

Contextuality Urban Green Space in Community Urban Green Space for Community Health. Study Case: Kampung Ketandan, Surabaya

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Keywords:

Health well-being; kampung;
open green space; green
canopy; vertical greenery.

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Abstract

Rapid urbanization in Indonesian cities, including in the city of Surabaya, has put tremendous pressure on ecologic functions and narrowed urban green spaces, severely impacting public health and well-being. This research centers on Kampung Ketandan, an urban community situated inside the Tunjungan CBD boundary, which is experiencing land shortages, large populations, and urban heat stress exposure. Employing qualitative means through participatory observation, in conjunction with the Driver–Activity–Pressure–State–Impact–Response (DAPSIR) model, this research examines the application of contextual urban green spaces—namely, green canopy and vertical greenery—in supporting community resilience. Findings indicate that these interventions not only manage microclimatic regimes and enhance environment quality, but also advance psychological and health-oriented well-being, as well as cultural identity and social cohesion in the kampung. These indicators affirm that community-based greening initiatives offer low-cost solutions with large impacts in mitigating rapid urbanization through sustainable urban health. This research concludes that green canopies and vertical gardens should become integral to dense kampung environments as formulative health infrastructure, establishing contextual urban green spaces as key adaptive tools in crafting more inclusive, resilient, and livable cities.

INTRODUCTION

Urbanization is happening in various cities in Indonesia, especially Surabaya. The population of Surabaya continues to grow, affecting the demand for land to support urbanization, such as for economic, housing, and social environment purposes (Katherina & Indraprahasta, 2019). This phenomenon can occur due to the shift in land use from agricultural purposes to residential purposes and so on. One of the main factors driving this phenomenon is the change in land use patterns, where land that previously had ecological functions such as agricultural land, green areas, or water catchment areas, is shifting to more densely built-up functions such as residential, commercial, or infrastructure (Sobirin & Fatimah, 2015).

In densely populated urban areas, especially in downtown areas such as Jalan Tunjungan, land use change is becoming more pronounced with increased development intensity and a lack of open green spaces. The change in land use from natural to built-up functions is generally marked by a decrease in soil infiltration capacity due to the loss of vegetation, a reduction in absorption areas, and the dominance of impermeable surfaces such as concrete, asphalt, and other building materials that have low capacity to absorb heat and water (Noviyanti, 2016). The existence of open green space located in the Tunjungan CBD area is temporary and has a high potential to be converted into buildings at any time, so it cannot be categorized as RTH that contributes to the city's green space (Sobirin & Fatimah, 2015).

Globally, the lack of urban green space has become a critical urban health issue. Open green spaces are an important component of urban areas, serving as public and private spaces covered with vegetation. They play a role in improving the quality of life of the community, the aesthetics of the city, and the quality of life in the environment or area (Dr. Mahipal et al., 2024; Noviyanti, 2016). Based on the data obtained, the study area has a proportion of open green space of only 3.15% of the total land area (6,409.07 m² out of 203,648.44 m²). This figure is far below the minimum threshold recommended by the WHO (20%) and the EEA (40%). This imbalance indicates an ecologically unbalanced environment, as well as high urbanization pressure in the area, including the kampung (urban village) around the Tunjungan Road corridor.

Tunjungan itself is a well-known CBD area, as well as a strategic economic area located in the Segiempat Emas Tunjungan area and its surroundings (Noviyanti, 2016). This area is a hub of activity, so the amount of energy required is also very high. Behind the activities taking place in the Tunjungan area lies a kampung that has been directly affected. Kampung experience disruption to their daily activities, and living in poorly ventilated houses, they feel uncomfortable and at risk. Heat stress, a condition that can significantly impact health and safety, is a major concern (Napitupulu et al., 2024). Rapid urbanization in cities like Surabaya has intensified the pressure on urban ecosystems, leading to a significant reduction in green open spaces, particularly within dense, inner-city settlements known as kampungs. One of the kampung affected by the activities taking place in Tunjungan is Kampung Ketandan, which is experiencing pressure from overcrowding and the impact of activities on buildings along the CBD area.

A kampung is a type of settlement in Indonesia characterized by dense, irregular, and organic housing structures, where social interaction and community ties are very strong (Hutama, 2018). One of the kampung located in Surabaya is Kampung Ketandan. Kampung Ketandan is one of the kampung located in the Tunjungan CBD area and is classified as an inner-city kampung, which is characterized by a network of small, irregularly patterned alleys connecting one kampung to another. Riding a bicycle in the kampung is strictly prohibited, and violating this rule is considered rude (Shirleyana et al., 2018).

The problem addressed in this study is the limited availability of urban green space in Kampung Ketandan, which is under heavy urbanization pressure from the surrounding Tunjungan CBD area. The conversion of land use from ecological to built-up functions has led to reduced environmental quality, low rainwater infiltration, and increased health risks for the kampung community due to overcrowding and heat stress. Therefore, this research aims to analyze the existing condition of green spaces in Kampung Ketandan, identify the environmental and health impacts of land-use change, and explore the role and potential of contextual urban green spaces in supporting community health and well-being in dense inner-city settlements.

LITERATURE REVIEW

Open Green Space / Urban Green Space

Open green spaces play an important role as a crucial element in sustainable urban architecture and planning (Cilliers, 2021). Green spaces not only function as the lungs of the city to improve air quality. Their presence supports ecological balance, improves the mental and physical health of the community, and creates spaces for social interaction that strengthen community cohesion. (Demircan & Sezen, 2018). Open green spaces can also be part of nature-based adaptation strategies that are cheaper and more resilient to disasters than purely technical engineering approaches. Therefore, the integration of green space into architectural design and urban planning must consider accessibility, equitable distribution, ecological functions, and community participation in its management, so that sustainable architecture does not stop at buildings but permeates the urban spatial order holistically (Kondo et al., 2018).

Importance of Urban Green Spaces for Community Health

Urban green open spaces are increasingly recognized as critical infrastructure for promoting physical and mental health in densely populated environments. From a physical health perspective, the presence of vegetation reduces air pollution, mitigates the urban heat island effect, and encourages active mobility such as walking and cycling, thereby reducing the risk of obesity, cardiovascular disease, and respiratory illness (Cox et al., 2018). Concurrently, interaction with natural environments plays a significant role in psychological well-being, offering restorative experiences that reduce stress, anxiety, and depression while enhancing cognitive function and overall life satisfaction. Beyond individual health, green spaces also strengthen social cohesion by creating inclusive environments where communities can interact, participate in recreational activities, and build a sense of belonging (Khanpoor-Siahdarka & Masnavi, 2025). However, despite growing evidence, rapid urbanization continues to reduce both the quantity and quality of accessible green spaces, creating health inequities between urban populations with and without access to such spaces (Cox et al., 2018). This tension highlights the need for urban planners and policymakers to view green open spaces not merely as aesthetic amenities but as essential health infrastructure, whose integration is fundamental to building sustainable and resilient cities.

Impact of Urban Green Spaces on Community Health in Kampung Ketandan

Urban green spaces have a direct and tangible impact on the quality of life in cities. These spaces serve as health-promoting environments for all members of the urban community, offering opportunities to reduce stress, improve mental health, and advance overall well-being (Ling et al., 2020). In contexts where green spaces are limited, providing public open areas and other communal facilities becomes a critical strategy for maintaining livability and urban resilience. Furthermore, the design and integration of vegetation into dense urban structures are not only ecological interventions but also social catalysts, as they encourage daily interactions, stimulate community engagement, and significantly contribute to psychological health and collective well-being (Kowarik et al., 2020).

Located within the Central Business District (CBD) of Tunjungan, Kampung Ketandan represents an inner-city settlement characterized by high population density, compact building

masses, and limited availability of green areas. The neighborhood further reflects a dynamic layering of historic and modern urban fabrics. These conditions collectively underscore the urgent need for innovative strategies to provide adequate urban green space that can support both environmental quality and community well-being. (ESCAP et al., 2019; Fan et al., 2019).

From Urban Green Space to Contextual Greening in Dense Settlements

Urban green spaces are widely recognized as crucial elements for promoting physical and mental health, supporting ecological balance, and strengthening social cohesion in cities (Hashida et al., 2005). However, the conventional model of parks and large green areas is often unfeasible in hyper-dense, organically developed settlements like the kampungs of Indonesia.

In environments such as Kampung Ketandan, severe land limitations and intense development pressure from the surrounding CBD demand a paradigm shift from traditional green infrastructure to more innovative, space-efficient solutions. This challenge has spurred the adoption of adaptive strategies that utilize unconventional spaces. This study focuses on two such interventions that are central to the community's response in Kampung Ketandan: green canopies and vertical greenery.

Characteristics of Kampung Ketandan's Urban Green Spaces

Green Canopy

Green canopy can be understood as an architectural and ecological element consisting of multilayered vegetation, both vertically and horizontally arranged—either natural or artificial—that functions as a climate and environmental regulator within the context of a city, neighborhood, or local environment (Aboagye, 2021). This concept encompasses not only the natural tree canopy, but also integrated systems such as climbing vegetation, living canopy structures, and technologically mediated greening solutions that collectively contribute to urban cooling, enhancement of biodiversity, and social well-being (Hashida et al., 2005). More importantly, the definition of green canopy extends beyond surface greening, as it emphasizes the qualitative and functional aspects determined by canopy density, plant species diversity, spatial configuration, and the integration of ecological technology (Aboagye, 2021). Within the broader discourse of sustainable urbanism, green canopy thus serves as a multifunctional infrastructure—bridging ecological performance and socio-cultural values—while simultaneously reinforcing resilience against climate change, mitigating the urban heat island effect, and providing restorative benefits for community health and quality of life.

In the context of public health, green canopy systems serve as restorative infrastructure that supports physical and psychological well-being. The use of layered vegetation has been shown to reduce stress, improve emotional well-being, and expand opportunities for social interaction in urban public spaces (Aboagye, 2021). Beyond its aesthetic contributions, the canopy structure provides essential environmental services such as temperature regulation, air filtration, and shade, thereby creating a more livable microclimate that allows residents to utilize outdoor environments more comfortably and safely. These findings align with empirical evidence that plant canopy structures act as microclimate moderators, creating local “cool spots” that alleviate thermal stress while filtering harmful ultraviolet radiation—thus protecting human health in densely populated urban environments (Hashida et al., 2005).

Vertical Greenery

Vertical greenery are vegetation systems installed on the vertical surfaces of buildings to provide environmental, aesthetic, and functional benefits (Manouchehri et al., 2024). In the context of contemporary architecture, the application of vertical plants is not only viewed as an additional decorative element but also as an integrated design strategy based on sustainability principles. Given the limitations of horizontal land availability in dense and compact urban areas, the expansion of green spaces is often restricted, making vertical greening the most feasible alternative (Fonseca et al., 2023). Vertical greenery systems (VGS) therefore emerge as a strategic planning approach to mitigate the adverse effects of urbanization while simultaneously enhancing the ecological performance of buildings. The implementation of VGS has become increasingly practical and adaptable, as vegetation can be integrated onto building facades or other vertical structural modules, applied in both interior and exterior contexts (Ling & Chiang, 2018).

Generally, vertical gardens are divided into two main categories: green walls and living walls, both designed to provide multidimensional contributions that go beyond purely visual aspects. The implementation of these systems actively contributes to microclimate control by creating a protective layer that reduces building surface temperatures, mitigates the urban heat island effect, and enhances energy efficiency through reduced cooling loads. Which are:

Table 1. Types of vertical greenery

Types of Vertical Greenery	Description	Characteristics
Green Facades	Plants grow vertically by climbing or hanging.	● Direct Green Facades Vines climbing directly onto the walls of buildings ● Indirect Green Facades Plants grow on separate structures (such as wire, trellis, or cable) installed parallel to the wall.
Living Walls	A planting system with structured and modular media.	● Soil-based systems: ○ <i>Planter systems:</i> Plants in pots or planting boxes arranged vertically. ○ <i>Pocket systems:</i> Plants in textile or flexible pockets. ○ <i>Hollow systems:</i> Plants planted in hollow structures (hollow panels for planting media). ● Sheet-based systems Using sheets of material (such as felt or synthetic fiber) with an automatic irrigation system (usually hydroponic or aeroponic).

The application of vertical greenery includes simple forms such as plants placed in pots and arranged vertically on shelves, grids, or retaining walls. This system falls under the category of planter systems, which are part of soil-based living wall systems. (Manouchehri et al., 2024). Although structurally simpler, this approach still meets the criteria for vertical greenery because of its vertical orientation, use of indirect planting media (pots), and ecological, visual, and thermal benefits. This is particularly relevant in the context of densely populated settlements

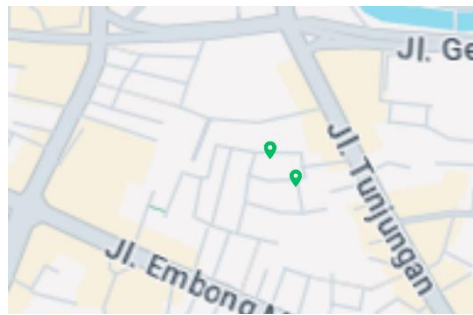


Fig. 2. Location of Vertical Greenery in Tunjungan
(Source: author)

This study uses a qualitative approach with participatory observation as the main method, in which data collection is carried out through direct interaction and observation of community interactions with green elements in their environment (Amalik, 2020). The qualitative perspective is applied to capture and interpret the phenomenon of how local residents interact with green elements in their environmental context (Sugiyono, 2017). The field research is planned to take place from February 2025 to August 2025, providing sufficient time to observe, document, and collect data comprehensively.

The collected data will be analyzed using a systemic framework, namely the Driver–Activity–Pressure–State–Impact–Response (DAPSIR) model, which allows for a comprehensive understanding of the interactions between human activities, the social environment, and the ecological conditions of Kampung Ketandan (Ling et al., 2020). The strength of the DAPSIR framework lies in its ability to operate at both macro and micro scales—from the level of the Ketandan Village environment to the broader urban context—while revealing the diverse relationships between elements (Martin et al., 2018).

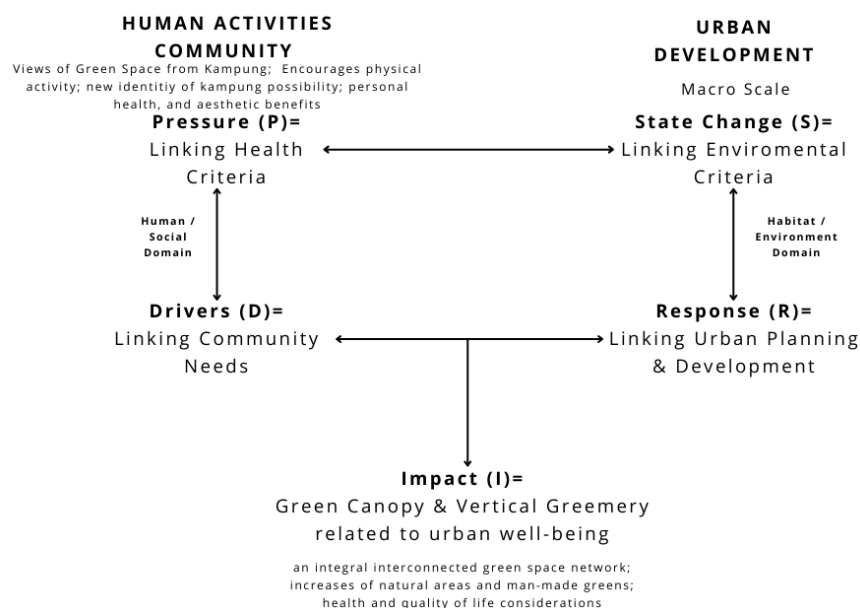


Fig. 3. Green Canopy & Vertical Greenery kampung well-being casual DAPSIR Diagram
(Source: author)

From the contextual relationship between the environment and the social domain (Pressure), which then spreads to village environmental issues (Condition Change) and social

context (Drivers) to obtain answers and connect environmental and social issues (Response). The relationship between the environmental and social domains (Pressure) produces positive and impactful results (I) on the human/social domain in terms of “Why” and “Which,” and on the environmental/habitat domain in terms of “Where,” “How,” and “What.”

In the ‘Human/Social’ domain:

- The “Why” category includes assessing appeal, perceived recovery levels, and how well-being can be enhanced. The functions provided by the prototype in terms of feasibility, space, economy, and social aspects contribute to greenery strategies (Sharma & Rajput, 2017).
- The “Which” category includes emphasizing the cultural or social relevance that vertical greening can bring to communities and scales.

In the “Environmental/Habitat” domain:

- The “Where” category evaluates the position of the man-made greens and the characteristics of these elements.
- The “How” category evaluates the relevance of green plants
- The “What” category emphasizes plant age, future management methods, and passive energy saving systems.

Parameters for Urban Health Well-Being

At the micro level, this involves observation and visual connection with green spaces, while at a more advanced level it includes active participation, such as planting, maintenance, or acquiring knowledge about vegetation, and ultimately contributing to community-based greening initiatives. These activities lead to well-being activities (A) (Ling et al., 2020). Complementing this, DAPSIR's comprehensive assessment further defines parameters in the fields of ecology and humanities, such as construction methods, spatial relevance, plant typology, energy conservation, cultural value, and place identity. Together, these indicators provide a holistic perspective for measuring how vertical greening interventions impact urban health, enabling the evaluation of environmental performance and social well-being in the context of densely populated urban areas (Hansen & Pauleit, 2014; Martin et al., 2018).

The assessment of urban health and well-being within the DAPSIR framework is based on parameters that include the functional role of green spaces and the level of community involvement. Activities related to vertical greening are evaluated using a 0–6 rating scale, ranging from passive to interactive relationships, which is Never = 0, 1–2 times per week = 0–1; Take notice to green = Never = 0, 1–2 times per week = 0–1, Visual Connection to green = 2; 1–2 times per week = 1–1.5; Active linkage (Numerical value of 3–4); Physical Connection to green = +3; Learning and Caring for green = +4; Caretaking the green = +5; and Acquiring knowledge on green = +6 (Ling et al., 2020).

By assessing DAPSIR holistically, the relationship between the human/social domain and the environmental/habitat domain is crucial and produces an impact (I). The response function (R), activity (A), and state of change (S) are described. Comprehensive DAPSIR assessment framework.

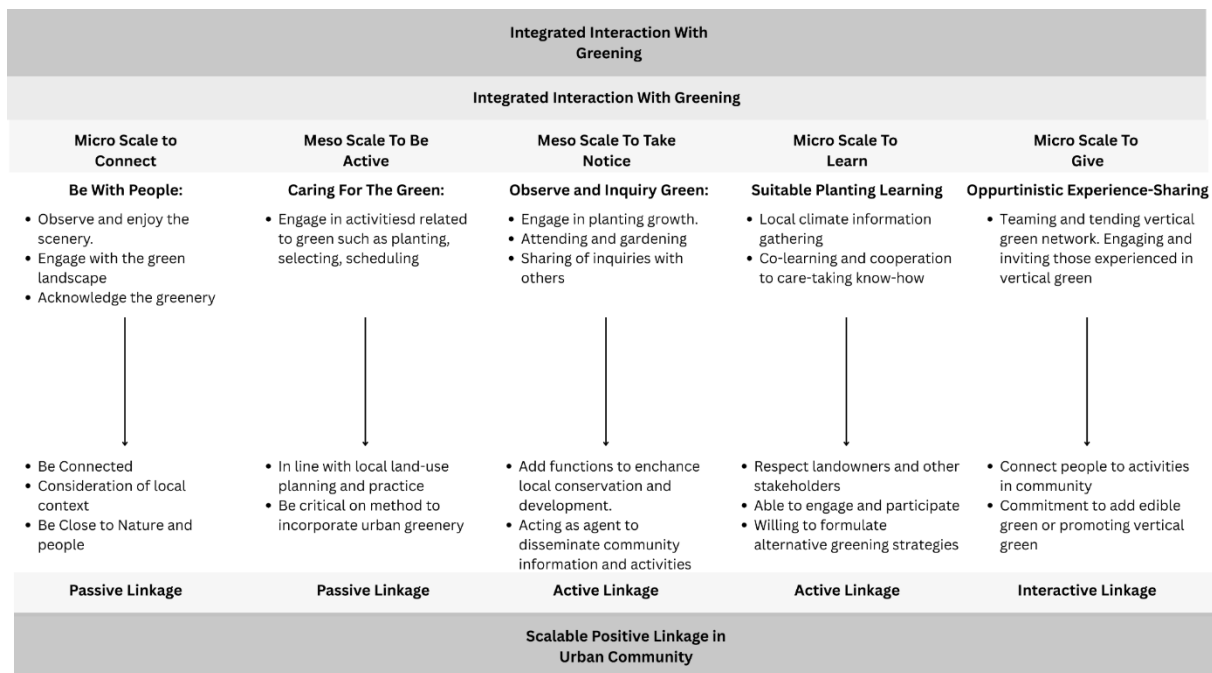


Fig. 4. Activities (A) involving green canopy and vertical greenery related to positive linkage of well-being in DAPSIR Framework
(Source: author)

Driver	Function	kampung well-being consideration (Activities)	
Why: (Impact) Aesthetic Value Cultural Relevance Cultural Heritage Satisfaction Quality of Life	Visual Improvement	Passive Linkage	
	Revisit and contribution in the field of education/arts	1. Connect 2. Be Active	4. Keep Learning 5. Give
	Local based history	1. Connect 2. Be Active	4. Keep Learning 5. Give
Which: (Impact) Place Identity Social Relevance Kampung Inclusion Quality of Life	Community Socialization	1. Connect 2. Be Active	4. Keep Learning 5. Give
	Human Health Connection to nature (accessibility)	1. Connect 2. Be Active	4. Keep Learning 5. Give
	Plant Species	2. Be Active	Active Linkage
Where: (Impact) Placement Evaluation Spatial Composition & Configuration	Typology	1. Connect	Passive Linkage
	Area Size	1. Connect	Passive Linkage
	Comfort	1. Connect Passive, active, and interactive linkage	4. Keep Learning
How: (Impact) Relevance Characteristics	Microclimate Control	1. Connect 5. Give	4. Keep Learning Passive, active, and interactive linkage
	Diversity	1. Connect 5. Give	4. Keep Learning Passive, active, and interactive linkage
What: (Impact) Environment Relevance Usability			

Fig. 5. DAPSIR assessment that results in Function and Well-Being Consideration.
(Source: author)

RESULTS AND DISCUSSION

This empirical study aims to select a village located in the Tunjungan CBD area as a location for conducting a contextual analysis of DAPSIR and evaluating green canopies and vertical greenery in the village. After determining the location of man-made greenery, we then assess the greenery using the DAPSIR diagram for the health and well-being checklist. Each step allows for broad consideration of the effect it has on increasing the state of well-being.

Green Canopy for the Well-Being of Kampung Communities

Described in the methods section, there are two urban canopy elements that have developed in Kampung Ketandan, namely Green Canopy 1 and Green Canopy 2. Both have specific characteristics that are formed from the type of plants, vegetation density, structure height, and the level of shade produced. These characteristics have varying impacts. To assess their well-being, we will include them in Table 2 below:

Table 2. Green Canopy Framework Checklist for Well-being

Green Canopy Framework Checklist for Well-being (DAPSIR Method)							
Intervention	Drive (D)	Activities (A)	Pressure (P)	State Change (S)	Impact (I)	Response (R)	Well-Being Benefit (W)
What: Revelation Environment Relevance (Habitat)	Design answer to: alleviate climate condition	Design promotes: green use & encourages physical activity	Design reduces the impact of: displacement from nature	Enhance energy efficiency protection Biodiversity Level of intimacy	Interconnect green network natural/man-made areas Singular partition	Application & maintenance of green canopy in kampung alleys	<i>To take notice</i> Passive linkage Numerical value = +2
Where: Placement Evaluation Spatial Relevance (Habitat)	Design answer to: meso-environment degradation	Design promotes: interaction with greens	Design reduces the impact of: lack of greens High density	Creating community desirability	physical activity & health	Renovation & surveillance Public ownership & accessibility	<i>To be active</i> Interactive linkage Numerical value = +6
How: Characteristic Economic Relevance (Habitat)	Design answer to: Increase Kampung value	Design promotes: health-incentive activities	Design reduces the impact of: Household friendliness / age / occupation issues	Biodiversity Economic character & micro-climate control	Typology Program requirement	Health incentive programs for greening kampung	<i>To give</i> Active linkage Numerical value = +4

Why: Aesthetic Value Cultural Relevance (Human)	Design answer to: Comple- ment to architec- ture feature	Design promotes: health & aesthetic benefits	Design reduces the impact of: mental & physical fatigue / negative attitudes	Urban design improve Architec- ture education	Visual & cultural value Sense of belonging	Kampung percep- tion Advancing green environ- ment via social participa- tion	<i>To learn</i> Interactiv e linkage Numerical value = +5
Which: Place Identity Social Relevance (Human)	Design answer to: Streng- then identity / social engage- ment	Design promotes: recreation, personal gratifica- tion	Design reduces the impact of: distraction, low interaction, poor social relation	community cohesion mental well- being	Quality of life Sense of belonging	Promote system benefit Streng- then social support	<i>To connect</i> Interactiv e linkage Numerical value = +6

The findings obtained from both semi-structured interviews and direct participant observations were systematically compiled and analyzed. These results are then organized using the Green Canopy Framework Checklist for Well-being, presented in Table 2, which applies the DAPISR method (Drive–Activities–Pressure–State Change–Impact–Response) to capture the comprehensive dimensions of environmental, spatial, economic, cultural, and social relevance in relation to well-being benefits.

Driver (D) stage

In the driver stage, the “How” category received the highest score, followed by ‘Which’ and “What.” This indicates that the method or mechanism of implementing green canopy is the primary concern, particularly in relation to the local economy, village typology, and microclimate control. Respondents assessed that the most important driver is not only the existence of green space itself, but how the system can be operated and provide tangible benefits to residents' daily lives.

Activities (A) stage

In the activities stage, the “What” category was rated as the most dominant, followed by ‘Why’ and “Which.” The ecological functions of green canopy—such as biodiversity, energy efficiency, and human closeness to nature—emerge as the top priorities for activities that must be preserved.

Pressure (P) stage

At the pressure stage, the “Why” category received the highest ranking, followed by ‘How’ and “Which.” Environmental and social pressures around the village demand clear reasons why a green canopy is needed: whether to improve aesthetics, strengthen cultural values, or support public health. Place-based contextual analysis in the “How” category serves to clarify the orientation of these pressures.

State Change (S) stage

Spatial placement and canopy configuration were considered crucial in determining the long-term impact on the village environment. Respondents assessed that location, size, and connectivity with social spaces were key factors, while ecological benefits (what) and economic-health mechanisms (how) provided additional support.

Impact (I) stage

At the impact stage, the “Where” and which category became dominant, followed by “What” and “How”. Spatial placement and canopy configuration were seen as crucial in determining the long-term impact on the village environment and human well-being. Respondents assessed that location, size, and connectivity with social spaces were key, while ecological benefits (what) and economic-health mechanisms (how) provided additional support.

Response (R) stage

In the response phase, the categories “Where” and “which” are considered equally important. This means that the installation process, interaction with the surrounding environment, health incentive support, and cultural values need to be integrated holistically. In other words, the success of the response depends heavily on coordination between the ecological, spatial, operational, and cultural dimensions.

Well-being (W) result

The categories “Where” and “Which” were considered the most dominant, followed by “Why.” This confirms that the well-being of village residents is greatly influenced by the spatial placement of green spaces and the resulting socio-cultural connections.

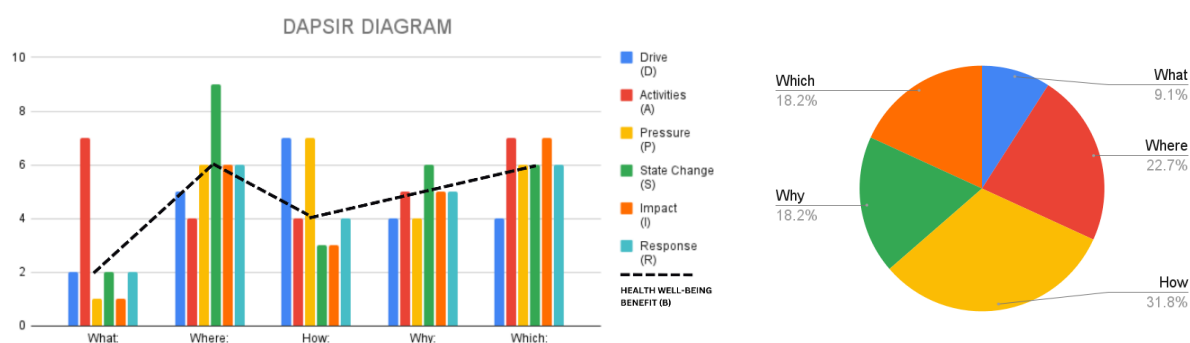


Fig. 6. Integrated Result of Green Canopy Framework Checklist for Well-Being (DAPSIR Method).
(Source: author)

The results of data processing using the DAPSIR framework in Figure 6 show variations in category dominance across five assessment stages with “How” category (31.8%) is the main factor in providing welfare benefits, followed by “Where” (22.7%), and ‘Why’ and “What” (18.2% each). This confirms that public health and well-being are greatly influenced by how green canopies are implemented in practice, their appropriate spatial location, and their aesthetic value and social identity, which strengthen residents' connection with their environment. Meanwhile, the “What” aspect (9.1%) was rated the lowest because it tends to be general and passive.

Overall, green canopy design must integrate ecological, social, and cultural aspects with a focus on health and well-being. Proper implementation not only maintains environmental

quality but also improves physical health, reduces psychological stress, and strengthens social interaction. Therefore, the implementation of green canopy in rural areas can serve as an integrated strategy to improve the quality of life of the community holistically.

Vertical Greenery for the Well-Being of Kampung Communities

As described in the methods section, there are two elements of vertical greenery that have developed in Kampung Ketandan, namely vertical greenery 1 and vertical greenery 2. Both have specific characteristics that are formed from the type of plants, vegetation density, structure height, and the level of shade produced. These characteristics have varying impacts. To assess their health well-being, we will include them in Table 3 below:

Table 3. Vertical Greenery Framework Checklist for Well-being

Vertical Greenery Framework Checklist for Well-being (DAPSIR Method)							
Intervention	Drive (D)	Activities (A)	Pressure (P)	State Change (S)	Impact (I)	Response (R)	Well-Being Benefit (W)
What: Vertical greenery as façade treatment (Habitat)	Design answer to: urban heat mitigation	Design promotes: passive shading & natural cooling	Design reduces the impact of: excessive artificial cooling lack of wall greening	Surface temperature Air pollutant absorption	Indoor comfort Outdoor thermal quality	Application & continuous maintenance of green facade	<i>To take notice</i> Passive linkage Numerical value = +1
Where: Placement Evaluation Spatial Relevance (Habitat)	Design answer to: meso-environment degradation kampung density	Design promotes: social interaction around shaded/green walls	Design reduces the impact of: lack of greenery in high density overheating spaces	Creation of shaded pockets Micro-scale biodiversity	Social desirability Community thermal comfort	Encourage placement on kampung alleys, façades & pedestrian lanes	<i>To be active</i> Interactive linkage Numerical value = +6
How: Characteristic Economic Relevance (Habitat)	Design answer to: cost-effectiveness & low-maintenance greening strategy	Design promotes: household-based greening initiatives	Design reduces the impact of: limited resources for green infrastructure	Affordable retrofit strategy Improved Climate adaptation at household level Streetscape improvement	Resilience Typology adaptable to kampung housing	Household participation in maintaining vegetation	<i>To give</i> Active linkage Numerical value = +4
Why: Aesthetic Value Cultural Relevance (Human)	Design answer to: enhance cultural identity visual greening of kampung	Design promotes: aesthetic appreciation mental well-being	Design reduces the impact of: visual monotony mental & physical fatigue	Green cultural identity reinforcement	Aesthetic value Psychological health	Neighbourhood participation in vertical greening	<i>To learn</i> Interactive linkage Numerical value = +5

Which: Place Identity Social Relevance (Human)	Design answer to: kampung identity support community bonding	Design promotes: recreation, personal gratification	Design reduces the impact of: distraction, low interaction, poor social relation	sense of belonging community stewardship	↑Quality of life Social cohesion	Strengthen collective effort in sustaining greenery	<i>To connect</i> Interactive linkage Numerical value = +6
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The implementation of vertical greenery in urban areas is not only considered an aesthetic strategy, but also an ecological approach that can address environmental, social, and economic challenges. The existence of vertical greenery elements can be comprehensively studied to understand the driving factors, the forms of activity they generate, the pressures they seek to overcome, the resulting changes in conditions, the impacts they create, and the forms of response required. This analysis enables a more systematic description of how vertical greenery plays a role in improving the quality of the built environment and the welfare of urban communities. Through the DAPSIR analysis framework (Driving Factors, Activities, Pressures, Condition Changes, Impacts, Responses), we can examine the impact of each of the following mentioned above:

Driver (D) stage

In the driver stage, the “How” category received the highest rating. This highlights that the mechanism or method of implementing vertical gardens is a key aspect that needs to be considered, especially in relation to urban space efficiency, microclimate control, and the achievement of sustainability targets.

Activities (A) stage

In the activities stage, the “What” category was rated as the most dominant. The ecological functions of vertical gardens—such as pollutant absorption, air quality improvement, heat reduction, and creation of healthier visual spaces—emerge as key priorities that must be maintained. Therefore, activities related to plant care, vegetation selection, and integration with building functions become key activities for maintaining the sustainability of the ecological benefits of vertical gardens.

Pressure (P) stage

At the pressure stage, the “Why” category received the highest ranking. Environmental and social pressures in urban areas—such as rising temperatures due to the urban heat island effect, declining air quality, and limited horizontal green open spaces—are compelling reasons why vertical greenery is necessary. This context is clarified through the “How” category, which explains that vertical solutions were chosen to address the limitations of urban land while responding to the urgency of sustainability.

State Change (S) stage

At this stage, location and function become equally important categories. Spatial changes resulting from the implementation of vertical gardens include improved thermal comfort, air quality, and visual aesthetics in densely populated urban areas. The placement of vertical gardens on building walls, street corridors, and semi-public spaces results in a more balanced spatial transformation between ecological functions and human needs.

Impact (I) stage

At the impact stage, it shows the integration between the “What” and “Why” categories. The main impacts include ecological benefits (lower temperatures, increased urban biodiversity, and improved air quality) and socio-economic benefits (resident comfort, improved building image, and potential economic value).

Response (R) stage

In the response phase, the categories “Where, How, and Why” are considered equally important. This means that the success of vertical gardens requires comprehensive integration between ecological aspects (what are the benefits), spatial aspects (where are they applied), operational aspects (how are the systems implemented), and socio-cultural motivations (why are they important to the community). Policy responses, technological support, maintenance incentives, and community participation are determining factors for the sustainability of vertical gardens as a green architecture strategy in urban areas.

Well-being (W) result

The categories “Where” and “Which” were considered the most dominant, followed by “Why.” This confirms that the well-being of village residents is greatly influenced by the spatial placement of green spaces and the resulting socio-cultural connections. Respondents felt that connecting and being active were the most crucial components in supporting quality of life.

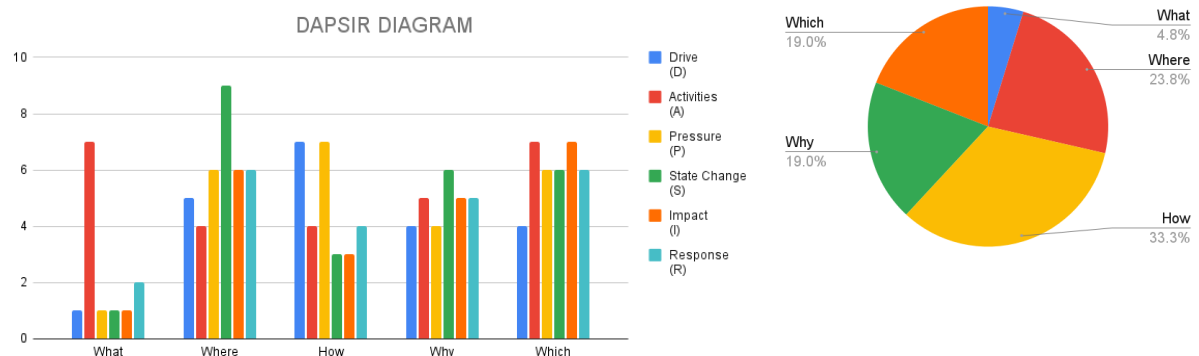


Fig. 7. Integrated Result of Vertical Greenery Framework Checklist for Well-Being (DAPSIR Method).
(Source: author)

The integrated DAPSIR analysis shows that vertical greening plays a crucial role in improving health and well-being through ecological, spatial, cultural, and operational dimensions. The results show that the “How” dimension (33.3%) is the most dominant, highlighting the importance of economic, functional, and health incentive aspects in greening integration. The “Where” dimension (23.8%) highlights the spatial relevance of green vegetation in dense urban contexts, ensuring accessibility and interaction with nature. Both the “Why” and “Which” dimensions (19% each) highlight the cultural, aesthetic, and social identity values of vertical green vegetation, demonstrating its contribution to community cohesion and psychological well-being. Although the “What” dimension (4.8%) has the smallest proportion, it remains fundamental as green infrastructure that provides climate regulation, air purification, and physical health benefits. Overall, vertical greenery emerges as a holistic intervention that not

only addresses environmental pressures but also strengthens social resilience, cultural values, and economic vitality, positioning it as a strategic solution for sustainable urban well-being.

CONCLUSION

This research has demonstrated that urban green spaces, especially green canopies and vertical gardens, are significant in enhancing the quality of life and health of community populations in densely populated urban territories like Kampung Ketandan in Surabaya. However, the unique contribution of this case study, derived from the DAPSIR framework analysis, is the identification of how these benefits are achieved. The findings demonstrate that the success of greening initiatives is determined less by the quantity of green space and more by the implementation mechanism. The implementation mechanism ("How") and the spatial appropriateness of its placement ("Where"). In Kampung Ketandan, the community-led integration of green canopies in alleys and vertical gardens on facades proved to be a low-cost, high-impact solution that directly improved thermal comfort, fostered social interaction, and reinforced cultural identity. These are found to be the most significant in kampung health well-being, as these are direct influences as well as community interaction opportunities. Additional interpretation reinforces that green infrastructure not only contributes to environmental advantages—it reinforces cultural identity, enhances social cohesion, as well as minimizes health risks.

The Ketandan case reveals that these bottom-up strategies are not merely aesthetic additions but are functional health infrastructure. They actively regulate the microclimate, provide psychological relief, and strengthen social cohesion in ways that top-down, conventional parks cannot achieve in such a constrained environment. This study provides empirical evidence that community-based greening initiatives offer a powerful model for mitigating the negative impacts of urbanization.

Therefore, this research advocates for a shift in urban policy and design. Municipal governments and planners, particularly in Indonesian cities facing similar pressures, should recognize and support these contextual greening strategies. Rather than viewing vegetation as an amenity, it must be treated as essential health infrastructure. Future efforts should focus on empowering communities by providing incentives for household-based vertical gardens and facilitating the creation of neighborhood-scale vegetation networks. Ultimately, this study establishes that contextual urban green spaces are crucial tools for building community resilience, promoting health equity, and shaping more livable and inclusive cities.. Overall, this research confirms that contextual urban green spaces are as much environmental capital as crucial community resilience tools, promoters of health well-being, and shapers of fairer and more inclusive cities.

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