UNIVERSITI TEKNOLOGI MARA

Cawangan Perak

LAN653 LANDSCAPE ARCHITECTURE SEMINAR

TALKS 5.0

THE ACCLAIMED LANDSCAPE OF KNOWLEDGE SHARING

"Harmony in Spaces : Blending Heritage, Nature and Design"

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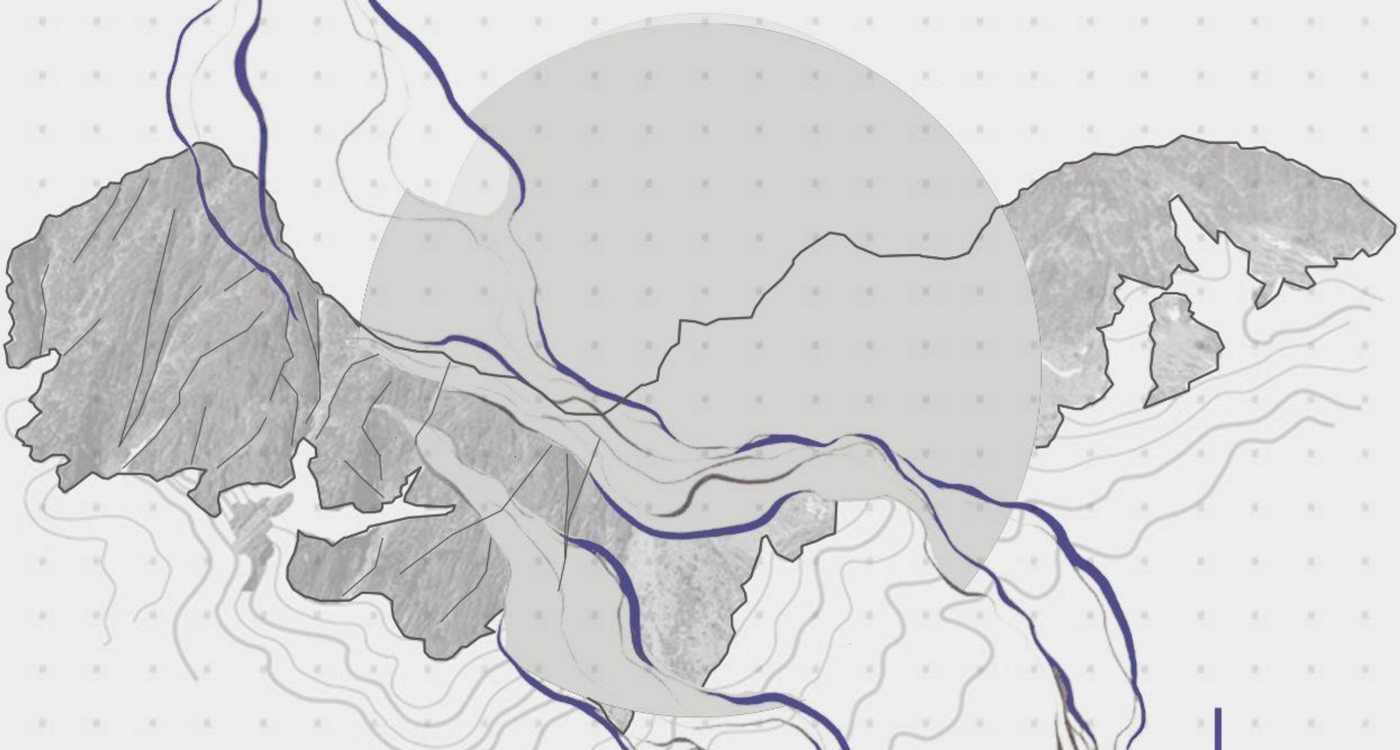

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Precision and Prediction of the Ecosystem Benefit Assessment in Campus Tree Planting: A Case Study at UiTM Seri Iskandar, Perak

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ABSTRACT

Campus tree planting plays a vital role in supporting environmental sustainability by sequestering carbon, improving air quality, and mitigating urban heat. However, the lack of reliable data, inappropriate species selection, and limited use of digital tools have hindered optimal landscape planning in Malaysia universities. This study evaluates and predicts the ecosystem benefits of campus trees at Universitities Teknologi MARA (UiTM) Seri Iskandar using the i-Tree MyTree application. The objectives include measuring selected trees, quantifying their contributions to carbon storage, air purification, and stormwater management, and forecasting their long-term ecological impact. A mixed-method approach combining field surveys and digital modelling was employed, focusing on two key areas: the main campus entrance *(Jalan Ipoh)* and the plaza at the Faculty of Architecture, Planning and Surveying Building in (Annex 2). Results highlight the significance of native and evergreen species, particularly *Khaya senegalensis* and *Syzygium campanulatum,* in enhancing campus microclimate resilience and contributing to climate the mitigation. The study underscores the value of data-driven urban forestry management in line with Malaysia's Low Carbon Cities Framework and Sustainable Development Goals (SDGs)11 and 13, reinforcing the role of digital integration in green campus strategies.

***Keyword*:** Campus tree planting, Ecosystem benefits value, MyTree i-Tree

INTRODUCTION

With the onset of rapid urbanization and climate change, tree planting on the campus of universities is being identified as one of the core drivers to promote sustainable development. Trees are not simply decoration in landscape design, they play a crucial role in infrastructure provision for ecosystem services, including carbon sequestration, mitigation of air pollution, temperature control, and stormwater management (Rahman et al., (2020), Shaharudin et al., (2022). However, most Malaysian campuses are yet to have fundamental data and proper digital incorporation to effectively evaluate and optimize such advantages (Rizal and Ismail, (2013), Shaharudin, Ismail Rahman, (2022). Within the Universiti Teknologi MARA (UiTM) Seri Iskandar Campus of Perak, there are various species of trees dispersed throughout learning areas and places for recreation.

However, there is no formal evaluation of real ecosystem benefits contributed by such trees on campus. Globally, universities like the University of British Columbia and the University of Melbourne have developed web-based tree inventories to monitor tree growth and value over time (Young, 2010). A study by (Rizal and Ismail, (2013) in Malaysia placed significant emphasis on choosing the right indigenous tree species to enhance tropical ecosystem resistance to climate change. Through digital apps like the i-Tree MyTree application, quantifying and predicting ecosystem services has become more precise (Nowak, & Greenfield, 2023). The aim of this research is to evaluate and predict the ecosystem benefits of campus trees at Universiti Teknologi MARA (UiTM) Seri Iskandar using the i-Tree MyTree application, with the goal of supporting sustainable and data- driven landscape planning., which is a software package created by the USDA Forest

Service. The study emphasizes quantifying tree characteristics, analyzing present-day ecosystem services (e.g., carbon storage, pollution removal, and stormwater control), and forecasting future situations based on species development.

Thus, this research assessment on the ecosystem benefits of campus tree planting at the UiTM Seri Iskandar has proven how a combination of field measurement and digital analysis using the i-Tree MyTree tool are able to support sustainable landscape planning. The use of the MyTree application demonstrates that digital tools can make the evaluation of tree ecosystem services more accurate, accessible, and future-oriented. It to helps to guide decisions in line with Malaysia's Low Carbon Cities Framework and Sustainable Development Goals (SDG 11 & 13). Overall, the findings support the idea that trees on campus are not just decorative elements, but essential green infrastructure that provide real ecological benefits both now and in the future.

LITERATURE REVIEW

i. Campus Tree Planting

The presence of campus environments supports climate comfort, air improvement and positively affects the mental wellbeing of everyone using the area. Experts point out that purposeful tree planting on campuses increases biodiversity in cities and benefits learning by creating special climates (Akpinar (2016); Rahman et al. (2020). The University of British Columbia and the University of Melbourne, among other global universities, have started using digital inventories to track the health of their trees and determine planting plans (Young, (2010); McPherson & Peper, (2012).

In Malaysia, the advancement of green infrastructure is ongoing, thought the integration of digital tools like the i-Tree system remains limited (Rizal and Ismail, (2013). At UiTM Seri Iskandar, the presence of native species such as *Dipterocarpus semivestitus* (Keruing Padi) presents an opportunity for science-based landscape planning. Recent surveys conducted through platforms like BIObase@Campus and INaturalist have recorded over 62 plants species in campus, highlighting untapped ecological potential (USDA Forest Services, 2022: MFM, 2024). Stretegic planting-such as *Khaya senegalensis* for symbolic gateway functions and *Syzygium jambos* and *Mimusops elengi* for shading-demonstrates the multifunctionality of urban trees in campus settings. However, long-term data on tree performance in tropical climates remains scarce and poorly organized, making challenging to accurately evaluate tree growth, forecast ecological benefits, or implement evidence-based maintenance strategies (Shaharudin, Ismail, and Rahman, 2022).

ii. Ecosystem Benefits Value of Trees

Urban trees offer a wide range of ecosystem services that are measurable and valuable, especially in urban and campus settings. Among the key benefits that can be assessed using digital tools like i-Tree are:

- **Carbon Dioxide Uptake** (Carbon Sequestered[1] & CO_2 Equivalent[2])
- **Storm Water Mitigation** (Runoff Avoided & Rainfall Intercepted)
- **Air Pollution Removal** (Carbon Monoxide, Ozone, Nitrogen Dioxide, Sulfur Dioxide & $PM_{2.5}$)
- **Energy Usage Per Year[3]** (Electricity Savings & Heating Fuel Savings)

Because of tools like the i-Tree suite, people are now able to see and measure the positive effects of trees and their ecosystems (Nowak et al., (2013); McPherson et al., (2016). Experts found out that urban trees more than 20 years old can trap 100–200 kg of carbon every year, store thousands of litres of rainfall and filter harmful substances in the air such as $PM_{2.5}$, SO_2 and NO_2 (Rahman, et al., (2020); Fahmi, Ramli, and Jamaludin, (2021). Ensuring that campus is planned with these ecosystem functions in mind supports the environment and helps get budgets approved for tree care and growth.

Despite the proven value of tools like i-Tree in quantifying the environmental of urban trees, their adoption remains limited across Malaysian campuses (Shaharudin et al, 2022). Incorporating such tools not only enables data-driven assessments but also allows for the translation of ecological benefits into economic terms, supporting informed decision-making and aligning campus development with national sustainability goals.

iii. Current Situation, Issues, and Challenges

Even though tree planting on campus provides many benefits, its implementation still faces several challenges. Among the main issues are the lack of basic data on tree species and condition, inappropriate species selection, and lack of effective maintenance (Shaharudin et al., 2022). Physical development often results in the felling of mature trees that are difficult to replace immediately, thus affecting ecosystem benefits (Rahman et al., 2020).

Moreover, climate stressors like elevated temperatures and the urban heat island effect hasten the deterioration of tree health. The adoption of digital tools like i-Tree remains limited, despite its capability to facilitate more sustainable and data-driven landscape planning. Insufficient awareness regarding native trees like Keruing Padi (*Dipterocarpus oblongifolius*) also restricts campus conservation opportunities (Rizal and Ismail, 2013). Other indigenous species like Merawan Siput Jantan (*Hopea odorata*), Tembusu (*Fagraea fragrans*), Penarahan (*Syzygium grande*), and Jelutong (*Dyera costulata*) are likewise underutilized or misidentified, which further obstructs attempts to improve biodiversity, shade provision, and long-term ecological stability in campus environments.

iv. Towards Future Prediction

Predicting the future ecosystem contributions of campus trees is critical to ensuring that the landscape of an educational institution remains sustainable, climate resilient, and provides long-term value to the campus community. Digital tools such as i-Tree MyTree not only assess current benefits but also allow users to model tree growth based on species, location, and environmental conditions. These predictions are invaluable in helping campus management plan more strategic and sustainable landscape development. A study by (Peper et al. (2001) demonstrated that tree modeling can accurately predict ecosystem size and benefits, thus supporting investments in high-impact green infrastructure.

In addition, the use of digital forecasting in landscape planning helps the university meet its commitments to with Malaysia's Low Carbon Cities Framework and Sustainable Development Goals (SDG 11 – Sustainable Cities & Communities, and SDG 13 – Climate Action). The use of forecasting technology also reduces the risk of ecosystem value loss due to unsurpassed tree felling and can be used as the basis for long-term campus conservation policies.

RESEARCH METHODOLOGY

This study conducts quantitative methodology to measure the tree specifications using measurement tools, including diameter tape for measuring Diameter at Breast Height (DBH) and MyTree is a tool in the i-Tree Tools suite specifically designed to provide a quick assessment of the ecosystem benefits contributed by individual trees.

Table 1 Data Require for research methodology

Research Objective	Methodology Approach	Data Collection Tools & Techniques	Outcome/Result
1. To measure tree specifications and estimate ecosystem benefits of campus trees.	Quantitative (Field Measurement)	- Diameter tape to measure Diameter at Breast Height (DBH)	-Accurate DBH measurement for tree specifications
2. To assess the ecosystem services using i-tress, including carbon sequestration, air pollution reduction, and stormwater	Quantitative (Digital Tool)	- i-Tree MyTree tool, inputting tree characteristics (DBH, height, species)	- Assessment of ecosystem services like carbon sequestration, air pollution removal, and stormwater

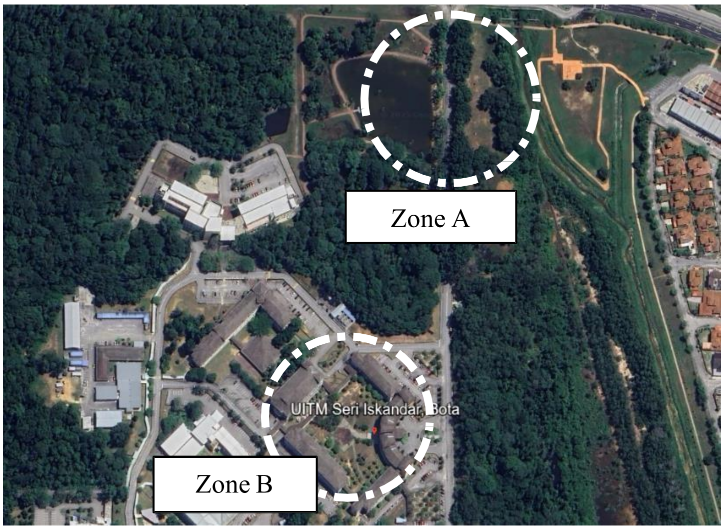
management.			interception.
3. To predict the future value of ecosystem services provided by trees in campus settings.	Quantitative (Digital Tool)	- i-Tree MyTree tool's predictive analysis feature based on tree growth projections	- Predictions of future ecosystem service contributions over time.

Table 1 presents a comprehensive overview of the research methodology, matching each of the three primary research objectives with related methods, instruments, and anticipated results. For objective 1, field data collection is conducted using established arboriculturally methods, including measuring Diameter at Breast Height (DBH) with a diameter tape, to obtain precise physical data on chosen tree species. Objective 2 incorporates these field measurements into the i-Tree MyTree application to assess environmental advantages, such as carbon capture, air quality improvement, and stormwater management. Objective 3 entails forecasting the long-term ecological benefits of campus trees utilizing digital simulations and model results. This framework not only elucidates the methodological approach but also demonstrates the shift from empirical data gatheringto digital analytics and environmental forecasting, thus enhancing the study's analytical robustness and alignment with its sustainability-focused objectives.

Site Selection

The research was conducted at **Universiti Teknologi MARA (UiTM), Seri Iskandar Campus**, covering 285.5 acres. The campus, established in 1995, contains diverse tree species within both newly planted and mature landscapes. Two specific zones were selected based on tree accessibility, spatial functions, and ecological value:

- **Zone A:** Main Entrance along Jalan Ipoh – a formal tree-lined boulevard that serves as the primary access point from the Ipoh-Lumut highway. Refer figure 2.
- **Zone B:** Plaza at the Faculty of Architecture, Planning and Surveying (Annex 2) – an academic square surrounded by architectural buildings and structured plantings. Refer figure 3.



Zone A

Compared to other areas in UiTM Seri Iskandar, Zone A stands out as a formal, continuous green corridor featuring mature trees planted in linear patterns. Many parts of the campus are occupied by buildings, car parks, or scattered green patches, making Zone A one of the most consistent and accessible green open spaces suitable for ecological study.

Zone B

The plaza is surrounded by buildings, hardscapes, and pedestrian movement, providing an opportunity to study how trees perform in built-up microclimates, a condition not fully represented in other zones.

Figure 1 Site Plan UiTM Seri Iskandar Campus, Perak, Malaysia

Figure 2: Zone A: Jalan Ipoh: Main Entrance.

Figure 3: Zone B: Plaza at the Faculty of Architecture, Planning and Surveying Building in (Annex 2).

Figure 3: Zone B: Plaza at the Faculty of Architecture, Planning and Surveying Building in (Annex 2).

Data Collection

This study employs a quantitative research approach to assess and predict the ecosystem services of campus trees at UiTM Seri Iskandar, Perak. Data were collected through two main methods: **on-site tree measurements** and **digital analysis using the i-Tree MyTree tool.**

i. Measuring Tree Specifications

This study uses a quantitative approach that emphasizes the collection of numerical data through physical measurements of tree specifications in the study area, Zone A: Jalan Ipoh: Main Entrance and Zone B: Plaza at the Faculty of Architecture, Planning and Surveying Building in (Annex 2). Among the measurement tools used are a measuring tape to calculate the trunk circumference at breast height (DBH) refer (Figure 6) and a GPS using a phone to record the coordinates of the tree location.

The findings from this method not only provide an economic value for each ecosystem service but can also be used as a basis for evidence-based decision-making for more sustainable tree management plans and green landscape planning (Mullaney et al., 2015). Guidance was obtained from an expert, LAr. Dr. Helmi Bin Hamzah (CA), is a senior lecturer at UiTM Seri Iskandar Campus and specific expertise in urban tree care (Arboriculture), on how to measure trees using a measuring tape as well as the correct way to read the measuring tape reading. Refer Figure 6.

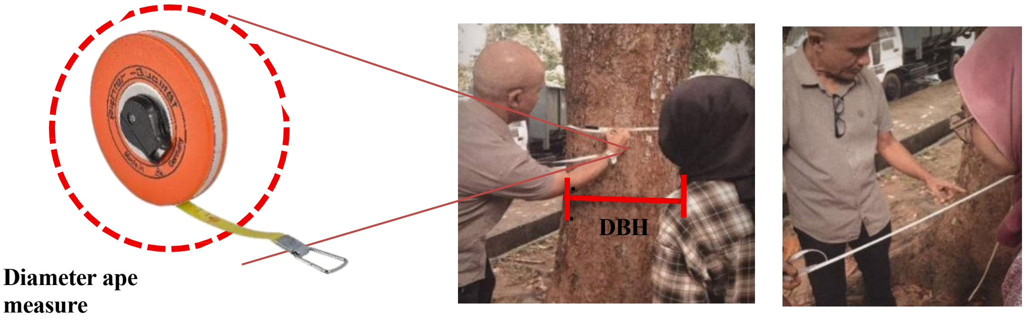
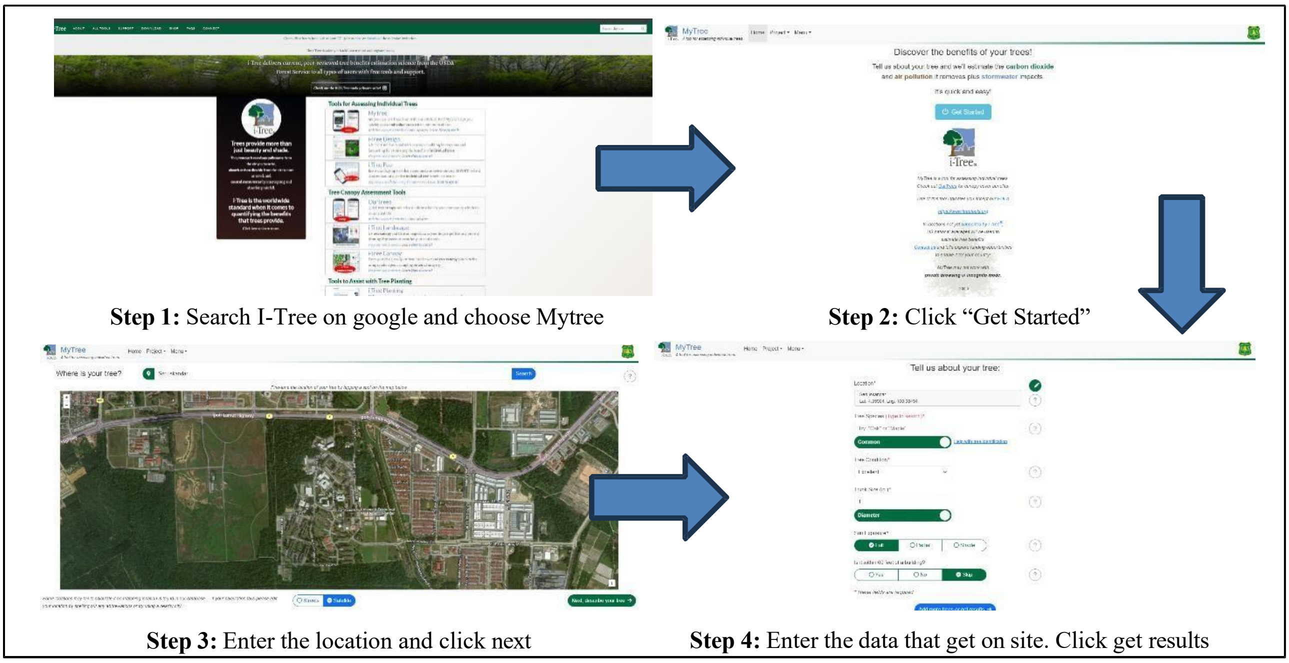


Figure 6: Tool used to take measurements and the demonstration how to take tree measurements.

ii. i-Tree MyTree Tools

i-Tree MyTree is a simplified tool under the i-Tree suite developed by the USDA Forest Service to help individuals and communities estimate the benefits of individual trees, including carbon storage, air pollution removal, and energy savings. Unlike other modules in the i-Tree system that require intensive data collection, MyTree is designed to be user-friendly, allowing users to input basic tree data such as species, size, and location refer to Figure 7, to quickly estimate environmental and economic benefits (USDA Forest Service, 2022).



Step 5: Choose the blue circle **Step 6:** Showing the value data of tree

Figure 7: i-Tree system that requires intensive data collection.

Figure 7 illustrates the step-by-step process of using the i-Tree MyTree tool, a simplified web-based application developed by the U.S. Forest Service. This tool is designed to help individuals, students, and urban planners estimate the ecosystem benefits of individual trees using basic field data. The visual guide in the figure outlines six key steps:

Step 1: Accessing the Tool
- Users begin by searching for "i-Tree MyTree" on a web browser and selecting the official website.

Step 2: Getting Started
- After entering the site, users click the "Get Started" button to initiate the assessment process.

Step 3: Entering Location
- The user is prompted to input the tree's location, which allows the tool to consider regional environmental conditions in its calculations.

Step 4: Inputting Tree Data
- The user then enters on-site tree measurements, including species, trunk diameter (DBH), and height.

Step 5: Selecting the Tree
- The tool allows the user to visually select the tree or location from the interactive map interface.

Step 6: Viewing Results
- The tool generates a summary of environmental benefits, such as carbon storage, energy savings, air pollution removal, and stormwater interception, based on the inputted data.

This figure supports the research methodology by demonstrating how field-collected tree data can be processed digitally to estimated and visualize ecological benefits. The tool's user-friendly interface and quick output make it especially useful for academic settings and public engagement in green infrastructure planning.

FINDINGS AND DISCUSSION

This study identified five tree species located within the two designated zones at UiTM Seri Iskandar, Perak. Zone A (Jalan Ipoh, main entrance) is dominated by *Khaya senegalensis,* while Zone B Plaza at the Faculty of Architecture, Planning and Surveying (Annex 2) consists of a diverse mix including *Syzygium jambos*, *Cocos nucifera*, *Mimusops elengi*, and *Filicium decipiens*. Measurements were taken on-site, and results were analysed using the i-Tree MyTree tool to quantify the ecosystem services provided by each species.

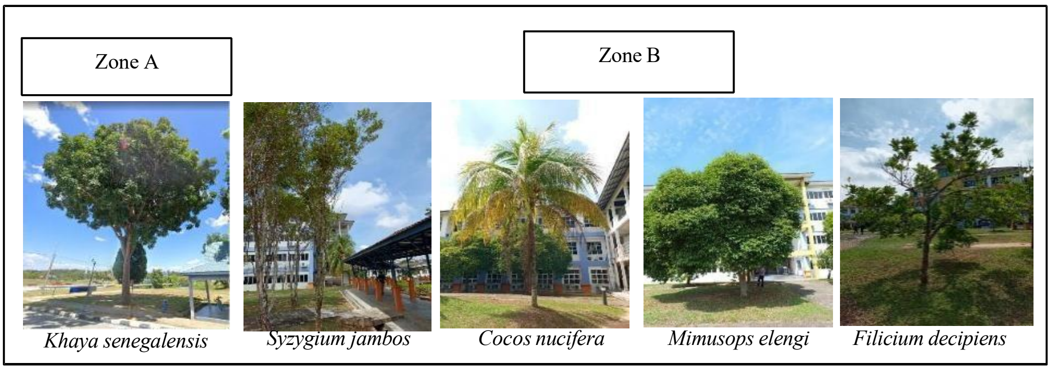


Figure 8: Tree Species Composition by Zone.

i. Tree specification analysis and summary through observation

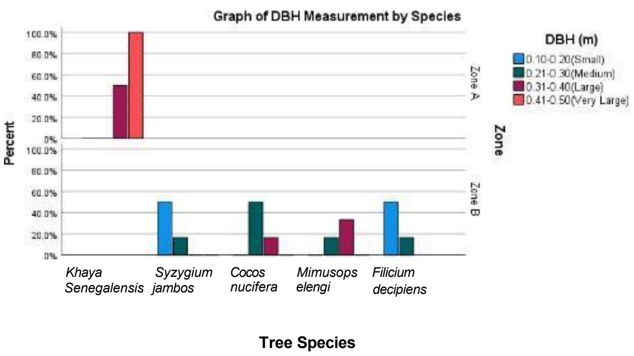


Figure 9: The graph showing the DBH measurement of tree in both Zones.

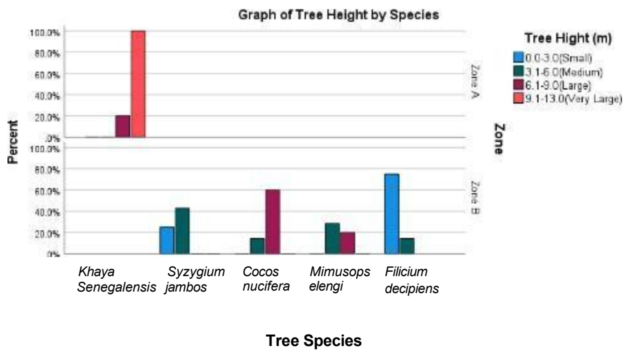


Figure 10: The graph showing the tree height in both Zones.

Based on chart *Khaya senegalensis* shows the largest DBH values in Zone A, with a dominant presence. For the *Syzygium jambos*, and *Filicium decipiens* are consistently found in smaller DBH categories, particularly in Zone B, indicating they are generally smaller in size compared to other species. Refer figure 9. Based on chart shows *Khaya senegalensis* has a dominant tree height in Zone A. Although *Filicium decipiens* are the smallest tree among other tree species in Zone B, by refer the figure 10. In summary *Khaya senegalensis* exhibits the largest size both in DBH and height across the zones, with *Syzygium jambos* and *Filicium decipiens* being relatively smaller in both measurements.

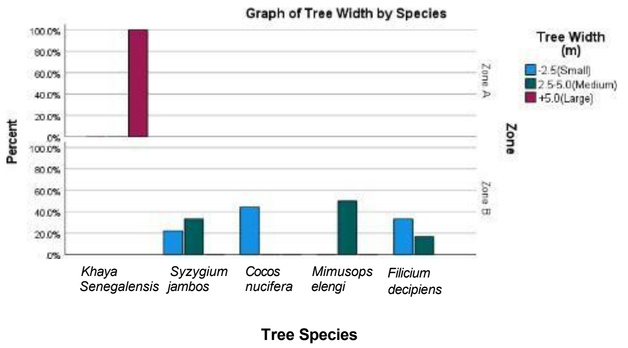


Figure 11: The graph showing the tree width in both Zones.

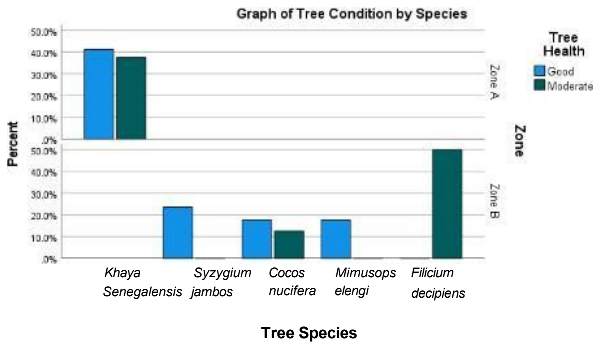
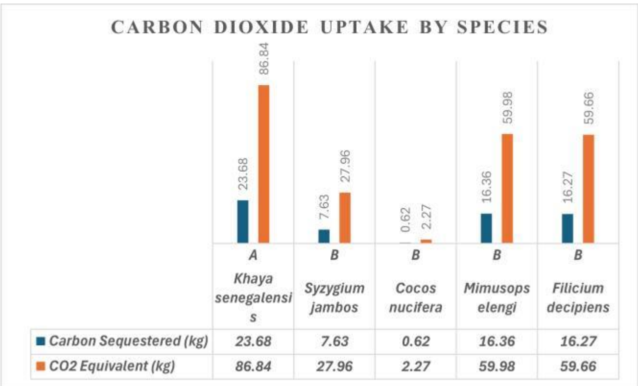


Figure 12: The graph showing the tree condition by species in both Zones.

Based on the chart refer to *Khaya senegalensis* dominant to large canopy in Zone A, compared to the Zone B *Cocos nucifera* has a smaller canopy width than any other tree species. Refer figure 11. Based on chart, *Khaya senegalensis* shows the highest percentage in the **"Good"** condition in zone A. Meanwhile, *Filicium decipiens* in zone B exhibits large percentage in the **"Moderate"** category by refer figure 12. In summary, *Khaya senegalensis* shows good health and moderate width growth, while *Filicium decipien***s** appears to be in a moderate health state and relatively smaller in both width and DBH measurements.

ii. Tree analysis for present time through i-Tree MyTree Tools



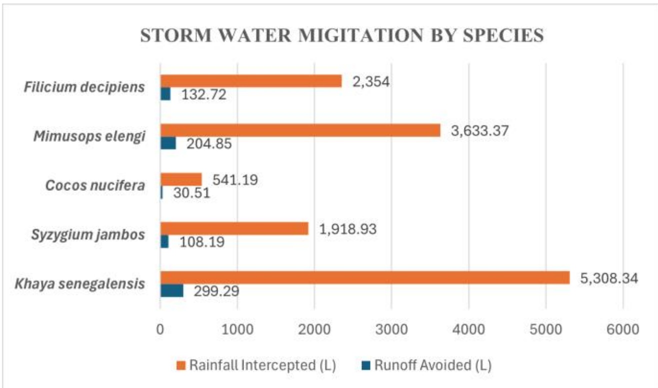


Figure 13: The graph showing the tree width in both Zones.

Figure 14: The graph showing the tree condition by species in both Zones.

MyTree's i-Tree analysis identified that *Khaya seneggalensis*, *Mimosops elengi* and *Filicium decipiens* were best in carbon sequestration and CO_2 absorption to the tune of an average of about 80 to 60 kg per specie, while the others had lower absorption. For water mitigation against storm water, the best was *Khaya senegalensis*, which could absorb rainwater of over 5,308 litres, followed by *Mimosops elengi* and *Filicium decipiens*.These results show that the diversity of tree species at UiTM Seri Iskandar not only contributes to a greener and more comfortable environment, but also provides important ecological benefits, especially in terms of carbon reduction and rainwater management

Table 2 Data of Air Pollution Removal by species by i-Tree tools tools

Species	Zone	CO Monoxide (g)	Ozone (g)	Nitrogen Dioxide (g)	Sulfur Dioxide (g)	PM2.5 (g)
Khaya senegalensis	A	10.18	484.76	40.22	86.78	25.31
Syzygium jambos	B	3.68	175.24	14.54	31.37	9.15
Cocos nucifera	B	0.55	26.04	2.16	4.66	1.36
Mimusops elengi	B	6.96	331.8	27.53	59.4	17.32
Filicium decipiens	B	4.51	214.97	17.84	38.48	11.22

The findings from Table 2 highlight that tree species selection significantly affects air pollution removal efficiency. Larger and denser-canopy species like *Khaya senegalensis* contribute the most to urban air quality improvement, while ornamental or sparse-canopy species like *Cocos nucifera* offer minimal benefit. These insights are critical for informing species selection in sustainable landscape planning, especially in areas with high human activity or traffic exposure.

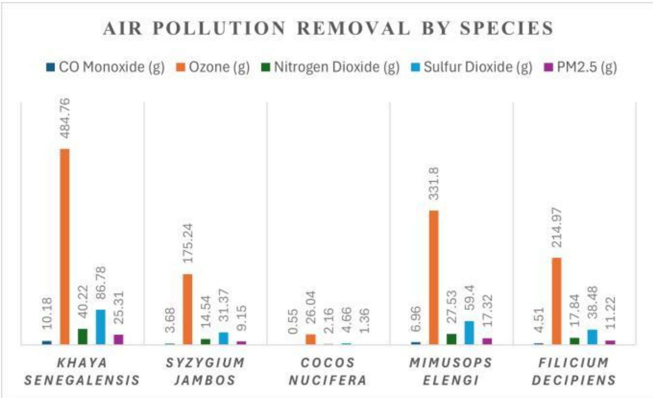


Figure 15: The chart shows air pollution removal by trees in both zones.

Based on the analyzed i-Tree MyTree chart, in terms of carbon monoxide (CO) removal, *Khaya senegalensis* (Zone A) is the most superior species, absorbing 10.18 grams, while *Cocos nucifera* (Zone B) absorbs the least, around 0.55 grams. For ozone (O_3), *Khaya senegalensis* also dominates when it can absorb 484.76 grams, followed by *Mimosops elengi* (331.8 grams) and *Filicium decipiens* (214.97 grams). In terms of nitrogen dioxide (NO_2) removal, *Khaya senegalensis* reaches 40.22 grams, while *Cocos nucifera* only 2.16 grams. In addition, in terms of sulfur dioxide (SO_2), the most superior tree *is Khaya senegalensis* (86.78 grams) and the lowest is *Cocos nucifera* (4.66 grams). In terms of fine particles (PM2.5), *Khaya senegalensis* is also the most superior (25.31 grams), followed by *Mimosops elengi* (17.32 grams) and *Filicium decipiens* (11.22 grams). Overall, large and mature trees especially *Khaya senegalensis* exert the most influence on air purification in the UiTM Seri Iskandar region.

iii. Tree analysis prediction benefits through i-Tree MyTree Tools

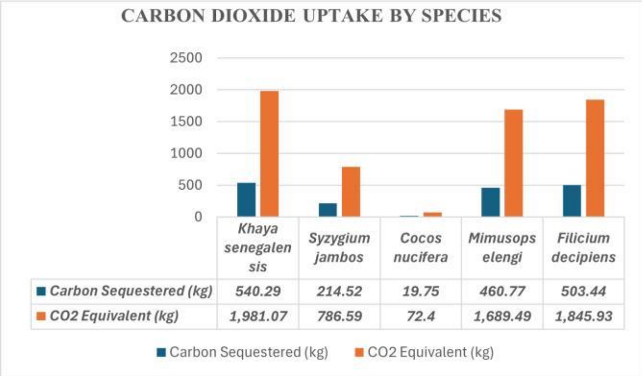


Figure 16 :The graph showing the tree width in both Zones.

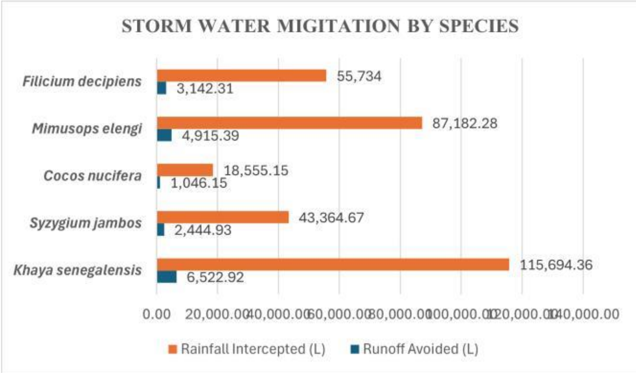


Figure 17: The graph showing the tree condition by species in both Zones.

Through i-Tree tools, it is predicted in the next 20 years, the trees at the UiTM Seri Iskandar site, Perak are expected to have a significant impact on nature. *Khaya senegalensis* sequesters 540.29 kg of carbon, followed by *Filicium decipiens* (503.44 kg) and *Mimosops elengi* (460.77 kg). *Syzygium jambos* and *Cocos nucifera* also help absorb 214.52 kg and 19.75 kg of carbon, respectively. In addition to absorbing carbon, these trees also function to store rainwater. *Khaya senegalensis* is also expected to store 115,694.36 liters of water, followed by *Mimosops elengi* (87,182.28 liters) and so on. This additional drainage function is needed to cool the environment, prevent flooding, and keep soil quality stable, especially during heavy rain.

Therefore, the campus would be of great value to the campus because it would allow decreasing the level of CO 2 in the atmosphere and serve as a natural water retention system, which would positively affect how the campus copes with climate change. The mentioned ecosystem services have helped in creating a healthier, more livable campus environment, one that is supportive of biodiversity and engaging in sustainable water management as well as incorporating the concept of green infrastructure into the campus environment to make it more comfortable both thermally and in terms of liability.

Table 3 Data of Air Pollution Removal by species by i-tree tools

Species	Zone	CO Monoxide (g)	Ozone (g)	Nitrogen Dioxide (g)	Sulfur Dioxide (g)	PM2.5 (g)
Khaya senegalensis	A	221.78	10,565.28	876.56	1,891.28	551.62
Syzygium jambos	B	83.13	3,960.09	328.55	708.89	206.76
Cocos nucifera	B	22.96	1,093.88	90.75	195.81	57.11
Mimusops elengi	B	167.12	7,961.54	660.54	1425.19	415.67
Filicium decipiens	B	106.84	5,089.65	422.27	911.09	265.73

The findings from Table 3 presents that tree species with larger canopies and denser foliage are significantly more effective in air pollutant removal. Trees such as *Khaya senegalensis* and *Mimusops elengi* are vital assets for improving air quality on campus, particularly in zones with high human activity and vehicular access. These results support the strategic planting of high-performing species to meet environmental sustainability goals, reduce campus pollution, and align with SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action)

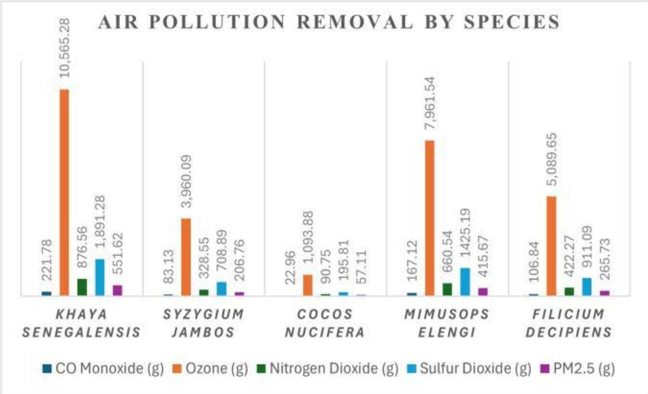


Figure 18: The chart shows air pollution removal by trees in both zones.

Figure 18 reflected result of the air pollution removal of five tree species in two simultaneous zones. *Khaya senegalensis* from Zone A performed best in removing CO Monoxide (221.78 g) and ozone (10 565.28 g), followed by *Mimusops elengi* in Zone B which was also effective in cleaning from the ozone layer (7 961.54 g), sulfur dioxide (1 425.19 g). In Zone A, *Syzygium jambos* and *Cocos nucifera* showed the compressed pollutant removal value, *Cocos nucifera* which only reduced 22.96 g CO Monoxide and 57.11 g PM2.5 respectively. *Filicium decipiens*, although not outstanding in any way, also added a bit of spice in pollutant removal. With the prediction that these environmental benefits will increase in the next 20 years, the selection of effective tree species will reduce air pollution by 80% around 10 years by effective. *Mimusops elengi* and *Filicium decipiens* show more balanced removal rates, with *Mimusops elengi* standing out for its effective ozone and sulfur dioxide removal.

DISCUSSION

The study reveals that *Khaya senegalensis* plays a significant role in ecosystem services at UiTM Seri Iskandar, particularly in Zone A. This tree has effectively reduced air pollution, captures carbon, and manages rainwater. The i-Tree MyTree analysis shows it excels in reducing carbon monoxide (221.78 g), ozone (10,565.28 g), and PM2.5 (551.62 g), with potential for over 540 kg carbon sequestration and 115,694 liters of stormwater interception in 20 years due to its size and dense canopy.

In relation to **Research Objective 1**, in measuring tree specifications and estimate ecosystem benefits, the study successfully documented species characteristics through DBH, canopy width, and health condition assessments. The physical superiority of Khaya senegalensis in DBH and canopy width directly correlates with its higher ecological outputs, affirming the link between structural tree traits and ecosystem performance.As for **Research Objective 2**, which focused on assessing ecosystem services such as carbon sequestration, pollution reduction, and stormwater management, the study met its goal through the integration of field data into the i-Tree MyTree digital tool. The tool provided quantified estimates, revealing that trees such as *Khaya senegalensis*, *Mimusops elengi*, and *Filicium decipiens* play pivotal roles in air purification and carbon uptake. These values emphasize that species selection directly influences the magnitude of ecosystem services delivered within campus landscapes. Finally, the **Research Objective 3**, which sought to predict the future value of these ecosystem services, the study demonstrated the effectiveness of the i-Tree MyTree forecasting feature. Projections indicated that *Khaya senegalensis* will continue to offer significant ecological benefits, including carbon sequestration and stormwater retention, over the next two decades. This predictive insight supports the argument for its continued prioritization in urban and campus tree planning

These results are supported by previous research by Akbar et al. (2022) who has identified *Khaya senegalensis* as a top carbon sequestration tree in urban areas, while Jhariya et al. (2020) noted its pollution tolerance and compatibility for roadside planting. Rizal and Ismail (2013) highlighted its durability and shading benefits for Malaysian landscapes. Nowak et al. (2013) confirmed that large, mature trees enhance urban ecosystem services, aligning with this study's findings. The research advocates cultivating high-performing indigenous species like *Khaya senegalensis* to enhance campus livability, support Malaysia's Low Carbon Cities Policy, and meet Sustainable Development Goals, particularly SDG 11 and SDG 13. This evidence informs tree selection and green infrastructure planning in Malaysian campuses.

CONCLUSION

This study demonstrated that *Khaya senegalensis* provides the most noteworthy ecosystem services at UiTM Seri Iskandar, particularly in air pollution reduction, carbon storage, and stormwater control. The study utilized the i-Tree MyTree tool for analysis, measuring environmental benefits and estimating ecological worth over a predicted 20-year span. The integration of i-Tree enabled the generation of precise and valuable data, offering quantifiable insights into tree performance that are essential for evidence-based planning. Its user-friendly interface and forecasting capabilities allowed for accurate assessment of individual tree contributions, making it a powerful tool for guiding sustainable campus landscape strategies. Trees with significant biomass, such as *Khaya senegalensis, Mimusops elengi,* and *Felicium decipiens,* are advised for campus landscape design because of their ability to improve urban air quality and alleviate climate challenges. The results support data- informed urban greening approaches and sustained investment in targeted tree planting to enhance Malaysia's Low Carbon Cities Policy and Sustainable Development Goals (SDGs 11 and 13). This research further advocates for the wider use of digital tools in managing green infrastructure and inspires subsequent studies on local tree inventories and ecosystem effectiveness.

REFERENCES

Akbar, M. et al. (2022). Urban Trees and Carbon Sequestration Potential in Nigeria: A Case Study of Khaya senegalensis.

Akpinar, A. (2016). How is high school greenness related to students' restoration and health? Urban Forestry & Urban Greening, 16, 1–8. https://doi.org/10.1016/j.ufug.2016.01.001

Jhariya, M. K. et al. (2020). Air Pollution Tolerance Index and Anticipated Performance Index of Urban Trees: A Case Study of Khaya senegalensis.

Jim, C. Y., & Chen, W. Y. (2009). Ecosystem services and valuation of urban forests in China. Cities, 26(4), 187–194. https://doi.org/10.1016/j.cities.2009.03.003

Livesley, S. J., McPherson, E. G., & Calfapietra, C. (2016). The urban forest and ecosystem services: Impacts on urban water, heat, and pollution cycles at the tree, street, and city scale. Journal of Environmental Quality, 45(1), 119–124. https://doi.org/10.2134/jeq2015.11.0567

Lohr, V. I., Pearson-Mims, C. H., Tarnai, J., & Dillman, D. A. (2004). How urban residents rate and rank the benefits and problems associated with trees in cities. Journal of Arboriculture, 30(1), 28–35. https://opinion.wsu.edu/tarnai/paper/jarbhr.pdf

McPherson, E. G., & Peper, P. J. (2012). Urban tree growth modeling. Arboriculture & Urban Forestry, 38(2), 58–65. https://www.fs.usda.gov/treesearch/pubs/41665

McPherson, E. G., Simpson, J. R., Peper, P. J., Maco, S. E., & Xiao, Q. (2005). Municipal forest benefits and costs in five US cities. Journal of Forestry, 103(8), 411–416. https://doi.org/10.1093/jof/103.8.411

McPherson, E. G., van Doorn, N. S., & de Goede, J. (2016). Structure, function and value of street trees in California, USA. Urban Forestry & Urban Greening, 17, 104–115. https://doi.org/10.1016/j.ufug.2016.03.004

Nowak, D. J., & Dwyer, J. F. (2007). Understanding the benefits and costs of urban forest ecosystems. In J. Kuser (Ed.), Urban and Community Forestry in the Northeast (2nd ed., pp. 25–46). Springer.

Nowak, D. J., & Greenfield, E. J. (2018). Declining urban and community tree cover in the United States. Urban Forestry & Urban Greening, 32, 32–55. https://doi.org/10.1016/j.ufug.2018.03.006

Nowak, D. J., & Greenfield, E. J. (2018). Urban tree cover trends and forecasting. Urban Forestry & Urban Greening.

Nowak, D. J., Hirabayashi, S., Bodine, A., & Greenfield, E. (2013). Carbon storage and sequestration by trees in urban and community areas of the United States. Environmental Pollution, 178, 229–236. https://doi.org/10.1016/j.envpol.2013.03.019

Peper, P. J., McPherson, E. G., & Mori, S. M. (2001). Equations for predicting diameter, height, crown width, and leaf area of San Joaquin Valley Street trees. Journal of Arboriculture, 27(4), 169–180. https://www.researchgate.net/publication/242614320

Rahman, M. A., et al. (2020). Traits of trees for cooling urban heat islands: A meta-analysis. Urban Forestry & Urban Greening, 49, 126630. https://doi.org/10.1016/j.ufug.2020.126630

Rahman, M. A., Moser, A., Gold, A., Rötzer, T., & Pauleit, S. (2020). Traits of trees for cooling urban heat islands: A meta-analysis. Urban Forestry & Urban Greening, 49, 126630. https://doi.org/10.1016/j.ufug.2020.126630

Rizal, M. F., & Ismail, S. (2013). Native tree species in Malaysian urban landscape: A review. Journal of Tropical Forest Science, 25(4), 558–566. https://www.jstor.org/stable/23617093

Rizal, M. F., & Ismail, W. H. W. (2013). The implementation of landscape management practices in Malaysian public universities. Procedia - Social and Behavioral Sciences, 105, 715–722. https://doi.org/10.1016/j.sbspro.2013.11.075

Shaharudin, A., Ahmad, A. G., & Musa, A. (2022). Campus sustainability and green infrastructure: Malaysian public universities' initiatives. International Journal of Built Environment and Sustainability, 9(1), 35–43. https://doi.org/10.11113/ijbes.v9.n1.927

Shaharudin, I., Ismail, S., & Rahman, N. A. (2022). Challenges in urban tree planting in Malaysia: A review. Urban Forestry & Urban Greening, 68, 127483. https://doi.org/10.1016/j.ufug.2022.127483

Shamsuddin, S., & Ujang, N. (2008). Making places: The role of attachment in creating the sense of place for traditional streets in Malaysia. Habitat International, 32(3), 399–409. https://doi.org/10.1016/j.habitatint.2008.01.004

United Nations. (2015). Sustainable Development Goals (SDG 11 & 13).

Young, R. F. (2010). Managing the city for urban sustainability: A study of the Portland, Oregon, model. Journal of Environmental Planning and Management, 53(1), 41–66. https://doi.org/10.1080/09640560903399780