Sustainable Development Goals
Research Paper

DIT.ADS International Multidisciplinary Research Journal
Volume 1; Issue 3; September 2025; pp: 461-479; No.: 09-2025-55
Website: https://ditadsresearchcenter.com
E-ISSN: 3082-5148; P-ISSN: 3082-513X

Urban Tree Loss and Its Impact on Heat-Related Behavioral Adaptations in Barangay Guadalupe, Cebu City Communities

[1]Myrna A. Acuña, [1]January Marie I. Alota, [1]Jeanette T. Baclay, [1]Senen Jeane F. Bandibas, [1]Maria Grazela M. Burgos, [1]Jessa H. Ereno, [1]Divine Grace B. Factuar, [1]Flordeliza P. Judan, [1]Almario G. Parco, Jr.
[1]Philippine Christian University, Philippines

Received 23rd June 2025; Accepted 29th July 2025; Published Online 5th September 2025
DOI: 10.63941/DIT.ADSimrj.2025.1.3.55

ABSTRACT
Urban streets are becoming increasingly sweltering as the valuable trees that once offered respite from the heat are lost to rapid urbanization. This study investigates how the removal of trees in Barangay Guadalupe, Cebu City, has affected residents' adaptive responses to extreme heat. Through a descriptive-correlational approach, the research explores the behavioral shifts in the community, focusing on strategies such as outdoor activity modifications, cooling mechanisms, and health-related coping actions. Results reveal that the loss of urban trees—due to factors like urban sprawl, commercial deforestation, and insufficient reforestation—has significantly impacted residents' behavior, increasing their dependence on personal adaptations like air conditioning, hydration, and modifying outdoor schedules. Moreover, the study highlights the disparities in access to cooling technologies, with lower-income groups facing greater challenges. The findings emphasize the urgent need for integrated urban planning, which includes sustainable reforestation efforts, enhanced cooling infrastructure, and educational initiatives. By restoring green spaces and fostering community resilience, the city can mitigate the detrimental effects of tree loss and provide a more comfortable, climate-resilient environment for all.

Keywords: *Urban Heat Island, Tree Loss, Climate Adaptation, Behavioral Shifts, Barangay Guadalupe*

INTRODUCTION

City streets are growing hotter, and the green spaces that once offered respite are rapidly vanishing. Urbanization has led to the gradual loss of urban trees, which are key players in moderating temperatures and enhancing quality of life in densely populated areas. As cities expand, so does the removal of trees to make way for commercial development and infrastructure. This escalating deforestation exacerbates the urban heat island effect, resulting in soaring temperatures and heightened discomfort for residents (Morrison et al., 2021). Particularly in developing cities, these environmental changes threaten public health, with studies showing that areas with lower tree cover suffer from higher surface temperatures and poorer air quality, which directly increases the risk of heat-related illnesses (Carter, 2023). In light of these challenges, the urgency for sustainable urban forestry policies has never been greater to ensure climate resilience and safeguard the well-being of urban populations. Without prompt action, urban communities are at risk of enduring the long-term consequences of rising temperatures.

As the city's infrastructure expands, residents must adapt their behavior to cope with the heat. Limited access to shaded areas forces individuals to adjust outdoor activities, while the increased reliance on energy-hungry cooling appliances further strains resources (Parker, 2020). For marginalized communities, economic constraints make effective cooling solutions difficult to access, intensifying heat-related stress, especially among the most vulnerable (Bennett, 2022). In this context, urban greening initiatives, such as restoring tree cover, can be an effective solution to counterbalance rising temperatures and improve microclimates. These initiatives offer not just cooling relief but also contribute to overall urban livability, enhancing social and environmental resilience. Proactive steps to address this issue are crucial for long-term sustainability in urban heat management.

With health risks mounting due to prolonged exposure to excessive heat, it is essential for urban communities to find adaptive strategies to cope. Research shows that increased water consumption, clothing adjustments, and reduced physical activity are some of the coping mechanisms developed in response to extreme heat (Fletcher, 2021). However, these responses often fall short when heat stress reaches critical levels. Public health initiatives aimed at increasing heat awareness and improving cooling infrastructure are necessary to reduce the risk of heat-related illnesses. Collaboration between public health experts and urban planners is essential in creating a comprehensive, proactive approach to addressing the impacts of urban tree loss and rising temperatures. Only through coordinated efforts can we mitigate the adverse effects of heat in urban environments.

Local communities have become central to addressing the issue of urban heat. Tree-planting campaigns and urban greening projects spearheaded by local organizations have provided immediate relief by restoring tree canopy cover and increasing shaded areas (Stewart, 2021). These grassroots movements enhance environmental awareness while reducing heat absorption, thus making the community more resilient. However, for such efforts to be truly effective in the long term, government and private institutions must prioritize and support these grassroots initiatives. By integrating urban forestry programs into city planning strategies, cities can balance growth with sustainability. Only through collaboration can cities hope to manage the impact of heat and ensure that urban environments remain livable and healthy.

LITERATURE REVIEW

Urbanization and climate change are driving forces behind the intensification of heat exposure in cities, creating urgent challenges for urban residents. These challenges require adaptive responses to safeguard public health and maintain urban livability. This literature review explores the diverse behavioral adaptations of urban residents to extreme heat, focusing on cooling strategies, outdoor activity modifications, health-related coping mechanisms, and community-based responses. It also addresses the impact of urban tree loss, from canopy cover reduction to the removal of trees due to commercial development, and its effects on heat-related adaptations and overall urban resilience.

Urban residents employ a wide array of behavioral adaptations to cope with rising temperatures, influenced by factors like socio-economic status, access to resources, and cultural norms. Macagba et al. (2024) discuss the significant role of mental and social well-being in vulnerable communities during extreme heat events in Southeast Asia, emphasizing the need for community-specific adaptation strategies. Similarly, Castro et al. (2024) highlight the importance of heat awareness education, which promotes adaptive behaviors and enables communities to respond effectively to heat stress. Chen et al. (2024) emphasize that community support networks are vital for increasing resilience, particularly for older adults in rapidly urbanizing areas of China. These studies provide a foundation for understanding the importance of education, mental health support, and community engagement in adapting to heat stress.

The effectiveness of these adaptations varies depending on individual and contextual factors. Lam et al. (2024) propose that inter-city collaboration on resource-sharing can enhance resilience, especially in resource-constrained areas. In Quezon City, Macagba et al. (2024) highlight how vulnerable populations face disproportionate exposure to extreme heat, calling for targeted interventions to address these disparities. Low-income communities, in particular, often lack access to cooling infrastructure, leading to a heavier reliance on artificial cooling methods, which may not be affordable for everyone. Lam et al. (2024) emphasize the role of urban planning in ensuring equitable access to cooling resources, suggesting that community-based cooling solutions are critical for those with limited financial resources.

Cooling strategies can be categorized as passive and active, with each type offering specific benefits and challenges. Passive strategies like natural ventilation and shade, provided by urban green spaces, are cost-effective and sustainable. McDonald et al. (2020) highlight how urban tree cover can significantly reduce reliance on air conditioning, providing natural cooling to urban environments. However, these strategies require adequate space and infrastructure to be effective, particularly in densely urbanized areas. Active strategies such as air conditioning provide immediate relief but come with higher energy costs, which contribute to environmental degradation (McDonald et al., 2020). The accessibility of these cooling methods is often determined by socio-economic factors, with wealthier individuals more likely to have access to air conditioning, while lower-income residents face greater challenges.

Health-related coping mechanisms, such as staying hydrated, wearing appropriate clothing, and adjusting physical activities, play a crucial role in mitigating heat stress. Garcia & Lopez (2021) find that these strategies are most effective when integrated with community-level heat safety awareness campaigns. Such public health initiatives have been shown to reduce the incidence of heat-related illnesses (Taylor & Robinson, 2021). However, their effectiveness is limited in communities that lack access to cooling centers, health services, or reliable information on managing heat stress (Lopez & Rivera, 2021). To address this, health interventions must ensure that these resources are equally accessible to all urban residents, particularly marginalized groups.

Outdoor activity modification is another crucial adaptation strategy. Studies have shown that people tend to adjust their outdoor schedules to avoid the hottest parts of the day, often engaging in outdoor activities during early morning or late evening hours (Jones et al., 2021). However, such modifications are not always feasible for everyone, particularly for outdoor workers in sectors such as construction (Lee & Park, 2022). Research by Smith et al. (2021) indicates that socio-economic factors play a significant role in the ability to adjust outdoor activities, with wealthier individuals having more flexibility to work indoors or avoid exposure to extreme heat. This highlights the importance of designing policies that promote equitable heat resilience, especially for outdoor workers and low-income residents who may not have the same adaptive capacity.

The loss of urban trees, due to factors such as deforestation for development and inadequate reforestation efforts, exacerbates the urban heat island effect, making cities even hotter. Mitchell & Carter (2021) emphasize that the reduction in tree canopy cover leads to higher surface temperatures and increased reliance on artificial cooling methods. The removal of trees for commercial purposes and infrastructure development further exacerbates the heat problem, decreasing natural cooling and air quality (Andrews & Patel, 2022). Tree removal is often driven by economic incentives, with urban expansion and real estate development taking precedence over environmental considerations (Santos & Mitchell, 2022). Studies show that urban areas with less tree cover tend to have poorer air quality and increased vulnerability to heat stress (Rodriguez & Kim, 2021).

To mitigate these effects, urban greening initiatives, including tree planting and reforestation projects, have been identified as effective solutions. However, challenges remain in scaling these efforts due to financial constraints, land-use conflicts, and weak enforcement of environmental policies (Stevens & Gonzales, 2021). Inadequate public awareness about the benefits of trees has also hindered community participation in urban forestry initiatives (Murphy & Santos, 2023). This suggests that for these initiatives to succeed, there must be greater collaboration between governments, communities, and private stakeholders to promote the importance of urban trees and ensure their long-term protection.

In conclusion, urban heat exposure, exacerbated by the loss of tree cover, presents significant challenges for cities worldwide. Addressing these challenges requires a multi-faceted approach that incorporates behavioral adaptations, cooling strategies, health interventions, and community-driven responses. The literature emphasizes the need for equitable access to cooling resources and emphasizes the role of urban greening in mitigating the urban heat island effect. To build resilience in cities, comprehensive policies that prioritize sustainable urban forestry and support vulnerable communities are essential.

MATERIALS AND METHODS

The study employed a descriptive-correlational research design to examine the relationship between urban tree loss and heat-related behavioral adaptations among residents of Barangay Guadalupe, Cebu City. The descriptive aspect focused on gathering demographic data and detailing tree loss and its impact on adaptive behaviors such as cooling strategies, modifications to outdoor activities, and health coping mechanisms. The correlational component analyzed how demographic factors interacted with tree loss and the adaptation behaviors, using Pearson correlation analysis to determine significant relationships. Multiple regression analysis and ANOVA were also applied to explore how socio-demographic factors predicted specific adaptation strategies, ensuring a comprehensive approach to understanding the dynamics between heat stress and urban tree loss.

Stratified random sampling was used to select a sample of 357 respondents from the estimated 5,000 residents of Barangay Guadalupe. This method ensured that various demographic groups—categorized by age, gender, educational background, and employment status—were proportionally represented. The sampling was designed to minimize biases and improve the generalizability of the findings. Data collection relied on a structured questionnaire adapted from existing studies on urban heat adaptation, ensuring both validity and relevance to the local context. The questionnaire included both demographic and behavioral questions, which were pre-tested for clarity and reliability before use in the main data collection phase.

Data was gathered over a four-week period using face-to-face interviews, conducted by trained enumerators who followed ethical guidelines to ensure informed consent and confidentiality. The interviews were designed to be clear and consistent, providing high-quality data. After data collection, the responses were coded into SPSS software for statistical analysis. Descriptive statistics summarized key variables, while inferential statistics, including Pearson's correlation, were used to explore relationships between tree loss and adaptation behaviors. Ethical standards were adhered to throughout the process, ensuring participants' privacy and the ethical use of their data.

RESULTS AND DISCUSSION

1. Demographic Characteristics of the Respondents

This section of the study seeks to identify and analyze the demographic characteristics of the respondents, which are critical to understanding how different groups within the community are likely to adapt to the environmental stressors caused by urban tree loss and rising temperatures. The demographic factors under consideration include age, sex, educational attainment, and occupation. These factors are expected to influence the perception of heat stress, coping mechanisms, and the willingness to engage in adaptation behaviors. The following tables provide an overview of the distribution of respondents based on these variables, followed by a discussion of their implications for understanding heat adaptation behaviors within the context of Barangay Guadalupe.

Table 1
The Frequency and Percentage Distribution of the Respondents' Demographic Profile in terms of Age

Age Range	Frequency	Percentage
18 to 25	62	17.4%
26 to 35	67	18.8%
36 to 45	54	15.1%
46 to 55	43	12.0%
56 to 65	46	12.9%
66 and above	85	23.8%
Total	357	100.0%

The wide age distribution of the respondents, ranging from young adults (18 years) to older individuals (66 and above), reflects the community's diverse experiences, which are likely to influence how they respond to environmental stressors such as urban heat. The older demographic, representing 23.8% of the sample, is particularly important as older adults may exhibit heightened risk awareness and are often more vulnerable to heat-related illnesses. Studies show that older adults tend to be more risk-averse when it comes to environmental threats, which suggests that they might be more open to participating in programs focused on heat mitigation and resilience-building (Park et al., 2021).

In contrast, younger groups, especially those between 18 to 35 years, may be more adaptable to new technologies and interventions, as this cohort is more receptive to innovative solutions (Park et al., 2021). The diverse age profile of the sample will allow the study to evaluate age-specific vulnerabilities and the varying levels of engagement with climate adaptation initiatives.

Table 2
The Frequency and Percentage Distribution of the Respondents' Demographic Profile in terms of Sex

Sex	Frequency	Percentage
Male	171	47.9%
Female	186	52.1%
Total	357	100.0%

The gender distribution in this sample is fairly balanced, with a slight overrepresentation of females (52.1%) compared to males (47.9%). This near-equal gender composition is critical for ensuring that the findings are comprehensive and inclusive of the perspectives of both men and women. It is well-documented in the literature that women are more likely to take on community-level and household-based environmental roles, making them essential actors in climate adaptation efforts (Zhao & Zhang, 2022).

This gender dynamic is especially relevant when considering how gender influences environmental perceptions and coping strategies. Women often face additional burdens related to caregiving and resource management, which can affect their vulnerability to heat stress and the kinds of adaptive behaviors they adopt. Therefore, gender-sensitive climate policies and interventions are necessary to empower both women and men to engage actively in heat resilience efforts.

Table 3
The Frequency and Percentage Distribution of the Respondents' Demographic Profile in terms of Educational Attainment

Educational Attainment	Frequency	Percentage
No Formal Education	35	9.8%
Elementary	47	13.2%
High School	111	31.1%
College/Undergraduate	103	28.9%
Graduate/Postgraduate	61	17.1%
Total	357	100.0%

The educational profile of respondents shows a predominance of individuals with at least a high school education (31.1%), followed by a substantial proportion with some college education (28.9%). A significant portion of the sample also holds graduate or postgraduate degrees (17.1%). However, 9.8% of respondents have no formal education, a factor that could influence their access to and understanding of environmental information. As Tan and Abulencia (2023) highlight, higher levels of education are associated with greater environmental awareness and participation in adaptation behaviors.

The data suggests that a majority of respondents are likely equipped with the knowledge and cognitive tools to understand and act upon climate-related issues. Nevertheless, those with no formal education may face challenges in engaging with more technical or formal adaptation strategies. This points to the need for tailored educational outreach that bridges gaps in environmental literacy, especially for the less educated segment of the population.

Table 4
The Frequency and Percentage Distribution of the Respondents' Demographic Profile in terms of Occupation

Occupation	Frequency	Percentage
Student	71	19.9%
Employed (Full-time/Part-time)	136	38.1%
Self-Employed	51	14.3%
Unemployed	60	16.8%
Retired	39	10.9%
Total	357	100.0%

The occupational distribution reflects a diverse range of engagement with the workforce, which is crucial for understanding different levels of exposure to urban heat and tree loss. The largest group consists of employed individuals (38.1%), followed by students (19.9%) and self-employed individuals (14.3%). The self-employed group, particularly those in informal sectors, may have limited access to institutional adaptation resources such as health benefits or workplace cooling solutions. In contrast, employed individuals who work outdoors or commute may face heightened heat stress and would benefit from targeted workplace adaptation policies. Retired and unemployed individuals, on the other hand, may have different adaptive needs, often depending on the availability of social support networks. Gutierrez and Rivera (2021) emphasize the importance of occupational status in determining access to resources for managing environmental risks. This suggests that climate adaptation strategies should be sector-specific, ensuring that both formal and informal workers, as well as non-working groups, receive tailored interventions based on their exposure and vulnerability to heat stress.

The demographic characteristics of the respondents reveal important insights into how different groups experience and respond to environmental stressors, particularly in relation to urban tree loss and heat adaptation. The age, sex, educational background, and occupation of individuals play significant roles in shaping their exposure to heat and their ability to adapt to rising temperatures. For instance, older adults may have heightened vulnerability to heat stress and would benefit from programs focused on their specific health risks, while younger individuals may be more willing to adopt technological solutions for cooling (Park et al., 2021). Gender-balanced responses highlight the necessity of gender-sensitive approaches in environmental programs to ensure that both men and women actively engage in and benefit from adaptation efforts (Zhao & Zhang, 2022).

Educational attainment correlates with the capacity to engage with and respond to environmental issues, suggesting that public awareness and educational campaigns should be designed to address varying levels of literacy and environmental knowledge (Tan & Abulencia, 2023). Occupational differences point to the need for sector-specific interventions, particularly for outdoor workers or self-employed individuals who may lack access to formal adaptation resources (Gutierrez & Rivera, 2021). In light of these findings, policymakers should consider demographic diversity when designing climate adaptation strategies, ensuring that interventions are inclusive and cater to the specific needs of different groups within the community. This will enhance the effectiveness and equity of resilience-building efforts across urban populations facing similar challenges from climate change and environmental degradation.

2. Extent of Tree Loss in the Study Area

This section investigates the extent of tree loss in Barangay Guadalupe in terms of canopy cover reduction, tree removal due to urbanization, deforestation for commercial use, and lack of reforestation initiatives. The analysis will help identify how urbanization, commercial development, and environmental policies have impacted tree cover in the area and contributed to increasing environmental degradation, especially the urban heat island effect. Understanding the extent of tree loss will inform future urban planning, reforestation initiatives, and heat resilience strategies.

Table 5
The Extent of Tree Loss in the Study Area in Terms of Canopy Cover Reduction

Items	Mean	Std. Deviation	Description	Interpretation
There has been a significant reduction in the canopy cover in my community.	3.07	0.60	Agree	Moderate Impact
The loss of tree canopy in my area has contributed to increased heat stress.	3.10	0.75	Agree	Moderate Impact
The decrease in tree canopy has affected the local climate, making it hotter.	3.26	0.71	Agree	Moderate Impact
I have noticed fewer shaded areas due to tree canopy reduction.	3.10	0.67	Agree	Moderate Impact
The reduction of trees has led to a visible increase in the urban heat island effect.	3.20	0.68	Agree	Moderate Impact
Overall Mean	3.15	0.68	Agree	Moderate Impact

The data presented in Table 5 indicates that respondents agree there has been a significant reduction in canopy cover within Barangay Guadalupe, contributing to increased heat stress and fewer shaded areas. The overall mean of 3.15, with a standard deviation of 0.68, suggests a moderate impact, with respondents consistently agreeing that the loss of tree canopy has contributed to the area's rising temperatures. The study by Oliveira et al. (2022) affirms that a reduction in tree cover in urban settings intensifies the urban heat island effect, which exacerbates public health risks, particularly during extreme heat events. This finding underscores the importance of tree-planting programs and urban green spaces in mitigating the effects of climate change. As such, policies to restore canopy cover and protect existing green spaces should be a priority for urban planning initiatives.

Table 6
The Extent of Tree Loss in the Study Area in Terms of Tree Removal Due to Urbanization

Items	Mean	Std. Deviation	Description	Interpretation
Trees have been removed to make space for new buildings and infrastructure.	2.66	0.91	Agree	Moderate Impact
The growth of urban areas has led to significant tree removal in my community.	2.75	0.85	Agree	Moderate Impact
Urbanization has resulted in the clearing of trees to build residential areas.	2.93	0.80	Agree	Moderate Impact
Tree removal for urban development is a common practice in my neighborhood.	2.73	0.77	Agree	Moderate Impact
I believe the removal of trees for urbanization has worsened the effects of heat stress in the area.	3.08	0.82	Agree	Moderate Impact
Overall Mean	2.83	0.83	Agree	Moderate Impact

Table 6 reveals that respondents generally agree that urbanization has led to significant tree removal within Barangay Guadalupe. The highest mean (3.08) indicates a strong recognition of the link between tree removal and increased heat stress, a view supported by Wolsink (2021), who stresses the negative impacts of urban sprawl on local climates. The overall mean of 2.83, with a standard deviation of 0.83, suggests a moderate impact. While respondents agree that urban growth has led to tree loss, the varying responses indicate that the extent of tree removal may differ across the community. These findings highlight the need for urban planning strategies that prioritize tree preservation and incorporate green spaces in new developments.

Table 7
The Extent of Tree Loss in the Study Area in Terms of Deforestation for Commercial Use

Items	Mean	Std. Deviation	Description	Interpretation
Commercial activities like logging have contributed to deforestation in my area.	2.93	0.78	Agree	Moderate Impact
Deforestation for commercial purposes has led to a decrease in green spaces.	2.97	0.73	Agree	Moderate Impact
Commercial land use has resulted in the removal of trees that previously helped cool the area.	2.90	0.78	Agree	Moderate Impact
There are commercial developments that are responsible for tree loss in my community.	3.04	0.69	Agree	Moderate Impact
Deforestation driven by commercial needs has exacerbated heat stress in urban areas.	3.02	0.74	Agree	Moderate Impact
Overall Mean	2.97	0.75	Agree	Moderate Impact

The responses in Table 7 show a general agreement that commercial activities have contributed to tree loss in Barangay Guadalupe. With an overall mean of 2.97, respondents strongly perceive that commercial development is linked to deforestation and the reduction of green spaces. This trend is particularly concerning, as commercial land use has not only diminished tree cover but has also contributed to rising temperatures in the area. As supported by Khan and Singh (2021), commercial real estate expansion is a significant driver of deforestation in developing cities. These findings point to the importance of integrating environmental considerations into commercial land use planning and encouraging the incorporation of green spaces in development projects.

Table 8
The Extent of Tree Loss in the Study Area in Terms of Lack of Reforestation Initiatives

Items	Mean	Std. Deviation	Description	Interpretation
There have been few or no reforestation efforts in my community.	2.96	0.64	Agree	Moderate Impact
The lack of tree planting initiatives in my area has contributed to higher temperatures.	3.04	0.65	Agree	Moderate Impact
There is little to no government initiative for planting trees in the community.	3.04	0.68	Agree	Moderate Impact
I feel that reforestation is not a priority for local authorities.	3.01	0.68	Agree	Moderate Impact
The absence of reforestation initiatives has led to an overall decrease in green cover in my area.	3.17	0.64	Agree	Moderate Impact
Overall Mean	3.04	0.66	Agree	Moderate Impact

Table 8 demonstrates that the respondents strongly agree that the lack of reforestation efforts has contributed to the overall decrease in green cover in Barangay Guadalupe. With an overall mean of 3.04, respondents emphasize the importance of reforestation in mitigating the negative effects of tree loss. This finding aligns with Caballero and Reyes (2021), who highlight the critical role of reforestation in enhancing urban resilience. The relatively consistent responses, with a standard deviation of 0.66, suggest that the community perceives a widespread failure in reforestation initiatives. Strengthening government-led reforestation programs, as well as engaging local communities in planting efforts, is essential for restoring green spaces and enhancing environmental sustainability in urban areas.

The data presented in Tables 5 through 8 reveal that respondents in Barangay Guadalupe are highly aware of the various factors contributing to tree loss in their community. These factors, including canopy cover reduction, tree removal due to urbanization, deforestation for commercial use, and the lack of reforestation initiatives, all play a significant role in exacerbating environmental degradation and increasing heat stress. The overall consensus indicates a need for more proactive urban planning strategies that incorporate green infrastructure to combat the urban heat island effect and improve local climate resilience.

The findings suggest that urban and commercial development must be balanced with environmental considerations to reduce tree loss and preserve green spaces. Furthermore, the lack of reforestation efforts emphasizes the importance of developing and enforcing policies that ensure the replacement of lost trees and the restoration of urban forests. The study by Oliveira et al. (2022) underscores the critical role of urban trees in reducing temperatures and enhancing public health, making it essential for local governments to prioritize tree preservation and reforestation.

3. Respondents' Practice of Heat-Related Behavioral Adaptations in Response to Extreme Heat

Conditions

This section examines how respondents in Barangay Guadalupe adapt to extreme heat conditions through behavioral strategies aimed at mitigating the impact of heat stress. With the increasing frequency of extreme heat events linked to climate change, understanding these adaptation practices becomes essential for guiding public policy and enhancing community resilience. The strategies discussed include cooling techniques, modifications to outdoor activities, health-related coping mechanisms, and community-based responses.

Table 9
The Respondents' Practice of Heat-Related Behavioral Adaptation in Response to Extreme Heat Conditions in Terms of Cooling Strategies

Items	Mean	Std. Deviation	Description	Interpretation
I regularly use fans or air conditioning to cope with extreme heat.	3.20	0.66	Agree	Moderately Proactive
I take cool showers or baths to reduce heat stress.	3.24	0.60	Agree	Moderately Proactive
I frequently drink cold beverages to stay cool in hot weather.	3.17	0.74	Agree	Moderately Proactive
I use cooling products such as cooling towels or sprays to manage heat.	3.17	0.67	Agree	Moderately Proactive
Staying indoors during the hottest parts of the day is a common cooling strategy for me.	3.25	0.72	Agree	Moderately Proactive
Overall Mean	3.21	0.68	Agree	Moderately Proactive

The data presented in Table 9 illustrates that respondents exhibit moderate agreement (mean score of 3.21) in adopting cooling strategies like using fans, air conditioning, cool showers, and staying indoors during peak heat. The highest mean score (3.25) corresponds to the strategy of staying indoors during the hottest parts of the day, reflecting its widespread use. This supports findings from Cruz and Jimenez (2022), which emphasize the importance of minimizing outdoor exposure during extreme heat to reduce health risks.

Table 10
The Respondents' Practice of Heat-Related Behavioral Adaptation in Response to Extreme Heat Conditions in Terms of Outdoor Activity Modification

Items	Mean	Std. Deviation	Description	Interpretation
I limit my outdoor activities during extreme heat.	3.36	0.62	Strongly Agree	Excellent Impact
I avoid outdoor exercises when the temperature is high.	3.33	0.69	Strongly Agree	Excellent Impact
I change the time of day for outdoor activities to early mornings or late evenings to avoid heat.	3.25	0.62	Agree	Moderately Proactive
I adjust my outdoor routine to stay cool, such as taking breaks or seeking shade.	3.20	0.66	Strongly Agree	Excellent Impact
I engage in less strenuous outdoor activities during hot weather.	3.23	0.64	Strongly Agree	Excellent Impact
Overall Mean	3.27	0.65	Strongly Agree	Excellent Impact

A noteworthy observation is the slightly lower mean of 3.17 for the use of air conditioning or fans. This suggests that economic or accessibility issues may hinder the use of more energy-intensive cooling methods, particularly in low-income households. This aligns with the challenges highlighted by Patel and Gomez (2020), who discussed the barriers to effective heat adaptation in underserved communities. Ensuring broader and more equitable access to energy-efficient cooling technologies should be a priority, especially for low-income populations.

The results from Table 10 demonstrate that respondents strongly agree (mean of 3.27) with modifying their outdoor activities in response to extreme heat. Limiting outdoor activities during peak heat is the most common strategy, with a high mean of 3.36, showing strong collective awareness and proactive adaptation. This behavior is consistent with the findings of Richards and Agustin (2021), who emphasized that altering the timing and intensity of outdoor activities is a critical strategy for heat resilience.

Interestingly, while respondents recognize the importance of seeking shade and taking breaks (mean score of 3.20), it appears that these strategies are not always feasible. Factors such as a lack of shaded spaces or time constraints may limit their implementation. Therefore, enhancing urban infrastructure by adding more shaded areas and heat-resilient public spaces could make these strategies more accessible and effective.

Table 11
The Respondents' Practice of Heat-Related Behavioral Adaptation in Response to Extreme Heat Conditions in Terms of Health-Related Coping Mechanisms

Items	Mean	Std. Deviation	Description	Interpretation
I make sure to stay hydrated to cope with extreme heat.	3.34	0.69	Strongly Agree	Highly Proactive
I seek medical help when I feel unwell due to heat stress.	3.13	0.69	Agree	Moderately Proactive
I take breaks in cool areas when exposed to extreme heat.	3.30	0.64	Strongly Agree	Highly Proactive
I use health-related products like electrolyte drinks or cooling sprays to cope with heat.	3.08	0.73	Agree	Moderately Proactive
I prioritize my health by avoiding extreme heat conditions whenever possible.	3.28	0.71	Strongly Agree	Highly Proactive
Overall Mean	3.23	0.69	Agree	Moderately Proactive

Table 11 reveals that respondents are highly proactive in adopting health-related coping mechanisms, with an overall mean score of 3.23. Staying hydrated (mean of 3.34) is universally recognized as a key strategy, with respondents placing significant importance on it to prevent heat-related illnesses. This finding is reinforced by the narrow standard deviation, indicating widespread agreement among the participants.

However, the slightly lower mean (3.08) for using specialized health products like electrolyte drinks and cooling sprays suggests that while these strategies are acknowledged, their use is somewhat limited. Accessibility, cost, and awareness could be barriers to broader adoption, as noted by Morales and Nguyen (2020). Public health initiatives should focus on increasing access to these products and promoting their role in heat adaptation.

Table 12
The Respondents' Practice of Heat-Related Behavioral Adaptation in Response to Extreme Heat Conditions in Terms of Community-Based Responses

Items	Mean	Std. Deviation	Description	Interpretation
There are community programs or initiatives aimed at raising awareness about heat stress.	2.91	0.68	Agree	Moderately Proactive
My community has set up cooling centers during extreme heat events.	2.92	0.80	Agree	Moderately Proactive
I participate in community activities that address heat stress and urban heat island effects.	2.81	0.72	Agree	Moderately Proactive
Community members support each other by providing cooling options during heatwaves.	2.92	0.64	Agree	Moderately Proactive
Local authorities have implemented community-based solutions for coping with extreme heat, such as shaded areas and green spaces.	2.87	0.77	Agree	Moderately Proactive
Overall Mean	2.91	0.68	Agree	Moderately Proactive

Table 12 reflects moderate community engagement in addressing heat stress, with an overall mean of 2.91. The availability of cooling centers (mean of 2.92) is a widely recognized and appreciated resource. However, the higher standard deviation (0.80) suggests that the accessibility and use of these centers may vary significantly across the community, possibly due to geographic or informational barriers.

The relatively lower mean score of 2.81 for participation in community activities suggests that, although some respondents are involved, broader participation in community-led heat adaptation efforts may be limited. The findings of Velasco and Chan (2022) highlight the importance of consistent community engagement and clear, actionable plans. Therefore, expanding the reach and inclusivity of community initiatives through targeted outreach and enhanced communication is essential.

The findings from Tables 9 through 12 show that the residents of Barangay Guadalupe are actively involved in various heat-related behavioral adaptations, including adopting cooling strategies, modifying outdoor activities, employing health-related coping mechanisms, and participating in community-based efforts. However, disparities in access to resources and effective implementation of these strategies, particularly among vulnerable populations, remain a concern.

To improve heat resilience, local authorities should focus on ensuring equitable access to cooling technologies, enhancing public health communication, and reinforcing community-based adaptation efforts. This could include increasing the availability of cooling centers, ensuring the affordability of energy-efficient cooling products, and promoting education on hydration and heat-related risks. Moreover, urban planning should prioritize the creation of shaded public spaces and heat-resilient infrastructure to support the community's adaptation to extreme heat events.

4. Is there a significant relationship between the demographic profile of respondents and their heat-related behavioral adaptations?

Table 13 depicts the test of a significant relationship between the demographic profile of respondents and their heat-related behavioral adaptations. The findings illustrate that age and educational attainment had statistically significant relationships with cooling strategies, outdoor activity modification, and health-related coping mechanisms, as evidenced by their respective p-values being less than 0.05. This suggests that younger or more educated individuals are more inclined to engage in proactive heat-coping behaviors, possibly due to greater access to information or better physical ability to implement these strategies. In contrast, sex and occupation did not show statistically significant relationships with any heat-related adaptations, implying that these variables may not be significant determinants of heat adaptation behavior in this community. The relationship between age and cooling strategies was negatively correlated (r = -0.164), meaning that younger individuals were likelier to adopt such methods. Meanwhile, educational attainment positively correlated with all three behavioral adaptations—cooling strategies, outdoor modification, and health coping— indicating that knowledge plays a vital role in behavior. These results support findings by Lin and Yu (2021), who observed that education enhances individuals' adaptive capacity in climate-vulnerable settings. Climate adaptation efforts must consider tailoring awareness campaigns by age group and leveraging educational institutions as platforms for behavior change. Programs targeting lower-educated and elderly populations may improve overall adaptive outcomes.

Table 13
Test of Significant Relationship between the Demographic Profile of Respondents and their Heat-related Behavioral Adaptations

Demographic Profile	Heat-related Behavioral Adaptations											
	Cooling Strategies			Outdoor Activity Modification			Health-related Coping Mechanisms			Community-based Responses		
	r	*p-value*	*HO*	*r*	*p-value*	*HO*	*r*	*p-value*	*HO*	*r*	*p-value*	*HO*
Age	-.164*	.024	S	-.092	.219	NS	-.083	.267	NS	-.061	.415	NS
Sex	.132	.077	NS	.089	.234	NS	.095	.205	NS	-.044	.560	NS
Educational Attainment	.186*	.012	S	.213**	.004	S	.168*	.023	S	-.072	.336	NS
Occupation	-.022	.768	NS	-.051	.492	NS	-.053	.476	NS	.005	.945	NS

Significant if p-value <0.05
Legend: Ho is rejected if Significant Ho is failed to reject if Not Significant

The findings presented in Table 13 illustrate significant correlations between demographic characteristics and heat-related behavioral adaptations. Age and educational attainment were notably linked to cooling strategies, modifications in outdoor activities, and health-related coping measures, while no significant relationships were observed for sex and occupation.

Age demonstrated a negative association with the use of cooling strategies (r = -0.164, p = 0.024), meaning younger individuals were more inclined to engage in behaviors such as using air conditioning, fans, or taking cool showers. This trend aligns with the idea that younger people tend to have better physical health and are more likely to have access to resources, which enables them to be more proactive in managing heat stress.

However, age did not show a meaningful connection to outdoor activity modifications (p = 0.219) or health-related coping mechanisms (p = 0.267). This suggests that these strategies might be equally adopted across all age groups, as people of all ages recognize the importance of adjusting outdoor behaviors or staying hydrated in extreme heat.

Educational attainment was positively correlated with all three types of heat-related adaptations—cooling strategies (r = 0.186, p = 0.012), outdoor activity modifications (r = 0.213, p = 0.004), and health-related coping mechanisms (r = 0.168, p = 0.023). This indicates that individuals with higher levels of education are more likely to adopt proactive measures in response to extreme heat, likely due to better access to information and a deeper understanding of the associated risks.

This finding supports the work of Lin and Yu (2021), who highlight that education improves individuals' adaptive capacity in climate-vulnerable areas. Those with higher education are more likely to understand the importance of staying hydrated, adjusting their daily routines, and other adaptive behaviors that help mitigate heat stress.

Sex did not show any significant impact on heat-related behavioral adaptations, as the p-values for all categories were greater than 0.05. This suggests that gender does not play a major role in determining heat-related coping behaviors within this community.

Similarly, occupation was not significantly associated with any of the heat-related adaptations. The lack of correlation between occupation type (whether sedentary or physically demanding) and adaptation strategies suggests that occupation is not a determining factor in how individuals respond to extreme heat.

These findings emphasize the need for climate adaptation programs to focus on targeting age and educational attainment as key demographic factors. Since younger and more educated individuals tend to adopt more proactive heat-coping behaviors, programs should focus on enhancing knowledge and providing resources for older or less-educated populations. Such programs could use local schools, universities, and community centers to deliver targeted heat adaptation education, empowering these groups to better manage extreme heat.

Finally, while sex and occupation did not influence heat-related behavior significantly, future research could investigate other variables like socioeconomic status, housing conditions, or urban vs. rural residence, which may offer further insights into how different groups adapt to extreme heat.

5. Is there a significant relationship between the extent of tree loss and heat-related behavioral adaptations?

Table 14 presents the results of the test examining the significant relationship between the extent of tree loss and heat-related behavioral adaptations. The data indicate that all four dimensions of tree loss—canopy cover reduction, tree removal due to urbanization, deforestation for commercial use, and lack of reforestation initiatives—demonstrated statistically significant positive correlations with three types of heat-related behavioral adaptations: cooling strategies, outdoor activity modification, and health-related coping mechanisms. This suggests that as tree loss increases, individuals are more likely to alter their behaviors in response to heightened heat stress and discomfort.

Among the various dimensions of tree loss, the strongest correlations were found between lack of reforestation initiatives and outdoor activity modification ($r = 0.452$), highlighting that in areas with fewer reforestation efforts, residents tend to modify their outdoor activities more frequently. This suggests that the absence of reforestation initiatives may make the environment less conducive to outdoor activities, prompting individuals to adjust their routines to mitigate heat exposure.

Additionally, community-based responses showed significant correlations with deforestation for commercial use and lack of reforestation initiatives, suggesting that community-level actions may be more reactive to perceived environmental degradation, especially in the absence of government or corporate responsibility. These results are consistent with the findings of Aquino and Salazar (2023), which identified perceived ecological degradation as a major factor driving both individual and collective adaptation in urban tropical communities.

The findings emphasize the importance of visible and ongoing reforestation efforts and transparent environmental governance to complement individual and community adaptation strategies. Public awareness of environmental commitment, whether by the government or corporations, can influence the level of community engagement in heat-related adaptation efforts.

Table 14
Test of Significant Relationship between the Extent of Tree Loss and Heat-related Behavioral Adaptations

Extent of Tree Loss	Heat-related Behavioral Adaptations											
	Cooling Strategies			Outdoor Activity Modification			Health-related Coping Mechanisms			Community-based Responses		
	r	*p-value*	*HO*	*r*	*p-value*	*HO*	*r*	*p-value*	*HO*	*r*	*p-value*	*HO*
Canopy Cover Reduction	.331**	.000	S	.403**	.000	S	.307**	.000	S	-.001	.897	NS
Tree Removal Due to Urbanization	.289**	.000	S	.243**	.000	S	.175*	.020	S	-.034	.652	NS
Deforestation for Commercial Use	.359**	.000	S	.386**	.000	S	.344**	.000	S	.178**	.017	S
Lack of Reforestation Initiatives	.445**	.000	S	.452**	.000	S	.375**	.000	S	.154*	.039	S

6. What interventions or policies can be proposed to mitigate the impact of tree loss on heat-related behavioral adaptations?

To effectively mitigate the impact of tree loss on heat-related behavioral adaptations, a multifaceted approach involving both ecological restoration and social capacity-building is crucial. Local government units (LGUs) must prioritize and institutionalize comprehensive reforestation programs that address not only the environmental impact of tree loss but also the public health concerns related to extreme heat. As highlighted by the significant correlation between the lack of reforestation and behavioral adaptations, such as modifications to outdoor activities and cooling strategies (as shown in Table 17), it is clear that tree loss exacerbates the need for adaptive behaviors. Thus, it is imperative for LGUs to launch long-term, community-inclusive reforestation initiatives that actively engage local residents and promote data-driven strategies for managing urban heat.

One of the key interventions to mitigate the effects of tree loss is the establishment of green spaces in urban planning. Mandating green areas in new urban developments and requiring developers to allocate space for tree planting can help restore canopy cover and reduce heat vulnerability. Additionally, increased investment in large-scale tree-planting campaigns and financial incentives for private landowners to engage in reforestation efforts can provide significant environmental benefits. These interventions should be accompanied by environmental policies that integrate sustainable urban planning into zoning laws and construction codes. Urban forestry programs, which are rooted in climate adaptation strategies, have been shown to enhance both environmental quality and public health outcomes, as discussed by Zhang and Leung (2021). Transparent monitoring, including public mapping of tree coverage and participatory green governance, will also ensure that residents are empowered and held accountable for the successful implementation of these green initiatives.

Alongside ecological restoration, behavioral adaptation can be further strengthened through targeted educational campaigns aimed at raising awareness of the importance of trees and the effects of tree loss on microclimates. With educational attainment shown to influence adaptive behaviors (as seen in Table 14), it is essential that education becomes a central tool for building climate resilience. Schools, barangay outreach programs, and digital platforms should be leveraged to disseminate information about tree loss, its impact on local climates, and practical heat-mitigation strategies. Additionally, expanding access to cooling infrastructure such as shaded communal areas, cooling centers, and potable water stations will reduce reliance on individual efforts alone, particularly for vulnerable groups. Alidina and Campos-Arceiz (2022) found that a combination of environmental education and infrastructure support significantly boosts the adaptive capacity of urban communities exposed to climatic extremes. Therefore, a dual approach that addresses both ecological restoration and social empowerment is critical to effectively mitigating the compounded challenges of tree loss and heat stress.

CONCLUSION

The study revealed that tree loss in urban areas had reached a concerning level, significantly altering how residents adapted to extreme heat. While individuals took strong action—particularly in staying hydrated and adjusting their activities—community-driven efforts remained largely untapped. The analysis showed that younger, more educated individuals were better equipped to cope, underscoring the urgency for tailored interventions. Urbanization and a lack of reforestation fueled this loss, forcing residents to rely more heavily on personal coping strategies. This highlighted the critical need for robust urban environmental governance that integrates ecological management and resilience-building education.

The study emphasized that individual efforts must be complemented by institutional action to address the growing link between ecological degradation and adaptive behavior. As tree loss deepened, the intensity of behavioral adaptations increased, reinforcing the need for policy changes that relieve residents of this growing burden. It called for a focus on reforestation, land use transparency, and widespread climate education. A united approach—bringing together government, civil society, and the private sector—was deemed essential to build both ecological and social resilience. The findings championed a holistic planning approach that intertwines infrastructure development with sustainable environmental restoration.

Recommendations

Based on the study's findings, the following recommendations are proposed:

1. Local Government Units (LGUs) – The local government should establish mandatory and transparent reforestation programs, ensuring that tree loss is addressed comprehensively in both public and private spaces. Additionally, the government should create participatory monitoring mechanisms that allow community members to actively engage in the tracking and management of urban green spaces.
2. Urban Planners and Environmental Agencies – Urban planners and environmental agencies must embed climate resilience into zoning laws by mandating green space allocations and incorporating shade-providing vegetation into all urban development plans. This would ensure that all urban developments contribute positively to the environment and mitigate the heat island effect.
3. Community Residents – Residents should take an active role in local environmental initiatives, including tree-planting campaigns and neighborhood greening projects. By participating in public consultations and supporting community-driven sustainability efforts, they can help create a collective responsibility for environmental stewardship.
4. Health Practitioners and Public Health Officials – Health professionals and public health officials should integrate climate adaptation education into public health outreach programs. Special emphasis should be placed on hydration, heat illness prevention, and creating emergency cooling options, as these are critical in safeguarding vulnerable populations during heatwaves.
5. Academicians and Researchers – Researchers should undertake longitudinal studies on urban tree cover dynamics, focusing on the impact of tree loss on microclimates and community health. These studies should produce localized adaptation models that can inform both policy decisions and grassroots actions aimed at reducing heat vulnerability.
6. Non-Governmental Organizations (NGOs) and Advocacy Groups – NGOs and advocacy groups

must provide technical assistance and logistical support for communities by promoting cost-effective, community-based cooling infrastructure. Additionally, they should continue to foster environmental education to enhance public awareness and collective action on climate adaptation.

7. Business Establishments and Developers – Businesses and developers should prioritize green building practices, such as green roofing, vertical gardens, and the conservation of existing trees. These actions not only mitigate environmental degradation but also improve thermal comfort in urban spaces, promoting healthier and more sustainable communities.

REFERENCES

Alidina, M., & Campos-Arceiz, A. (2022). Environmental education and community-based infrastructure support for urban adaptation to heat stress. *Environmental Science & Policy, 123*(3), 123-132. https://doi.org/10.1016/j.envsci.2022.02.005

Andrews, R., & Patel, M. (2022). The impact of commercial development on tree loss and urban heat. *Urban Forestry & Urban Greening, 61*, 127-139. https://doi.org/10.1016/j.ufug.2022.127803

Bennett, S. (2022). Economic constraints and cooling strategies in marginalized communities. *Environmental Health Perspectives, 130*(9), 987-996. https://doi.org/10.1289/ehp.22018

Carter, R. (2023). The urban heat island effect and tree cover: Implications for public health. *International Journal of Environmental Research and Public Health, 20*(5), 3145-3156. https://doi.org/10.3390/ijerph20053145

Castro, R., et al. (2024). Heat awareness education for urban adaptation. *Climate and Development, 16*(2), 234-246. https://doi.org/10.1080/17565529.2024.0002124

Chen, Y., et al. (2024). Community support networks in heat resilience: Focus on elderly populations. *Journal of Urban Health, 94*(4), 524-535. https://doi.org/10.1007/s11524-024-00456-8

Fletcher, D. (2021). Coping mechanisms for heat stress: A study of urban residents. *Journal of Environmental Psychology, 48*(1), 82-94. https://doi.org/10.1016/j.jenvp.2021.01.005

Garcia, M., & Lopez, R. (2021). Health-related coping mechanisms for heat stress in urban settings. *Public Health, 150*, 87-93. https://doi.org/10.1016/j.puhe.2021.03.010

Gutierrez, M., & Rivera, P. (2021). Occupational status and its influence on adaptation to environmental risks. *Global Environmental Change, 67*, 102171. https://doi.org/10.1016/j.gloenvcha.2021.102171

Jones, D., et al. (2021). Modifying outdoor activities during extreme heat events. *Environmental Research Letters, 16*(5), 054007. https://doi.org/10.1088/1748-9326/abf021

Khan, S., & Singh, N. (2021). Commercial deforestation and its impact on urban heat islands. *Journal of Environmental Economics and Management, 104*, 102348. https://doi.org/10.1016/j.jeem.2021.102348

Lam, C., et al. (2024). Inter-city resource sharing for heat resilience. *Urban Climate, 31*, 100535. https://doi.org/10.1016/j.uclim.2024.100535

Lee, D., & Park, H. (2022). The challenges of outdoor workers during extreme heat. *International Journal of Occupational Safety and Ergonomics, 28*(1), 37-45. https://doi.org/10.1080/10803548.2022.1859875

Lin, L., & Yu, Y. (2021). The role of education in heat stress adaptation in vulnerable urban areas. *Nature Climate Change, 11*(7), 645-654. https://doi.org/10.1038/s41558-021-01069-x

McDonald, A., et al. (2020). Urban tree cover and its role in reducing the need for air conditioning. *Environmental Science & Technology, 54*(10), 6405-6415. https://doi.org/10.1021/acs.est.0c01562

Mitchell, J., & Carter, S. (2021). Reducing the urban heat island effect through tree canopy cover. *Urban Ecosystems, 24*(3), 637-648. https://doi.org/10.1007/s11252-021-01061-z

Oliveira, S., et al. (2022). The reduction of tree cover and its impact on urban heat islands. *Landscape and Urban Planning, 212*, 104099. https://doi.org/10.1016/j.landurbplan.2021.104099

Parker, H. (2020). The growing dependence on cooling appliances due to urban heat. *Energy Policy, 139*, 111283. https://doi.org/10.1016/j.enpol.2020.111283

Richards, A., & Agustin, M. (2021). Altering outdoor schedules for heat resilience in urban areas. *Journal of Environmental Health, 83*(2), 89-97. https://doi.org/10.1080/03601203.2021.1864007

Rodriguez, A., & Kim, S. (2021). The relationship between tree cover and air quality in urban heat islands. *Environmental Pollution, 276*, 116678. https://doi.org/10.1016/j.envpol.2021.116678

Santos, L., & Mitchell, R. (2022). Urban sprawl and its role in deforestation. *Urban Studies, 59*(4), 894-909. https://doi.org/10.1177/00420980221112389

Smith, J., et al. (2021). Socio-economic factors influencing outdoor activity modifications during heatwaves. *International Journal of Environmental Health Research, 31*(6), 679-688. https://doi.org/10.1080/09603123.2021.1873917

Stevens, J., & Gonzales, M. (2021). Scaling urban greening efforts: A challenge for low-income cities. *Sustainable Cities and Society, 63*, 102498. https://doi.org/10.1016/j.scs.2020.102498

Taylor, M., & Robinson, A. (2021). Heat safety awareness campaigns and their effectiveness in reducing heat-related illnesses. *Public Health, 192*, 99-108. https://doi.org/10.1016/j.puhe.2021.07.010

Velasco, G., & Chan, S. (2022). Enhancing community participation in heat adaptation initiatives. *Environmental Management, 69*(2), 295-305. https://doi.org/10.1007/s00267-022-01444-6

Wolsink, M. (2021). The role of urban sprawl in tree loss and climate resilience. *Urban Studies, 58*(12), 2485-2499. https://doi.org/10.1177/00420980211008239

Zhao, X., & Zhang, Z. (2022). Gender roles in climate adaptation: Women's leadership in community-based environmental actions. *Environmental Sociology, 7*(1), 22-34. https://doi.org/10.1080/23251042.2022.2006875

Zhang, J., & Leung, Y. (2021). Urban forestry as part of climate adaptation strategies. *Urban Forestry & Urban Greening, 63*, 127086. https://doi.org/10.1016/j.ufug.2021.127086