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Urban Residents' Perceptions of Urban Trees and Participation in Tree Planting Activities in a Rapidly Urbanising Neighbourhood of Accra, Ghana

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Abstract. Background: Urban trees provide multiple ecological, social, and climatic benefits, yet their long-term sustainability in rapidly urbanising cities depends on how residents perceive and engage with urban tree planting programmes and the governance systems that support them. However, limited research has examined how governance-related factors influence participation in urban tree planting activities in rapidly urbanising African cities. Methods: This study examined urban tree perceptions, participation in tree planting activities, and governance-related factors shaping engagement in Madina, a high-density neighbourhood in Accra, Ghana. A household survey of 395 respondents across 5 sub-areas was conducted. Descriptive statistics and logistic regression were used to assess perceived benefits of urban trees, participation patterns, programme awareness, institutional trust, and barriers to engagement. Results: Urban trees were widely valued, particularly for aesthetic enhancement, habitat provision, temperature regulation, and air purification. However, participation was uneven and awareness of formal urban tree programmes remained low despite strong interest in future involvement, revealing a pronounced participation-awareness gap. Logistic regression results showed that participation was more strongly associated with programme awareness, perceived effectiveness of local authorities, and trust in information sources than with sociodemographic characteristics. Reported barriers to participation were dominated by information gaps, lack of organised opportunities, time constraints, and limited planting space. Awareness of urban tree planting programmes emerged as the strongest predictor of participation. Conclusion: The findings highlight the importance of governance visibility, communication, and institutional credibility in translating positive perceptions of urban trees into sustained community participation. Strengthening neighbourhood-level coordination and continuous public engagement may therefore be critical for supporting long-term urban tree stewardship.

Keywords. Community Engagement; Tree Planting Participation; Urban Forestry; Urban Governance; Urban Tree Stewardship.

INTRODUCTION

Urban trees are widely recognised as integral components of urban green infrastructure, providing a range of ecosystem services that contribute to environmental quality, human well-being, and urban livability. These services include microclimate regulation, air quality improvement, biodiversity support, stormwater mitigation, and a variety of social and psychological benefits for urban residents (Roy et al. 2012; Nowak et al. 2013; Song et al. 2018; Keeler et al. 2019; Turner-Skoff and Cavender 2019; Puplampu and Boafo 2021). As cities continue to expand and densify, the capacity of urban trees to moderate environmental stressors such as heat and air pollution becomes increasingly important, particularly in neighbourhoods characterised by high population density and limited access to green space.

Despite their multifunctional value, urban trees are frequently exposed to pressures arising from urban development, infrastructure expansion, and weak or fragmented governance arrangements (Konijnendijk van den Bosch 2016; Cobbinah et al. 2023; Lüttge and Buckeridge 2023). Tree loss and degradation are often associated with competing land uses, limited enforcement of planning regulations, and unclear institutional responsibilities (Dobbs et al. 2011; Conway and Bang 2014). These challenges are especially pronounced in rapidly urbanising cities of the Global South, where population growth and informal development often outpace the capacity of urban planning and environmental management systems (Nagendra et al. 2018). In such contexts, sustaining urban tree cover extends beyond technical considerations of

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planting and maintenance and increasingly depends on social, institutional, and governance processes.

Beyond these structural and governance challenges, the ways in which residents perceive urban trees also play a critical role in determining their long-term conservation and management. Research has consistently shown that public perceptions influence how urban trees are valued, managed, and supported (Camacho-Cervantes et al. 2014; Fernandes et al. 2019; Barona et al. 2022). Perceived benefits shape residents' everyday interactions with trees, their acceptance of management interventions, and their support for urban greening policies (Lohr et al. 2004; Tyrväinen et al. 2005; Schneider et al. 2024). However, recognition of benefits does not necessarily translate into active engagement. Several studies have documented a gap between positive attitudes toward urban trees and actual participation in planting, maintenance, or stewardship activities (Conway 2016). This suggests that the relationship between valuation and behaviour is mediated by additional factors, particularly in dense urban environments where residents face spatial constraints, time limitations, and competing livelihood demands.

Understanding why positive perceptions do not always translate into action requires attention to the governance context within which urban tree management occurs. Urban tree management typically involves multiple actors operating across different scales, including municipal authorities, planning agencies, community organisations, and individual residents. The effectiveness of these arrangements depends not only on formal policies and technical capacity but also on how responsibilities are articulated, how information is communicated, and how trust is established between institutions and communities (Ostrom 1990; McMillen et al. 2016). Participation in urban tree planting programmes has been linked to the visibility of programmes, clarity of participation opportunities, and perceptions of institutional effectiveness (Locke et al. 2019). Where governance structures are fragmented or poorly communicated, residents may remain unaware of opportunities for engagement or perceive tree management as solely the responsibility of public authorities. In contrast, accessible information, trusted communication channels, and credible institutions can strengthen participation and collective stewardship. Trust in information sources has been identified as particularly important in contexts where residents rely heavily on informal networks or have limited direct interaction with municipal agencies (Stern and Coleman 2015).

Building on this governance perspective, recent urban forestry research increasingly conceptualises urban tree stewardship as a governance-mediated process shaped not only by environmental attitudes but also by institutional trust, communication pathways, programme visibility, and opportunities for co-produced environmental action (Ernstson et al. 2010; McMillen et al. 2016; Locke et al. 2019; Davies and Santo-Tomás Muro 2024; Scheuer et al. 2024; Boafo et al. 2025). This perspective shifts attention from urban trees as solely biophysical assets toward understanding how social and institutional conditions influence whether residents are able and willing to participate in urban greening initiatives. In rapidly urbanising cities, where formal and informal governance systems frequently overlap, participation in urban forestry may therefore depend as much on governance accessibility and institutional credibility as on positive perceptions of trees themselves.

Despite the well-documented benefits of urban trees and public perceptions of urban greenery (Lo et al. 2017; Collins et al. 2019; Fernandes et al. 2019; Drew-Smythe et al. 2023), several important gaps remain in the literature. These studies often examine perceptions or participation in isolation, without explicitly analysing how governance-related factors such as programme awareness, perceived institutional effectiveness, and trust mediate the relationship between valuation and engagement. Empirical evidence from rapidly urbanising cities in sub-Saharan Africa (Shackleton et al. 2015; Abass et al. 2019; Adeyemi and Shackleton 2025) also remains comparatively limited, with existing work often focusing on biophysical assessments or policy analysis rather than neighbourhood-scale dynamics of perception and participation. In addition, there is a lack of quantitative studies that simultaneously examine perception, awareness, trust, and participation within integrated analytical models, limiting understanding of their relative influence on urban tree stewardship in heterogeneous urban contexts where formal and informal governance arrangements coexist.

Addressing these gaps requires empirical evidence from rapidly urbanising cities where governance complexity and socio-spatial diversity shape everyday interactions with urban trees. Accra, the capital

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city of Ghana, illustrates many of the challenges associated with rapid urban growth, including mixed land-use development, high population density, and increasing pressure on environmental assets such as urban trees (Akubia and Bruns 2019; Gaisie et al. 2019; Korah et al. 2019; Songsore 2020). Urban tree management in the city occurs within a complex governance landscape shaped by multiple institutions, regulatory frameworks, and informal practices. Madina, one of Accra's major urban settlements, reflects these dynamics at the neighbourhood scale (Akagla and Boafo 2025). The area comprises planned residential zones, commercial corridors, high-density housing, and informal market areas, creating a heterogeneous urban environment in which access to green space, exposure to environmental stressors, and opportunities for participation in urban greening initiatives vary considerably.

Against this contextual backdrop, the present study makes 3 principal contributions to urban forestry research. First, it provides neighbourhood-scale empirical evidence from a rapidly urbanising African city where such evidence remains limited. Second, it integrates perceptual, behavioural, and governance-related variables within a single analytical framework. Third, it advances understanding of how institutional visibility, trust, and programme awareness shape participation in urban tree stewardship.

Guided by these contributions and the identified knowledge gaps, the objective of this study is to examine urban residents' perceptions of urban trees and the socio-demographic and governance-related factors associated with participation in urban tree planting activities in Madina, Accra. The following literature review synthesises existing research on urban tree perceptions, participation, and governance to provide the conceptual foundation for empirical analysis.

LITERATURE REVIEW

Urban forestry research has long documented the multifunctional role of trees in urban environments, emphasising their contributions to ecological regulation, climate moderation, and human well-being. Early work framed urban trees primarily in terms of ecosystem services, highlighting benefits such as temperature regulation, air quality improvement, stormwater control, and biodiversity support (Nowak 2010; Roy et al. 2012). More recent research has expanded this perspective to include social, psychological, and cultural dimensions, recognising urban trees as integral to place-making, neighbourhood identity, and everyday urban experience (Derkzen et al. 2015; Jennings et al. 2016; Graça et al. 2018; Kendal et al. 2022).

In Ghana, recent studies have shown that perceptions of urban trees influence planting, retention, and management behaviour among homeowners and landlords in built-up urban areas (Danquah 2023; Danquah et al. 2023). Although these studies provide important national evidence, they focus largely on property owners and built-up residential settings (Akagla and Boafo 2025), leaving scope for further neighbourhood-scale analysis of broader urban residents' perceptions, participation, and governance-related engagement.

This broader understanding has also shifted attention toward governance-related questions concerning how urban tree initiatives are managed, who participates in stewardship processes, and how institutional arrangements shape environmental responsibilities and participation. Governance-oriented research argues that urban forestry outcomes are influenced not only by ecological planning and technical expertise but also by the quality of coordination among institutions, accessibility of participation pathways, and the extent to which residents perceive governance systems as credible and responsive (Ernstson et al. 2010; Lawrence et al. 2013).

Within this perspective, multilevel governance approaches emphasise interactions among actors operating across institutional scales, while co-production perspectives highlight the importance of shared responsibilities, collaborative stewardship, and institutional trust in sustaining urban green infrastructure (Ostrom 1990; Lawrence et al. 2013). Participation in urban tree planting programmes is therefore increasingly understood as a socially and institutionally mediated process shaped by governance accessibility, communication pathways, and opportunities for meaningful engagement.

METHODS AND MATERIALS

Study Area

Madina is located within the La Nkwantanang–Madina Municipality in the Greater Accra Region of Ghana. The municipality was established by Legislative Instrument (L.I.) 2131 and inaugurated in June 2012 following its creation from the former Ga East

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Municipal Assembly (Ghana Statistical Service 2021). It forms part of the broader administrative restructuring of Metropolitan, Municipal, and District Assemblies aimed at decentralising governance and improving local service delivery. Madina serves as the administrative capital of the municipality (La Nkwantanang Madina Municipal Assembly 2023) (Figure 1).

Geographically, the municipality occupies approximately 70.9 km² and is situated in the northern part of the Greater Accra Region. It is bounded to the west by the Ga East Municipality, to the east by the Adentan Municipality, to the south by the Accra Metropolitan Assembly, and to the north by the Akwapim South District (La Nkwantanang Madina Municipal Assembly 2023). This positioning places Madina within a transitional urban corridor linking the central metropolitan core of Accra with rapidly expanding peri-urban and suburban settlements.

According to the 2021 Population and Housing Census, the municipality has a population of 244,676 residents, comprising 120,846 males and 123,830 females (Ghana Statistical Service 2021). The demographic profile reflects sustained urban growth and high population density relative to available land area. Madina is characterised by mixed land uses, including residential neighbourhoods, commercial corridors, market areas, educational institutions, and transport nodes. The built environment ranges from formal housing estates to high-density mixed residential-commercial clusters, contributing to spatial heterogeneity in settlement patterns.

In Ghana, urban tree governance involves multiple institutions, including Metropolitan, Municipal and District Assemblies (MMDAs), the Forestry Commission, environmental agencies, and community-level actors. The Forestry Commission primarily supports urban greening through technical guidance, tree planting campaigns, and broader national afforestation initiatives such as Green Ghana Day, although urban forestry policy frameworks remain relatively fragmented and are often implemented through decentralised environmental management structures

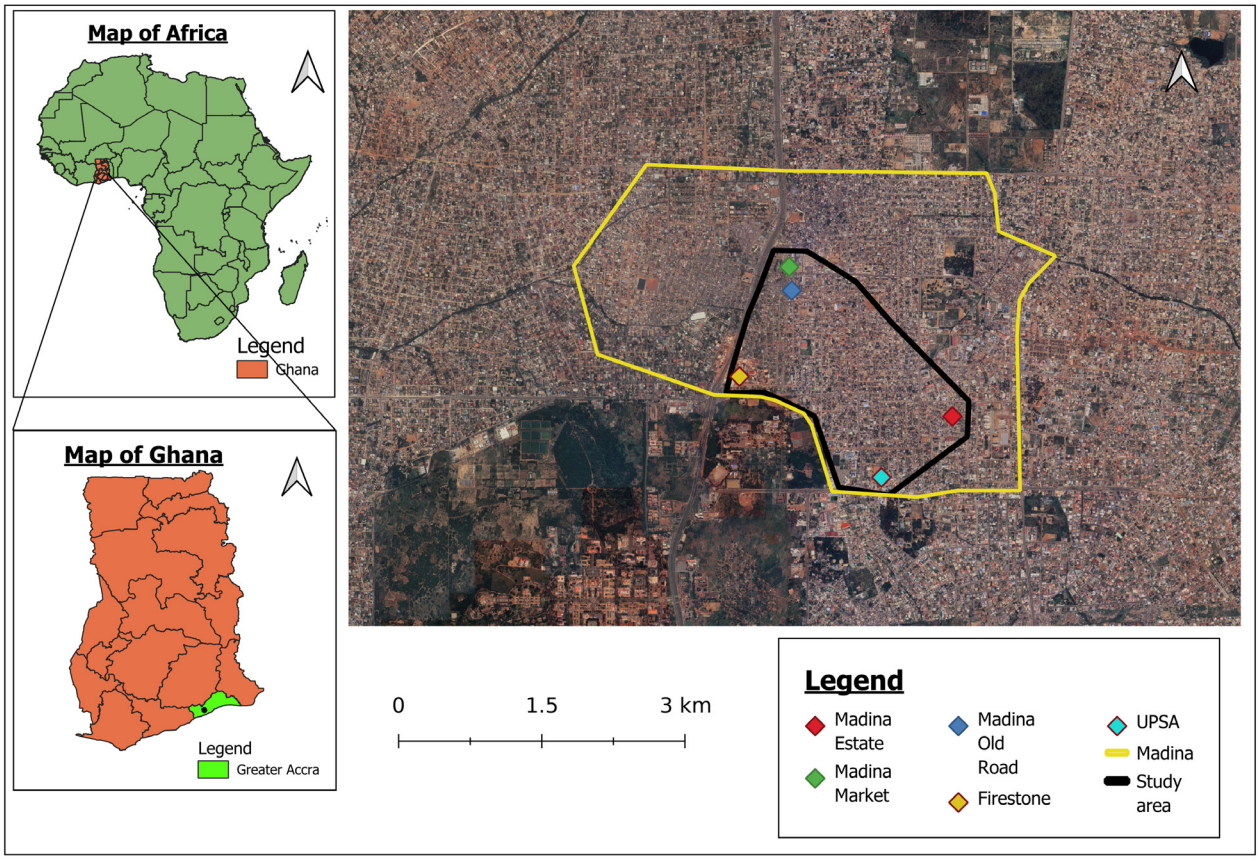

Figure 1. Location of the study area within the Greater Accra Metropolitan Area, Ghana, highlighting the 5 sub-areas of Madina (Madina Estate, UPSA enclave, Madina Old Road, Firestone, and Madina Market) where the household survey was conducted.

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rather than through a dedicated national urban forestry policy.

The combination of administrative decentralisation, rapid population growth, mixed tenure systems, and diverse land uses makes Madina a relevant site for examining neighbourhood-scale urban tree perceptions and participation. The municipality's urban character, together with ongoing infrastructure expansion and land use pressures, provides an appropriate context for investigating how residents relate to urban greening initiatives within a rapidly transforming metropolitan landscape.

Study Design

Sampling and Data Collection

Data were collected between July and September 2024 through a household-based survey administered to adult residents (18 years and above) across the selected sub-areas of Madina. A multistage sampling approach was adopted (Rahman et al. 2022). First, purposive sampling was used to select 5 sub-areas that reflected variation in residential density, land-use characteristics, institutional presence, and commercial activity within Madina (Patton 2002). This approach was considered appropriate for capturing the heterogeneous urban conditions and socio-spatial contrasts relevant to urban tree perceptions and participation. Second, households within each sub-area were systematically approached, and one eligible adult respondent was interviewed per household. At each selected household, interviewers first confirmed residency status and eligibility criteria before inviting participation. Where multiple eligible adults were present, one respondent was selected based on availability and willingness to participate. In compound houses and mixed-use settings, efforts were made to avoid repeated selection from the same dwelling unit in order to improve household-level variation within the sample. Systematic sampling was selected to ensure broad spatial coverage of households across the study locations while reducing interviewer selection bias. In predominantly residential areas, households were approached at regular intervals along accessible streets and footpaths. In mixed-use and commercially active areas, sampling included both residential compounds and nearby living spaces associated with informal economic activities to capture residents whose livelihoods are closely connected to outdoor urban environments.

The survey was administered using a structured questionnaire through face-to-face interviews, with interviewer assistance provided where necessary to account for varying literacy levels. Participation was voluntary, and respondents were informed about the study objectives, anonymity of responses, and their right to withdraw at any stage.

The sample size of 395 respondents was determined using Cochran's (1991) sample size estimation procedure for large populations (Taherdoost 2017). The initial sample size (n_0) was calculated using:

$$n_0 = \frac{Z^2 pq}{e^2}$$

where:

n_0 = required sample size for an infinite population;
Z = standard normal deviate corresponding to the desired confidence level (1.96 for 95% confidence);
p = estimated proportion of the population possessing the attribute of interest (0.5, assuming maximum variability);
$q = 1 - p = 0$; and
e = desired level of precision or margin of error (0.05).

Substituting these values yielded:

$$n_0 = \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2} = 384.16 \approx 384$$

Because the target population of Madina Municipality (N = 244,676) is finite, the sample size may be adjusted using Cochran's finite population correction:

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

where N is the population size. However, given the large population of the municipality, the corrected sample size differs only marginally from the initial estimate. Consequently, a target sample of 395 respondents was adopted, exceeding the minimum recommended sample size. The achieved sample was therefore considered adequate for the analytical requirements of the study, including the logistic regression analysis. In addition, the multistage sampling strategy was designed to capture variation

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across residential, commercial, and mixed-use sub-areas of Madina, thereby improving representation of the diverse socio-spatial characteristics of the study area.

Survey Instrument and Measures

Perceived benefits of urban trees: perceptions of urban trees were measured using Likert-scale items capturing ecosystem, social, and economic benefits relevant to dense urban settings such as Madina. Respondents assessed the role of urban trees in temperature regulation, air purification, stormwater management, carbon sequestration, habitat provision, mental health and stress reduction, aesthetic enhancement, recreational opportunities, noise reduction, energy savings, property value enhancement, job creation, and support for local businesses and tourism. Responses were recorded on a 5-point agreement scale. The scale ranged from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating stronger agreement regarding the perceived benefits of urban trees. For each perception item, a mean score was computed by averaging respondents' ratings, with higher mean values indicating stronger agreement regarding the perceived benefit of urban trees. Items were subsequently ranked in descending order of their mean scores to identify the most highly perceived benefits. Standard deviations were reported to indicate the degree of variability in respondents' ratings.

An aggregate Urban Tree Perception Score was computed by averaging responses across benefit items, with higher values indicating more positive perceptions. Internal consistency of the perception scale was assessed using Cronbach's alpha. The resulting alpha coefficient of 0.87 indicated high internal reliability and acceptable consistency among the Likert-scale items included in the perception index.

Participation in urban tree planting activities: participation was assessed using a binary indicator capturing whether respondents had ever participated in tree planting activities within Madina or the wider Accra metropolitan area. Future engagement was measured through self-reported interest in participating in tree planting activities, allowing differentiation between realised participation and latent willingness to engage.

Governance, policy awareness, and institutional trust: governance-related variables captured residents' awareness of urban tree planting programmes and policy initiatives operating within Accra; perceptions of the effectiveness of local authorities in managing and maintaining urban trees in Madina; and support for stricter regulations to protect and expand urban tree cover. Respondents also identified their main sources of information on urban trees and rated the perceived trustworthiness of such information. Cultural and historical significance of urban trees was included to capture place-based legitimacy and normative values associated with trees in Madina. Table 1 summarises the operationalisation, coding, and measurement of the variables used in the logistic regression analysis.

Barriers to participation and pathways for improvement: respondents who reported no prior participation were asked to explain reasons for nonparticipation using open-ended responses. All respondents were also asked to suggest ways to improve participation in tree planting activities and to identify priority areas requiring improvement in urban tree management within Madina. These responses provided contextual insight into practical, institutional, and social barriers shaping participation.

Socio-demographic and residential characteristics: socio-demographic variables included age, gender, education level, employment status, and home ownership. Residential context was captured through residential status and length of residence in Madina. These variables were included as controls in multivariate analyses due to their influence on environmental perceptions and civic engagement.

Analytical Framework

The factors associated with participation in urban tree planting activities were analysed using binary logistic regression because the dependent variable was dichotomous, indicating whether a respondent had ever participated in tree planting activities (1 = Yes; 0 = No). Binary logistic regression estimates the probability of participation as a function of a set of explanatory variables and is appropriate when the outcome variable is binary (Hosmer et al. 2013).

The probability that respondent i participated in urban tree planting activities is expressed as:

$$P(Y_i = 1) = \frac{\exp\left(\beta_0 + \sum_{j=1}^{k} \beta_j X_{ji}\right)}{1 + \exp\left(\beta_0 + \sum_{j=1}^{k} \beta_j X_{ji}\right)}$$

or equivalently in logit form:

$$\ln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ji}$$

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Table 1. Description of variables used in the logistic regression analysis.

Variable	Description	Measurement
Participation in tree planting activities (dependent variable)	Whether respondent had ever participated in tree planting activities	Binary: 1 = Yes, 0 = No
Urban Tree Perception Score	Average score across perceived environmental, social, and economic benefits of urban trees	Continuous Likert-based index (1–5)
Awareness of urban tree programmes	Self-reported awareness of urban tree planting programmes or policy initiatives	Binary: 1 = Aware, 0 = Not aware
Perceived government effectiveness	Respondent assessment of effectiveness of local authorities in urban tree management	Ordinal Likert scale
Trust in information sources	Perceived trustworthiness of information regarding urban trees and tree planting	Ordinal Likert scale
Age	Respondent age in years	Continuous
Gender	Respondent sex	Binary: 1 = Male, 0 = Female
Education level	Highest level of education attained	Ordinal categorical
Home ownership	Housing tenure status	Binary: 1 = Owner, 0 = Non-owner
Residential status	Type of residential setting	Binary: 1 = Urban, 0 = Other

where P_i is the probability that respondent i participated in urban tree planting activities; β_0 is the intercept; β_j represents the regression coefficient associated with explanatory variable X_j; and X_j denotes the explanatory variables included in the model.

A sequential modelling strategy was adopted to examine the incremental contribution of different categories of explanatory variables. Model 1 included socio-demographic and residential characteristics (age, gender, education level, home ownership, and residential status). Model 2 extended Model 1 by incorporating the Urban Tree Perception Score. Model 3 further included governance-related variables comprising awareness of urban tree programmes and perceived government effectiveness. Model 4 additionally included trust in information sources. The sequential model specifications were therefore defined as follows:

Model 1

X = (Age, Gender, Education, Home Ownership, Residential Status)

Model 2

X = (Model 1 + Urban Tree Perception Score)

Model 3

X = (Model 2 + Programme Awareness + Government Effectiveness)

Model 4

X = (Model 3 + Trust in Information Sources)

This sequential specification enabled assessment of the extent to which perceptual, governance-related, and informational factors improved model performance beyond socio-demographic characteristics.

Data Analysis

Data analysis was conducted in 3 stages aligned with the study objective. First, descriptive statistics were used to summarise respondents' socio-demographic characteristics, perceptions of urban tree benefits, participation in tree planting activities, programme awareness, and governance-related variables. Mean scores and standard deviations were computed for Likert-scale items, and perceived benefits were ranked according to their mean scores.

The binary logistic regression models specified in the Methods and Materials (Analytical Framework) were estimated to identify the factors associated with participation in urban tree planting activities. Prior to model estimation, diagnostic tests were conducted to assess multicollinearity among the explanatory variables. Variance Inflation Factor (VIF) values were below commonly accepted thresholds, indicating no serious multicollinearity concerns. Model fit was assessed using McFadden pseudo R^2 statistics and the

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Hosmer-Lemeshow goodness-of-fit test, both of which indicated acceptable model performance. Missing data were minimal and were handled through listwise deletion because incomplete responses represented only a very small proportion of the dataset and were not considered sufficient to bias the analysis. Odds ratios with 95% confidence intervals are reported for all regression models.

Ethical Considerations

The study involved minimal risk to participants. Informed consent was obtained from all respondents prior to participation. No personally identifiable information was collected, and all data were anonymised and securely stored in accordance with institutional research ethics guidelines.

RESULTS

Sample Characteristics

Table 2 summarises the socio-demographic and residential characteristics of the 395 respondents surveyed. The sample is broadly gender-balanced and dominated by younger and working-age respondents, with a substantial majority below the age of 45 alongside representation of older age groups. This age structure reflects a mix of life stages relevant for examining variation in perceptions, availability for participation, and engagement with neighbourhood-level activities. Educational attainment shows considerable variation. While secondary education is most common, a sizeable proportion of respondents reported tertiary-level education alongside respondents with primary or no formal education. This diversity provides scope for examining differences in awareness, trust, and participation across educational backgrounds.

Employment is largely characterised by self-employment, with additional representation of students, formally employed respondents, retirees, and unemployed individuals. Housing tenure is similarly mixed, with renters forming the largest group, followed by owner-occupiers and respondents living with family or relatives. These patterns indicate differing degrees of residential stability and attachment to place within the study area. Length of residence data suggest a predominantly established population, with more than half of respondents having lived in Madina for over 10 years alongside a smaller but meaningful share of newer residents.

Table 2. Socio-demographic and residential characteristics of respondents (*n* = 395).

Characteristic	Category	*n*	%
Gender	Male	204	51.6
	Female	191	48.4
Age group (years)	18–24	100	25.3
	25–34	98	24.8
	35–44	81	20.5
	45–54	45	11.4
	55–64	29	7.3
	65 and above	42	10.6
Education level	No formal education	24	6.1
	Primary education	51	12.9
	Secondary education / high school	176	44.6
	Vocational / technical training	47	11.9
	Bachelor's degree	81	20.5
	Graduate degree	16	4.1
Employment status	Self-employed	205	51.9
	Student	49	12.4
	Employed (full-time)	46	11.6
	Employed (part-time)	29	7.3
	Retired	31	7.8
	Unemployed	29	7.3
	Homemaker	6	1.5
Home ownership	Renting	166	42.0
	Owner-occupied	120	30.4
	Living with family / relatives	109	27.6
Length of residence in Madina	Less than 1 year	34	8.6
	1–3 years	41	10.4
	4–6 years	40	10.1
	7–10 years	53	13.4
	More than 10 years	227	57.5

Note: Percentages may not sum to 100 due to rounding.

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Perceived Benefits of Urban Trees

Overall, respondents perceived urban trees as providing important ecological, social, and economic benefits, although clear differences emerged across these dimensions (Table 3). Ecological and climate-related benefits received the highest levels of agreement, whereas social benefits were rated more moderately and several economic and infrastructure-related functions received comparatively lower evaluations.

Among the ecological and climate-related functions, aesthetic value and beautification received the highest mean score, followed by habitat provision, temperature regulation, air purification, and the role of trees in addressing climate change. These results indicate broad recognition of environmental functions that are directly experienced in everyday urban life. Among the economic benefits, support for businesses and tourism was also rated positively, although increased property values and energy savings from shade received comparatively lower evaluations.

Social and well-being related benefits, including community pride, mental health support, recreational opportunities, and health care savings, received moderate ratings, suggesting greater variability in how these functions are perceived across the study area. Likewise, less directly observable regulating services, including stormwater management, carbon sequestration, and noise reduction, recorded comparatively lower mean scores and larger standard deviations, indicating more variable levels of awareness or recognition among respondents.

Table 3. Perceived benefits of urban trees: mean scores and standard deviations (n = 395). SD (standard deviation).

Benefit	Mean	SD	Rank
Aesthetic value and beautification	4.42	1.07	1
Habitat for wildlife	4.32	1.10	2
Temperature regulation	4.14	1.28	3
Air purification	4.08	1.31	4
Role in addressing climate change	4.07	1.33	5
Support for businesses and tourism	4.02	1.21	6
Job creation	3.76	1.46	7
Community pride	3.75	1.33	8
Health care savings	3.68	1.55	9
Mental health and stress reduction	3.39	1.59	10
Recreational opportunities	3.38	1.29	11
Stormwater management	3.12	1.67	12
Carbon sequestration	3.09	1.69	13
Increased property values	2.79	1.55	14
Noise reduction	2.66	1.58	15
Energy savings from shade	2.22	1.54	16

Notes: Responses were measured on a 5-point Likert scale (1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree). Mean scores represent the arithmetic average of respondents' ratings, while rankings were assigned in descending order of mean scores. Higher mean values indicate stronger perceived benefits of urban trees.

Participation in Tree Planting Activities and Awareness of Urban Tree Programmes

Patterns of engagement with urban tree planting are summarised through respondents' reported participation, interest in future involvement, and awareness of existing programmes and policy initiatives (Table 4). Just under half of respondents reported having previously participated in tree planting activities, while a slightly larger share indicated no prior involvement.

Interest in future participation was substantially higher than observed engagement. Nearly 9 in 10 respondents expressed willingness to take part in tree planting activities in the future, pointing to a strong potential pool of participants. This expressed interest contrasts sharply with both past participation levels and institutional awareness.

Table 4. Participation, interest, and awareness related to urban tree planting (n = 395).

Variable	Category	n	%
Ever participated in tree planting activities	Yes	186	47.1
	No	209	52.9
Interested in participating in future tree planting activities	Yes	355	89.9
	No	40	10.1
Aware of urban tree programmes or policy initiatives	Yes	102	25.8
	No	293	74.2

Note: Percentages are calculated based on the full sample (n = 395).

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Awareness of formal urban tree programmes or policy initiatives was limited. Fewer than one-quarter of respondents reported being aware of such initiatives, while the majority indicated no awareness. The coexistence of high interest and low programme awareness reveals a notable gap between residents' willingness to engage and their exposure to organised urban tree efforts. This contrast between strong willingness to participate and low awareness of existing initiatives represents one of the clearest patterns emerging from the study, pointing to a substantial participation- awareness gap within the urban tree governance landscape of Madina.

Predictors of Participation in Tree Planting Activities

The results of the logistic regression analysis examining factors associated with participation in tree planting activities are presented in Table 5. The dependent variable was whether respondents had ever participated in tree planting activities (Yes / No).

In Model 1, which included only socio-demographic and residential variables, education level, home ownership, and urban residential status were significantly associated with participation. Age and gender were not statistically significant predictors. The explanatory power of this initial model remained relatively low, suggesting that socio-demographic characteristics alone provided limited explanation of participation patterns.

In Model 2, the inclusion of the Urban Tree Perception Score showed a positive and statistically significant association with participation. Respondents with more positive perceptions of urban trees were more likely to report having participated in tree planting activities. The increase in McFadden pseudo R^2 between Models 1 and 2 indicates that perceptions contributed meaningfully to explaining variation in participation.

In Model 3, after adding governance-related variables, awareness of urban tree programmes or policy initiatives was significantly associated with participation. Perceived effectiveness of local government in

Table 5. Logistic regression results for participation in tree planting activities (n = 395). Dependent variable: ever participated in tree planting activities (1 = Yes, 0 = No). OR (odds ratio); CI (confidence interval).

Variables	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Urban Tree Perception Score	–	1.45*** (1.18–1.78)	1.31** (1.07–1.61)	1.28** (1.04–1.59)
Awareness of urban tree programmes	–	–	2.64*** (1.71–4.07)	2.41*** (1.55–3.75)
Perceived government effectiveness	–	–	1.58** (1.12–2.22)	1.47** (1.04–2.09)
Trustworthiness of information sources	–	–	–	1.69** (1.15–2.47)
Age	1.01 (0.99–1.03)	1.01 (0.99–1.03)	1.00 (0.98–1.02)	1.00 (0.98–1.02)
Gender (1 = Male)	1.12 (0.76–1.65)	1.08 (0.72–1.61)	1.05 (0.69–1.60)	1.03 (0.67–1.58)
Education level	1.22* (1.01–1.47)	1.18 (0.98–1.42)	1.10 (0.91–1.34)	1.08 (0.89–1.32)
Home ownership (1 = Owner)	1.41* (1.01–1.97)	1.36* (0.97–1.90)	1.28 (0.90–1.82)	1.26 (0.88–1.80)
Residential status (1 = Urban)	1.52** (1.10–2.11)	1.44** (1.04–2.00)	1.31 (0.94–1.82)	1.29 (0.93–1.80)
Constant	0.18***	0.12***	0.09***	0.08***
Log likelihood	–251.84	–236.12	–214.37	–208.45
Wald χ^2	18.72***	29.41***	46.83***	53.27***
Prob > χ^2	< 0.001	< 0.001	< 0.001	< 0.001
McFadden pseudo R^2	0.07	0.13	0.21	0.24

Notes: ORs are reported with 95% CI in parentheses. *P < 0.10, ** P < 0.05, *** P < 0.01. Model 1 includes sociodemographic and residential variables. Model 2 adds the Urban Tree Perception Score. Model 3 additionally includes governance-related variables. Model 4 further includes trust in information sources. Higher ORs indicate greater likelihood of participation in tree planting activities. Reference category: did not participate in tree planting activities.

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managing and maintaining urban trees was also statistically significant. The magnitude of the perception score decreased but remained statistically significant. Respondents aware of existing programmes were substantially more likely to report prior participation than those without such awareness, indicating the strong influence of public awareness of programmes and access to information on engagement outcomes.

In Model 4, which included trustworthiness of information on urban trees, trust in information sources showed a statistically significant positive association with participation. Awareness of programmes and perceived government effectiveness remained statistically significant. Socio-demographic variables showed reduced or nonsignificant effects in the fully specified model. Trust in information sources emerged as an additional governance-related factor shaping participation, reinforcing the importance of institutional credibility and communication processes within urban tree initiatives.

Across models, the explanatory power increased with the inclusion of perception, governance, and information variables, as indicated by increases in the McFadden pseudo R^2 values. Governance-related variables exhibited stronger and more consistent associations with participation than most socio-demographic characteristics. Awareness of urban tree programmes emerged as the strongest predictor overall, followed by perceived government effectiveness and trustworthiness of information sources. The reduction in the effect size of the Urban Tree Perception Score following the inclusion of governance variables suggests that participation is shaped not only by positive perceptions of urban trees, but also by residents' connection to institutional and communication structures that facilitate engagement.

Barriers to Participation and Suggested Improvements in Urban Tree Planting

Responses regarding barriers to participation were analysed only for respondents who reported no prior participation in tree planting activities. Open-ended responses were coded into thematic categories to identify the most frequently reported constraints and suggested improvements (Table 6). The most frequently reported barrier was lack of information about tree planting activities, followed by lack of organised programmes or opportunities. Time constraints were also commonly cited, particularly among respondents engaged in full-time employment or informal economic activities. Limited space for planting trees, especially in densely built-up areas, was another frequently reported constraint.

Table 6. Reported barriers among respondents with no prior participation in tree planting activities (n = 209).

Barrier	*n*	%
Lack of information about tree planting activities	72	34.4
Lack of organised programmes / opportunities	61	29.2
Time constraints	46	22.0
Limited space for planting trees	38	18.2
Lack of interest	21	10.0
Lack of incentives / support	17	8.1
Perceived institutional inefficiency	14	6.7
Other reasons	9	4.3

Note: Percentages are calculated based on respondents who reported no prior participation in tree planting activities (n = 209). Multiple responses were permitted; percentages therefore do not sum to 100.

A smaller proportion of respondents cited lack of interest, lack of incentives, or perceived institutional inefficiency as reasons for nonparticipation. Very few respondents identified environmental conditions or personal physical limitations as barriers.

In addition to barriers, respondents provided suggestions for improving participation in urban tree planting activities. Commonly reported suggestions included increased public education and sensitisation, better organisation and regularity of tree planting programmes, stronger institutional coordination, and improved maintenance of planted trees. Respondents also highlighted the need for community involvement and supportive policies to enhance participation.

DISCUSSION

The present study provides empirical insight into how urban residents in a rapidly urbanising neighbourhood perceive urban trees, engage with tree planting activities, and relate to governance structures that shape participation. The results highlight a pattern of strong appreciation of urban trees alongside uneven engagement, suggesting that the sustainability of urban tree initiatives depends as much on institutional and informational conditions as on public attitudes (Riedman et al. 2022; Dakouré and

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Georges 2024). More broadly, the evidence reinforces governance-oriented perspectives that conceptualise urban tree stewardship as a socially and institutionally mediated process rather than solely an outcome of environmental awareness or positive attitudes toward urban greenery.

The findings relating to perceptions of urban tree benefits indicate that residents in Madina strongly value urban trees, particularly for functions directly experienced in everyday urban life. The observed pattern is consistent with evidence that benefits which are visually apparent or directly experienced in daily life tend to be more salient to urban residents than less tangible ecosystem services (Escobedo et al. 2011; Oyebade et al. 2013; Baró et al. 2014; Derkzen et al. 2015). The stronger evaluation of ecological and climate-related benefits relative to infrastructural or indirect ecosystem services further suggests that residents differentiate between immediately experienced functions and less visible long-term environmental processes. In contrast, lower ratings for services such as carbon sequestration, stormwater management, and energy savings from shade suggest that longer-term or indirect benefits may be less prominent in residents' valuation frameworks. This differentiation highlights the importance of distinguishing between biophysical functions and perceived benefits when assessing the social foundations of urban forestry initiatives (Jennings et al. 2016).

The findings on participation and programme awareness reveal an important disconnect between positive valuation of urban trees and actual engagement in tree planting activities. The contrast between high stated interest in future participation and low awareness of existing initiatives points to a participation-awareness gap that has been observed in other urban contexts (Locke et al. 2019; Riedman et al. 2022). In the context of this study, the participation-awareness gap emerged as one of the clearest indicators that willingness to engage does not automatically translate into participation where institutional visibility and communication pathways are weak. Rather than indicating resistance or indifference, this gap suggests that residents' willingness to engage is not matched by accessible or visible opportunities for participation. In dense urban environments, where residents' time and spatial flexibility are constrained, participation may depend critically on the clarity, regularity, and local presence of organised programmes.

The regression results provide further insight into the governance-related and informational factors shaping participation in tree planting activities. While higher perceived benefits of urban trees were positively associated with participation, awareness of urban tree programmes and perceived effectiveness of local government exhibited stronger and more consistent associations. Trust in information sources also emerged as a significant predictor in the fully specified model. The comparatively stronger explanatory influence of governance-related variables relative to most socio-demographic characteristics suggests that participation is shaped less by who residents are and more by how governance systems are experienced at the local level. The observed relationships support the view that participation is embedded within broader governance and communication systems rather than driven solely by individual attitudes (Lawrence et al. 2013; McMillen et al. 2016) and are consistent with recent evidence from Ghana demonstrating that participation in citizen-led nature-based solutions is strongly influenced by institutional support, programme awareness, and enabling governance conditions (Boafo et al. 2025). Once governance-related variables were included, the influence of socio-demographic characteristics diminished, suggesting that institutional conditions play a central role in enabling or constraining engagement across different population groups.

The barriers reported by respondents further clarify the structural and institutional conditions constraining participation. The predominance of information-related constraints, lack of organised activities, time limitations, and space constraints points to structural challenges rather than lack of interest. Similar barriers have been identified in studies of urban greening in high-density settings, where competing livelihood demands and limited planting space shape residents' capacity to participate even when support for urban greenery is high (Tian et al. 2012; Conway 2016; Triguero-Mas et al. 2017; Saldarriaga et al. 2020). Respondents' suggestions for improved organisation, communication, and maintenance further indicate expectations for sustained institutional involvement rather than ad hoc or symbolic interventions. The evidence indicates that participation constraints in rapidly urbanising environments are not solely behavioural, but are also closely linked to governance accessibility, institutional continuity, and the visibility of engagement opportunities.

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Respondents generally viewed public authorities as having primary responsibility for urban tree management (Haase et al. 2025), although support for shared responsibility involving communities was also evident. This pattern reflects a governance context in which residents recognise the role of state institutions in coordinating urban environmental management while remaining open to participatory arrangements. High levels of support for stricter regulations suggest normative backing for stronger governance interventions, provided they are accompanied by transparent communication and credible implementation. The observed governance pattern echoes arguments that effective urban forestry requires a balance between regulatory authority and community engagement, particularly in rapidly urbanising cities characterised by mixed formal and informal governance systems (Nagendra et al. 2018).

These results are particularly relevant in the context of large-scale national tree planting initiatives such as Ghana's Green Ghana Day, which mobilises citizens annually to plant millions of trees (N-yanbini 2023). While such initiatives increase public visibility of tree planting and demonstrate political commitment to environmental restoration, the Madina case suggests that episodic, event-based mobilisation alone may not be sufficient to translate widespread appreciation of urban trees into sustained local participation. The high levels of interest observed in this study, coupled with low programme awareness and limited prior engagement, indicate that residents' willingness to participate depends not only on national campaigns but also on continuous, locally embedded communication and coordination mechanisms.

Moreover, the prominence of information-related barriers and the strong association between participation and awareness of programmes highlight the importance of institutional presence beyond symbolic planting events. Where urban residents lack clarity regarding ongoing initiatives, responsibilities, or maintenance arrangements, engagement may remain intermittent. In dense urban neighbourhoods, particularly those characterised by mixed tenure systems and informal economic activity, sustained stewardship may require regularised neighbourhood-level programming, follow-up engagement, and visible maintenance structures. National campaigns may therefore achieve broader and more durable impacts when integrated with decentralised, community-level governance arrangements that extend beyond annual planting exercises.

Overall, the Madina case illustrates how positive public valuation of urban trees can coexist with limited participation when institutional visibility, programme awareness, and trust are weak. Translating appreciation into sustained engagement requires governance arrangements that are locally visible, accessible, and responsive to residents' everyday realities. In rapidly urbanising cities contexts, strengthening the social and institutional dimensions of urban forestry may be as critical as expanding tree cover itself.

Limitations of the Study

A number of limitations should nevertheless be acknowledged when interpreting the findings of this study. First, the cross-sectional design captures perceptions and participation patterns at a single point in time and therefore does not allow assessment of changes in engagement over time. Second, the study relies on self-reported responses, which may be influenced by recall effects or social desirability bias. Third, the findings are context-specific to Madina and should be interpreted within the socio-spatial and governance conditions characterising the study area. Despite these limitations, the study provides important neighbourhood-scale evidence on the interaction between perception, governance, trust, and participation in urban tree stewardship within a rapidly urbanising African context.

CONCLUSION

This study examined how urban residents in Madina perceive the benefits of urban trees, the extent to which they participate in tree planting activities, and the governance-related factors associated with participation. The study provides neighbourhood-scale empirical insight into the social and governance conditions shaping urban tree stewardship in a rapidly urbanising context by integrating perceptual, behavioural, and institutional dimensions within a single analytical framework.

The results show that urban trees are widely valued by residents, particularly for benefits that are directly experienced in everyday urban life, such as aesthetic enhancement, habitat provision, and temperature regulation. However, participation in tree planting activities remains uneven, and awareness of formal urban tree programmes is limited despite

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strong interest in future engagement. This contrast demonstrates that positive perceptions of urban trees do not necessarily translate into active participation, highlighting the importance of governance systems that create visible and accessible opportunities for engagement.

The analysis further demonstrates that participation is more strongly associated with programme awareness, perceived institutional effectiveness, and trust in information sources than with socio-demographic characteristics. This pattern underscores the importance of governance visibility, communication, and institutional credibility in shaping engagement. Reported barriers to participation, particularly lack of information, limited organisation of activities, time constraints, and space limitations, further suggest that participation is constrained more by structural and institutional conditions than by lack of interest.

Overall, the evidence positions urban tree stewardship in Madina as both a collective and governance challenge. While residents recognise the value of urban trees and express strong interest in engagement, translating this interest into sustained participation requires governance arrangements that are accessible, locally visible, and responsive to the realities of dense urban living. Institutionalising neighbourhood-level urban tree programmes, strengthening continuous public communication, and embedding clear maintenance responsibilities within local governance structures may therefore be as important as technical interventions aimed at expanding tree cover. Integrating national tree planting initiatives with decentralised, community-level implementation frameworks could further strengthen public awareness of programmes and long-term stewardship outcomes.

This study contributes to urban forestry research by providing neighbourhood-scale empirical evidence from a rapidly urbanising African city and by quantitatively linking perception, awareness, trust, and participation within a single analytical framework. Although the results are context-specific, they highlight broader considerations relevant to urban tree governance in cities experiencing rapid growth and institutional complexity. Future research could extend this work by examining longitudinal participation dynamics, investigating how formal and informal institutional arrangements shape post-planting stewardship practices, and assessing how maintenance structures, community networks, and accountability mechanisms influence the long-term survival and management of urban trees.

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