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The Governance of Amenity Trees in the Premises of Industrial Companies in Ibadan Metropolis, Nigeria †

Oyinlola Abiodun Fasoro *, Opeyemi Isaac Ajewole and Sulaimon Olamilekan Daud

Department of Social and Environmental Forestry, University of Ibadan, Ibadan 200132, Nigeria; oi.ajewole@ui.edu.ng (O.I.A.); owologeson1@gmail.com (S.O.D.)

* Correspondence: oyinlola4christ@gmail.com or oa.fasoro@ui.edu.ng; Tel.: +234-8063520878

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Abstract: Industries contribute to environmental pollution, and increasing tree cover is an often-proposed urban climate change adaptation strategy. This manuscript investigates the governance of amenity trees within industrial settings in Ibadan, Nigeria. It aims to encourage industries to develop policy frameworks that optimize tree management for environmental benefits. This study involved surveying twenty purposively selected active industries and analyzing the data through descriptive, correlation, and chi-square methods to assess tree species diversity, management practices, and the relationships between the number of species and the land area, as well as tree establishment and silvicultural activities. *Polyalthia longifolia* (30.8%) had the highest number, while *Eucalyptus camaldulensis* and *Alstonia boonei* (0.6%) had the lowest numbers. The respondents (38.3%) revealed that there was no department (unit) responsible for tree management, and there was no precise tree maintenance schedule. However, tree maintenance is conducted when needed. The respondents (98.0%) responded that no funds were set aside for tree management. The result of the correlation, r = −0.14412, represents a weak negative relationship between the number of tree species planted and the land area of the industries. The year in which trees were planted has a significant relationship with the silvicultural activities practiced.

Keywords: urban trees; governance; companies; management schedule; decision-making

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1. Introduction

Turner-Skoff (2019) [1] emphasized the substantial influence of human activity on Earth's systems. Population growth and industrial expansion, industrial pollution in particular, have impacts on the environment. Industries contribute to environmental pollution by dispensing toxic waste into the air, water, and land. Smoke containing undesirable gases like carbon dioxide, sulfur dioxide, and carbon monoxide emitted by industries causes air pollution. These consequences not only cause human health problems and climate change but they also have an impact on energy consumption and carbon emissions. Thus, industrial pollution has become a major concern for global organizations striving to combat environmental deterioration.

Increasing urban tree cover is a frequently recommended urban mitigation strategy for solving the rate of the increase in industrial pollution affecting biodiversity preservation, resource sustainability, and the ecosystem in general. Urban trees have an important role in pollution reduction, especially in industrial areas, through a variety of methods. One of their key benefits is their ability to capture and filter pollutants from the atmosphere. Trees absorb gasses like SO_2, NO_x, and O_3 through their leaves and bark. The leaf surface traps

particulate matter (PM), particularly PM2.5 and PM10, which are common in industrial emissions, preventing them from entering local populations' respiratory systems [2].

Furthermore, urban trees help to regulate temperature by providing shade and releasing water vapor through transpiration, which lowers ambient temperatures and reduces the generation of ground-level ozone, a major component of smog [3]. Their cooling effect is especially beneficial in industrial areas, where heat frequently exacerbates air pollution levels. Trees increase the soil quality, which can help minimize soil erosion and runoff, which can transport contaminants into rivers [4]. Urban forests intercept rainfall, reducing contaminated runoff into surrounding rivers and streams.

Pataki (2011) [5] stated that urban planners and policymakers frequently advocate for increased vegetation in cities and industries in order to improve livability and address the environmental concerns caused by urbanization. However, limited research has been conducted on strategies for ensuring the survival and health of the trees so as to ensure that trees provide optimal ecosystem services for industries. Governance in urban forestry refers to the structured processes, policies, and practices that drive decision-making and the implementation of plans for planning, managing, and maintaining urban trees and green areas. Multiple stakeholders, including local governments, industry leaders, environmental organizations, and community members, work together to build sustainable urban forests that contribute to environmental, social, and economic well-being [6]. When applied to industrial environments, urban forestry governance focuses on balancing economic development, environmental conservation, and public health. Effective governance ensures that decisions on tree planting, management, and preservation are linked to larger urban planning frameworks, with an emphasis on reducing industrial pollution, increasing air quality, and improving the living circumstances in nearby communities. This necessitates cross-sector coordination and adherence to policies that promote long-term outcomes [7].

Governance in these environments entails the alignment of policies with practical actions, such as selecting pollution-tolerant tree species, incorporating green buffers around industrial facilities, and developing monitoring systems to evaluate the impact of urban forestry on pollution levels [8]. This study therefore examined the tree management practices in industries with the aim of encouraging these industries to develop policy frameworks that optimize tree management for environmental benefits.

2. Methodology

2.1. Study Area

Ibadan is located in Oyo state, Nigeria. Ibadan city lies at the geographical coordinates of a longitude 3°14′56″ E and 3°16′58″ E and a latitude 7°26′33″ N and 7°38′22″ N [9]. Ibadan metropolis lies within the tropics; thus, it has tropical climate, with two district seasons. These are the raining season, which spans through April to October, and the dry season, spanning through November to March. Figure 1 shows a map of the study area.

2.2. Data Collection and Analysis

A reconnaissance study was carried out at the Ministry of Trade, Industry, Investment, and Cooperatives in Oyo state, Nigeria. This ministry is in charge of fostering economic diversification, creating employment, and strengthening the state's competitive advantage in a variety of industries. Our visit revealed that there was no up-to-date list of registered industries and that some of the industries recorded had folded and were no longer in operation, while others were not registered with the ministry. Thus, 20 active industries with trees in their environments were purposively selected from this list. The selected industries and their locations are shown in Table 1 and Figure 1, respectively. Three departmental/unit heads from each of the selected industries were selected based on the

directive of the management of the companies. A total of 60 respondents were selected. The data were analyzed through descriptive, correlation, and chi-square methods to assess tree species diversity, management practices, and the relationships between the number of species and the land area, as well as tree establishment and silvicultural activities.

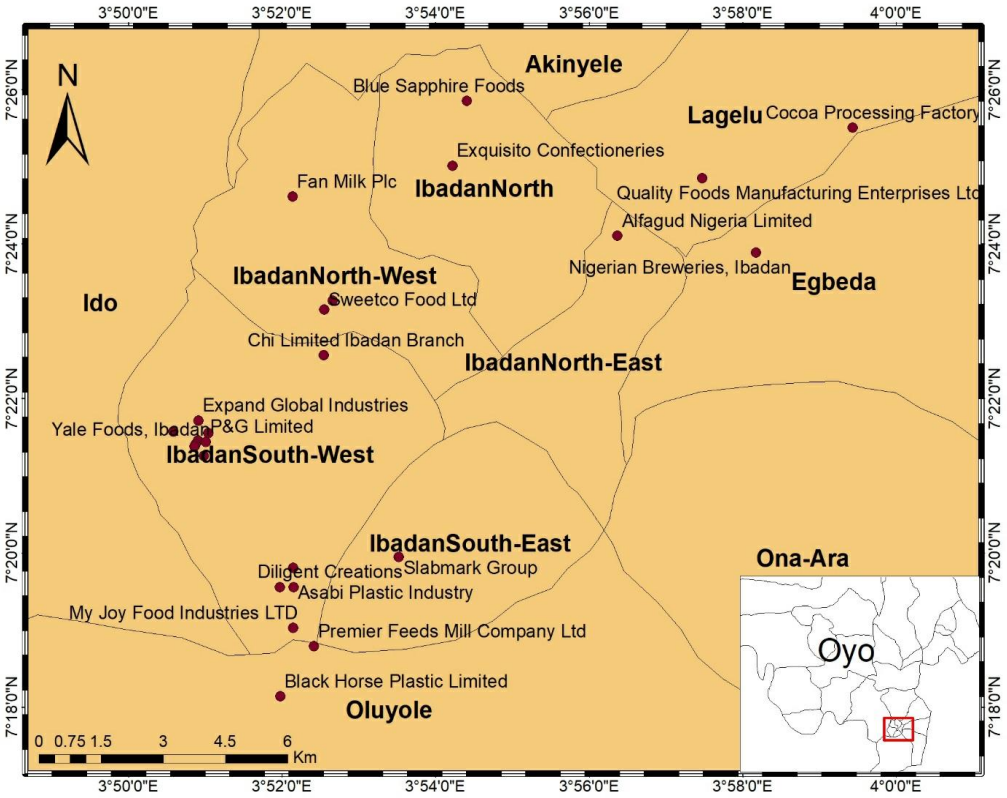

Figure 1. Map showing selected manufacturing industries in Ibadan metropolis. (The study area was identified using the red mark on the Oyo state map.)

Table 1. Companies surveyed based on age, category, and land area.

	Company's Name	Number of Questionnaires Administered	Age of Company	Category of Company	Land Area of Company (Hectares)
1	Nourdm Global company (Ibadan, Nigeria)	3	15	Manufacturing	10
2	Slabmark group (Ibadan, Nigeria)	3	10	Oil and gas	20
3	7up Bottling company (Ibadan, Nigeria)	3	12	Food processing	15
4	P and G Limited (Ibadan, Nigeria)	3	23	Manufacturing	18
5	Unilever Nigeria Plc (Ibadan, Nigeria)	3	26	Manufacturing	20
6	Black Horse Plastics Ltd. (Ibadan, Nigeria)	3	12	Manufacturing	10
7	FTN Cocoa Processor Plc (Ibadan, Nigeria)	3	14	Food processing	15
8	Agrited Group of Companies (Ibadan, Nigeria)	3	13	Agriculture	18
9	Chi Ltd. Ibadan Branch (Ibadan, Nigeria)	3	31	Food processing	25
10	Nigeria Eagle Flour Mills Ltd. (Ibadan, Nigeria)	3	15	Food processing	20

Table 1. *Cont.*

	Company's Name	Number of Questionnaires Administered	Age of Company	Category of Company	Land Area of Company (Hectares)
11	Asabi Plastics (Ibadan, Nigeria)	3	12	Manufacturing	12
12	Deepee Global (Ibadan, Nigeria)	3	30	Manufacturing	19
13	Sweetco Food Ltd. (Ibadan, Nigeria)	3	21	Food processing	10
14	Premier feed mill company (Ibadan, Nigeria)	3	15	Agriculture	23
15	WACOT Ltd. (Ibadan, Nigeria)	3	35	Manufacturing	20
16	AGAH (Ibadan, Nigeria)	3	15	Manufacturing	17
17	Expand global industries (Ibadan, Nigeria)	3	23	Manufacturing	5
18	Yale food Nigeria Ltd. (Ibadan, Nigeria)	3	42	Food processing	30
19	Altak industries Ltd. (Ibadan, Nigeria)	3	20	Manufacturing	15
20	Alfagud Nigeria Ltd. (Ibadan, Nigeria)	3	10	Oil and gas	20

3. Results

3.1. Population Diversity of Amenity Tree Species in and Around the Industries' Premises

A total of nineteen amenity tree species were identified in the industries. Figure 2 shows the percentage of species' occurrence in the industries. In these industries, the percentage of occurrence were *Mangifera indica* (8.5%), *Polyalthia longifolia* (30.8%), *Terminalia catappa* (7.6%), *Psidium guajava* (0.9%), *Azadirachata indica* (7.6%), *Eucalyptus camaldulensis* (0.6%), *Anacardium occidentalis* (3.5%), *Albizia lebbeck* (3.8%), *Citrus paradisi* (4.7%), *Cocos nucifera* (8.2%), *Elaeis guineenssis* (6.7%), *Delonix regia* (2.3%), *Ficus sycomorus* (1.8%), *Gliricidia sepium* (2.9%), *Tectona grandis* (4.4%), *Alstonia boonei* (0.6%), *Aquilaria malaccensis* (2.9%), *Blighia sapida* (0.9%), and *Terminalia mantalis* (1.2%). *Polyalthia longifolia* was the most common tree in the industries, accounting for 30.8% of the total population, while *Eucalyptus camaldulensis* (0.6%) and *Alstonia boonei* (0.6%) were the least common.

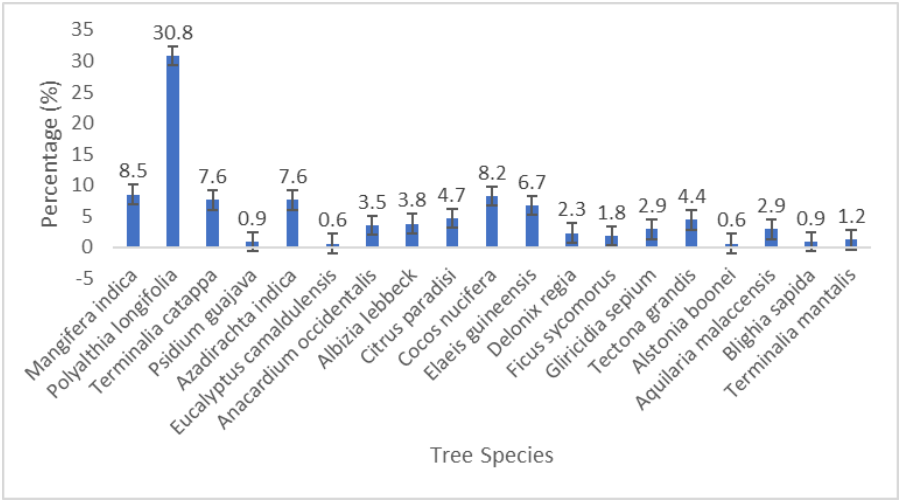

Figure 2. Percentage distribution of tree species' abundance in the study area.

3.2. Relationship Between Tree Density and Land Area in the Industries

The number of trees in each industry was enumerated. Nourdm Global company had 10 trees, Slabmark group 22, 7up Bottling company 16, P and G Limited 17, Unilever Nigeria Plc 9, Black Horse Plastics Ltd. 33, FTN Cocoa Processor Plc 13, Agrited Group of Companies 23, Chi Ltd. Ibadan Branch 14, Nigeria Eagle Flour Mills Ltd. 15, Asabi Plastics 15, Deepee Global 8, Sweetco Food Ltd. 16, Premier feed mill company 30, WACOT Ltd. 25, AGAH 17, Expand global industries 20, Yale food Nigeria Ltd. 14, Altak industries Ltd. 9, and Alfagud Nigeria Ltd. 15. According to Table 2, Black Horse Plastic Limited had the most trees (33) on its property, followed by Premier Feedmill (30). Premier Feedmill company, on the other hand, had a higher species richness (6) than that of Black Horse Plastic Limited, which had only five species. Deepee Global had the fewest trees (8) in and around its surroundings. The result of the correlation, $r = -0.14412$, represented a weak negative relationship between the number of species and the land area of the companies. A negative sign indicates that as the land area of the companies increases, the number of species tends to decrease slightly. Conversely, a smaller land area might be associated with a higher number of species. However, this correlation is weak, meaning that while there is a negative trend, it is not strong or consistent across the data.

Table 2. Tree density and land area in the industries.

	Company's Name	Number of Trees Identified	Land Area (Hectares)
1	Nourdm Global company	10	10
2	Slabmark group	22	20
3	7up Bottling company	16	15
4	P and G Limited	17	18
5	Unilever Nigeria Plc	9	20
6	Black Horse Plastics Ltd.	33	10
7	FTN Cocoa Processor Plc	13	15
8	Agrited Group of Companies	23	18
9	Chi Ltd. Ibadan Branch	14	25
10	Nigeria Eagle Flour Mills Ltd.	15	20
11	Asabi Plastics	15	12
12	Deepee Global	8	19
13	Sweetco Food Ltd.	16	10
14	Premier feed mill company	30	23
15	WACOT Ltd.	25	20
16	AGAH	17	17
17	Expand global industries	20	5
18	Yale food Nigeria Ltd.	14	30
19	Altak industries Ltd.	9	15
20	Alfagud Nigeria Ltd.	15	20

3.3. Years of Trees' Establishment and the Units Saddled with the Responsibility of Tree Management

Table 3 shows that 25.0% of the respondents were unaware of when the trees were planted; 23.3% of the respondents stated that the trees were planted between one and five years ago; 18.3% of the respondents, respectively, stated the trees were planted between six and ten years ago and not less than a year ago; and 15.0% of the respondents claimed that the trees were planted more than ten years ago. This indicates that the majority of the trees found in these companies were not present prior to their establishment but were planted recently. The table shows that 38.3% of the respondents reported that there is no single department or unit in charge of tree management in these industries. However, in some of the industries, 26.7%, 21.7%, 6.7%, and 6.7% of the respondents claimed that the

health, safety, and environment; horticulture; work and maintenance; and security and gardening units, respectively, are in charge of carrying out silvicultural activities on these industries' premises.

Table 3. Percentage distribution of the years the trees were planted and the units responsible for the management of the trees.

Variables	Frequency	Percentage (%)
Year trees were planted		
≤ a year ago	11	18.3
1–5 years ago	14	23.3
6–10 years ago	11	18.3
≥10 years ago	9	15.0
Unknown	15	25.0
Units/departments responsible for tree management		
Security and Gardening	4	6.7
Health, Safety, and Environment	16	26.7
Work and Maintenance	4	6.7
Horticultural Unit	13	21.7
None	23	38.3

3.4. Tree Maintenance Schedule in the Industries and the Funding Framework

As seen in Figure 3, 91.7% of the respondents stated that there is no precise schedule planned or prepared to ensure proper maintenance of the trees in the industries' environments. Table 4 shows that most of the companies' respondents claimed that planting (6.7%), pruning (5.0%), cutting (5.0%), and cleaning of the trees' surroundings (18.3%) were undertaken when necessary. Figure 4 reveals that most of the respondents (98.3%) stated that there is no allocated fund for tree maintenance.

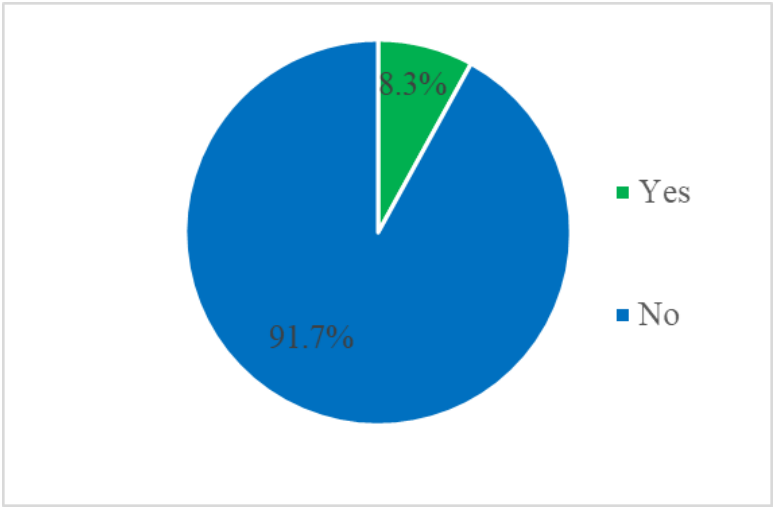

Figure 3. Respondents' perceptions of the tree maintenance schedules of the industries.

Table 4. Percentage distribution of the tree management schedules in the industries.

Occurrence	Silvicultural Activities (%)				
	Planting	Watering	Pruning	Cutting/Trimming	Cleaning
Daily	0	0	0	0	0
Weekly	3 (5.0)	2 (3.3)	0	0	0
Monthly	1 (1.7)	1 (1.7)	1 (1.7)	0	4 (6.7)
Quarterly	0	0	1 (1.7)	2 (3.3)	0
Biannually	0	0	2 (3.3)	0	1 (1.7)
Annually	2 (3.3)	1 (1.7)	1 (1.7)	1 (1.7)	1 (1.7)
Occasionally	1 (1.7)	2 (3.3)	0	1 (1.7)	4 (6.7)
As the need arises	4 (6.7)	0	3 (5.0)	3 (5.0)	11 (18.3)
Never	1 (1.7)	2 (3.3)	0	1 (1.7)	3 (5.0)

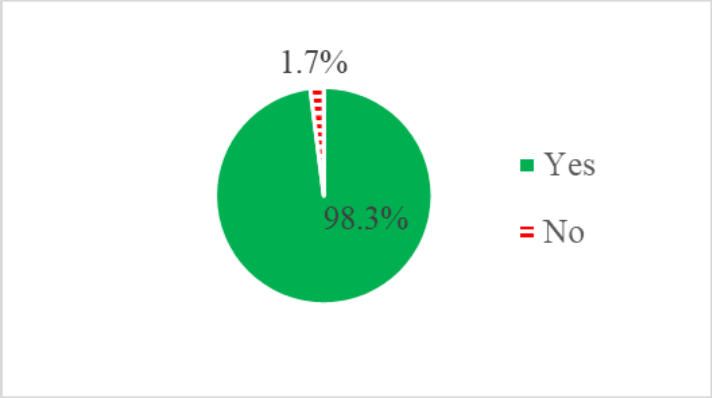

Figure 4. Percentage distribution of respondents' perceptions of the funding framework for tree maintenance in the industries.

3.5. Relationship Between Tree Establishment and Silvicultural Activities

In Table 5, the chi-square (χ^2) value of 47.044 at a *p*-value of 0.000 shows that there is a significant relationship between the year trees were planted and the type of silvicultural activities practiced in the industries. This implies that the timing of tree planting influences the silvicultural practices used by the industries.

Table 5. Presentation of chi-square results.

Variables	Value	Df	Significance
Year trees were planted	47.044	16	0.000

4. Discussion

All of the industries surveyed had trees on their properties. This study revealed that *Polyalthia longifolia* is the most common tree species in these industries, while *Eucalyptus camaldulensis* and *Alstonia boonei* are the least found tree species in these industries. According to [10], *Polyalthia longifolia* is an evergreen tree that requires minimal maintenance to grow. Its dense foliage effectively filters particulate matter and absorbs toxic gases like sulfur dioxide and nitrogen dioxide, so it significantly improves air quality [11]. *Eucalyptus camaldulensis*, on the other hand, grows quickly but requires a lot of water, which might deplete groundwater levels, making it less suitable for sustainable practices. Furthermore, its allelopathic properties can hinder the growth of nearby vegetation [10]. *Alstonia boonei* is valued due to its medicinal benefits, although it has a larger canopy and requires specific growth conditions; however, it may not be as successful at absorbing pollutants as

Polyalthia longifolia [11]. According to [12], industries emit pollutants, which are one of the world's leading causes of environmental health problems. To mitigate this risk, it has been proposed that tree planting be a company commitment and a component of company social responsibility. It is also important to note that the selection of tree species in industrial areas should be based on a thorough assessment of the local environmental conditions, soil type, and specific pollution concerns. Thus, *Polyalthia longifolia* aligns well with industrial landscaping needs. Most of the trees were planted after the companies were established. Some of the respondents said they did not know when the trees were planted. Given that these are private industries with employees that come and go, it is natural that some of the respondents may not have known who planted the trees and when.

This study revealed that the total number of trees planted by the industries did not correspond with the land area covered. A weak negative correlation indicated that larger land areas may not always support more species. It may indicate that the larger the land area, the fewer the tree species. This could be due to a variety of factors, including tree density and spacing. Different tree species require certain spacing to enable healthy growth and maximize their benefits; therefore, industrial land may have limits owing to infrastructure, buildings, or other operating requirements, reducing the space available for tree planting. According to [13], the Ministry of Environment, Forest, and Climate Change (MoEFCC) has mandated the establishment of green belts surrounding industrial regions to reduce pollution and improve environmental quality. Industries are required to set aside a section of their land for tree planting to serve as a buffer zone. However, there is no universal rule dictating the exact number of trees required around manufacturing industries; numerous countries have enacted environmental regulations and guidelines that encourage or compel the construction of green belts or tree planting in industrial zones. It is thus important for each country to set standards that specify the expected number of trees that should be present around industries based on their activities and the land area.

A substantial number of the respondents claimed that there is no department or unit in charge of carrying out silvicultural activities and that tree management is undertaken when the need arises. Further inquiry found that laborers (casual employees) are always hired from outside to perform these tasks as needed. This indicated that professionals or skilled laborers are not employed for tree management. One of the consequences of not using professionals is misappropriation and errors in management activities. For example, there are required times and season for specific silvicultural activities such as pruning, trimming, and cutting. Thus, industries should hire certified arborists or create partnerships with forestry organizations. The respondents said there is no unified financial and policy framework for tree maintenance. They went on to say that the management of trees on the companies' properties is tied to miscellaneous funding set aside at the start of the calendar year (annual expenditure budget). And occasionally, these funds come from funds designated for upkeep and repairs. Most manufacturing industries' budgets may lack funding for tree management due to a focus on core business priorities, regulatory gaps, the high costs and expertise required, the indirect nature of its benefits, reliance on third-party partnerships, and limited stakeholder pressure. All of these characteristics create an environment in which tree maintenance is frequently disregarded until external influences like strategic cooperation and social responsibility objectives drive its inclusion. According to a survey on corporate budgeting trends, most companies dedicate the majority of their budgets to operational and capital expenses, with environmental management frequently considered only when it is legally necessary or there is a clear return on investment [14].

This study revealed that the year the trees were planted had a significant relationship with the silvicultural activities practiced in these industries. The year in which the trees are planted may influence the type of silvicultural activities carried out on the premises.

The age and species of trees can influence the types of silvicultural treatments required. Older trees may need different management practices compared to younger trees. For example, a *Mangifera indica* or *Azadirachta indica* tree planted 10 years ago will require more trimming and cutting of damaged parts than those planted 5 years ago. Furthermore, aligning the planting years with climate predictions and applying targeted silvicultural practices enhances tree health and productivity. This strategic approach guides better policy development for industries, promoting sustainable, high-yield forestry operations.

5. Conclusions

This study provides useful insights into the management and strategic importance of trees in industrial areas. An effective and systematic tree care program is built on a management schedule; thus, industries should develop detailed policies describing the management, preservation, and growth of amenity trees, as well as clear roles and responsibilities. This will help them to manage amenity trees more effectively, maximizing their benefits while promoting sustainable and responsible environmental management.

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