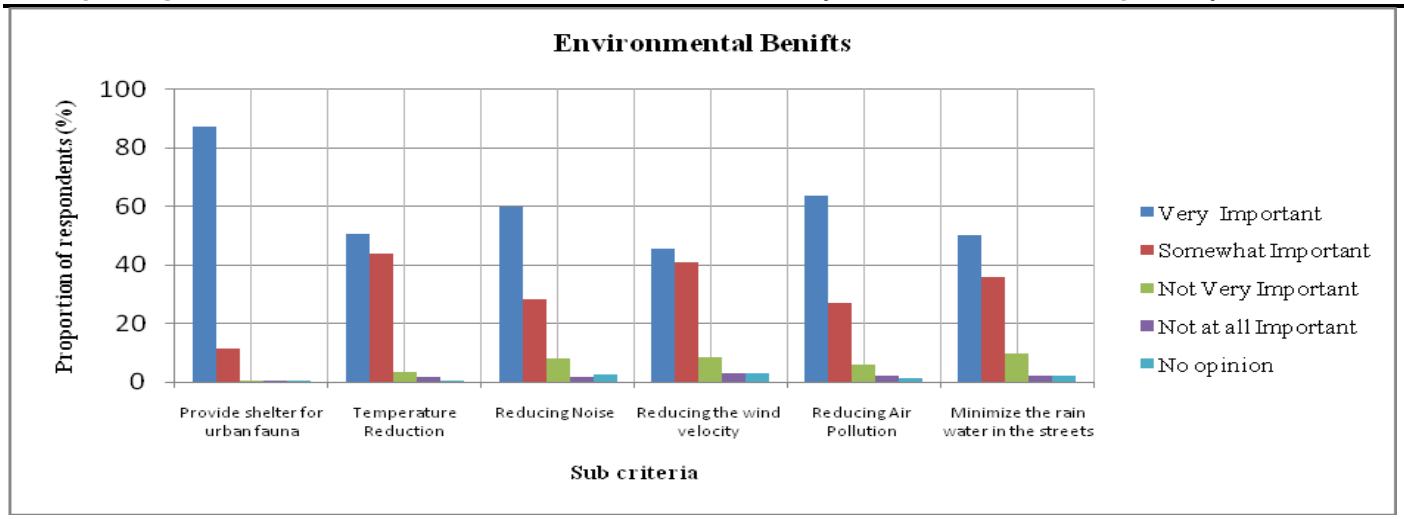


**Fig 5:** The environmental benefits of trees as per residents, Source: Author, 2023.

According to the figure 5, It is noticed that most of the respondents (24%) believed hat, street trees are very important to provide shelter for birds and other city fauna, whereas (18%) felt they reduced air pollution, (17%) of reducing noise, (14%) of temperature reduction, (14%) thought they minimized rainwater in the streets and (13%) said they reduced the wind velocity. It is concluded that, majority 524 (24%) of the respondents expressed that, street trees are very important to provide shelter for birds and other city fauna.

**ANNOVA test results** - Perceptions, importance and satisfaction of respondents with respect to environmental issues towards street trees.

A one-way ANOVA is performed to see if there is any significant difference in the importance of each factor given by the residents from Midhilapuri colony, East Point colony, Official colony, Madhavadhara, Pedhagentyada and Simhapuri colony. The result is shown in Table 1, and also analysis the Means, standard deviations and ANOVA results comparing among the perceptions, importance, and satisfaction of respondents with respect to environmental issues towards street trees.

Table 1: Mean comparing the perceptions of respondents with respect to Environmental issues towards Street Trees.Source: Researcher, 2023.

| Variable | Category | Number | Mean | Std.Dev. | F/t-value | p-value |
|---|---|---|---|---|---|---|
| Area | Midhilapuri Colony | 100 | 26.24 | 3.61 | $0.85^{NS}$ | 0.52 |
| | East Point Colony | 100 | 26.56 | 2.67 | | |
| | Official Colony | 100 | 26.81 | 3.14 | | |
| | Madhavadhara | 100 | 26.80 | 2.86 | | |
| | Pedagantyada | 100 | 27.08 | 3.61 | | |
| | Simhapuri colony | 100 | 26.93 | 3.40 | | |
| Gender | Male | 308 | 26.85 | 3.25 | $0.89^{NS}$ | 0.38 |
| | Female | 292 | 26.62 | 3.21 | | |
| Stay at place | Upto 10 | 222 | 27.28 | 3.35 | 4.22* | 0.01 |
| | 11 – 20 | 254 | 26.60 | 2.99 | | |
| | 21 – 30 | 100 | 26.05 | 3.39 | | |
| | Above 30 | 24 | 26.00 | 3.27 | | |
| Age | Below 18 Years | 102 | 26.87 | 3.80 | $2.03^{NS}$ | 0.11 |
| | 18 - 35 Years | 265 | 26.94 | 3.05 | | |
| | 35 - 60 Years | 188 | 26.62 | 3.03 | | |
| | Above 60 Years | 45 | 25.71 | 3.58 | | |
| Educational Qualification | Primary | 52 | 26.08 | 3.41 | 2.67* | 0.03 |
| | Secondary | 150 | 27.09 | 3.54 | | |
| | Intermediate | 130 | 26.76 | 2.83 | | |
| | Degree | 220 | 26.89 | 3.08 | | |
| | Above Degree | 48 | 25.58 | 3.51 | | |
| Occupation | Self Employed | 88 | 27.26 | 3.32 | $1.86^{NS}$ | 0.09 |
| | Business | 131 | 27.01 | 2.75 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Student | 139 | 26.09 | 4.18 | | |
| | Employed | 51 | 26.65 | 2.81 | | |
| | Homemaker | 75 | 26.53 | 2.82 | | |
| | Unemployed | 91 | 27.15 | 2.67 | | |
| | Other Occupation | 25 | 26.36 | 2.69 | | |
| Owner of the House | Owner | 234 | 26.97 | 2.84 | 4.10* | 0.01 |
| | Renter | 250 | 26.96 | 3.09 | | |
| | Provided by employer | 61 | 25.72 | 3.12 | | |
| | Use not paying Rent | 55 | 25.89 | 4.89 | | |

**Significant at 0.01, *Significant at 0.05 level and NS: Not Significant

Table 1, shows that, the mean perceptual scores of respondents based on their living area with respect to environmental factors; the mean perceptual scores of respondents for Midhilapuri Colony is 26.24, whereas for East Point Colony it is 26.56, 26.81 for Official Colony, 26.80 for Madhavadhara, it is 27.08 for Pedhagentyada and it is 26.93 for Simhapuri Colony. The SD values are 3.61, 2.67, 3.14, 2.86, 3.61 and 3.40 respectively. The 'F'-value is 0.85 and the p-value is 0.52, which is statistically not significant at any level. This shows that there is no significant difference among the perceptions of respondents based on their area and they perceived similar opinion towards environmental factors.

It is also revealed that, the mean perceptual scores of respondents based on their gender with respect to environmental factors, the mean perceptual score of male respondents is 26.85, whereas it is 26.62 for the female respondents while SD values are 3.25 and 3.21 respectively. The derived t – value is 0.89 and the p-value is 0.38 is statistically not significant. This shows that, there is no significant difference between the perceptions of male and female respondents, and they perceived similar opinion towards environmental factors.

However, the mean perceptual scores of respondents based on their period of stay at locality with respect to environmental factors, the mean perceptual scores of respondents for up to 10 years is 27.28, whereas for 11 – 20 years it is 26.60, for 21 - 30 years is 26.05, and 26.00 for above 30 years and the SD values are 3.35, 2.99, 3.39 and 3.27 respectively. The 'F'-value is 4.22 and the p-value is 0.01, which is statistically significant at 0.05 level. This shows that there is a significant difference between the perceptions of respondents based on their period of stay at a locality and respondents who had stayed for 10 years is perceived higher towards environmental factors than that of the rest. Based on results, the mean perceptual scores of respondents based on their age group with respect to environmental factors, the mean perceptual scores of respondents for below 18 years is 26.87, whereas it is for 18 – 35 years it is 26.94, it is 26.62 for 35 - 60 years and it is 25.71 for above 60 years; the SD values are 3.80, 3.05, 3.03 and 3.58 respectively. The 'F'-value is 2.03 and the p-value is 0.11, which is not statistically significant at any level. This shows that there is no significant difference among the perceptions of respondents based on their age group and they perceived similar opinion towards environmental factors.

It is observed from results, the mean perceptual scores of respondents based on their educational qualification with respect to environmental factors, the mean perceptual scores of respondents for primary education is 26.08, whereas it is 27.09 for secondary education, it is 26.76 for intermediate, it is 26.89 for degree qualification and it is 25.58 for above graduation degree; the SD values are 3.41, 3.54, 2.83, 3.08 and 3.51 respectively. The 'F'-value is 2.67 and the p-value is 0.03, which is statistically significant at 0.05 level. This shows that there is a significant difference between the perceptions of respondents based on their educational qualification and respondents who are qualified secondary education perceived higher towards environmental factors than that of the rest.

However, the mean perception of respondents based on their occupation with respect to environmental factors, the mean perceptual scores of respondents for self-employed is 27.26, whereas it is for business is 27.01, it is for student is 26.09, it is for employed is 26.65, it is for home maker is 26.53, it is unemployed is 27.15 and it is for other occupations is 26.36 and the SD values are 3.32, 2.75, 4.18, 2.81, 2.82, 2.67 and 2.69 respectively.. The 'F'-value is 1.86 and the p-value is 0.09, which is statistically not significant at any level. This shows that there is no significant difference among the perceptions of respondents based on their occupation and they perceived similar opinion towards environmental factors.

This Study shows that, the mean perceptual scores of respondents based on their owner of the house with respect to environmental factors, the mean perceptual scores of respondents for owner is 26.97, whereas it is 26.96 for renter of the house, it is 25.72 for employer, and it is 25.89 for those not paying rent; the SD values are 2.84, 3.09, 3.12, and 4.10 respectively. The 'F'-value is 4.10 and the p-value is 0.01, which is statistically significant at 0.05 level. This shows that, there is a significant difference among the perceptions of respondents based on their owner of the house and the respondents who are owner of the house perceived high towards environmental factors than that of the rest.

**Conclusion**

There is a knowledge gap in our understanding of conservation in urban green spaces, since many metropolitan regions have a poor understanding of the importance of street trees for environmental sustainability. The final weight of all sub-factors is determined; they can be rated from the highest value to the lowest value. This rating will determine which factors affect selection of street tree factors more than others. Regarding each sub environmental criterion factors, the Provide shelter for birds and other city fauna sub criteria received relatively higher preference in questionnaire analysis method. Pedhagentyada inhabitants (27.08) rated environmental issues higher on their preference score than residents of other nearby neighbourhoods. There is no statistically significant difference in respondents' opinions about environmental factors based on their area, gender category, age group and their occupation respondents they perceived. However, there is a significant difference in respondents' opinions about environmental factors based on their period of stay in the locality, their educational qualification and home ownership. This gives us a better understanding of the public's opinion broadly and enables us to provide recommendations for decision-makers regarding potential new approaches for urban arboriculture and planning the street vegetation based on the results of the analysis.

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