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Research Paper

Walkability Concept Toward Sustainable City: Comparative Insights of Brisbane and Bogor Urban Areas

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Abstract
A successful sustainable city prioritizes humans by integrating the transportation system with urban development. One of which is considering walkability. The walkability concept is important since walking reduces congestion, promotes low environmental impacts, and possesses social and economic values. Land use integration with walkable pedestrian facilities is a challenge for stakeholders in creating policies to actualize a sustainable city. This paper reviews the walkability condition and policies concerning pedestrian facilities in Brisbane, Australia and Bogor, Indonesia. Bogor was selected due to its strategic location as Jakarta's satellite city. Method used was literature review with comparative analysis, analyzing similarities, differences, advantages, and disadvantages of urban policies in prioritizing humans to achieve walkable and sustainable city in Australia and Indonesia. The indicators determining Brisbane community's behavior to walk are distance to destination (59%), travel time (14%), hot weather (19%), roads with various altitudes (4%), lack of paths (3%), and lack of green areas (1%). In Bogor, Indonesia, pedestrian facilities are lacked for people with special needs, elderlies, children, and pregnant women (16.5%), unsafe crossing facilities (19.8%), and unsafe rider behaviors (15.8%). Policies related to walkability can be used as a basis to influence the behavior of urban communities in walking, to achieve the shared goal: a sustainable city.

Keywords
Walkability, Walkable City, Sustainable City, Policy, Bogor, Brisbane

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1. INTRODUCTION

Active transportation modes such as walking are vital in overcoming various urban problems, e.g., dependency on motor vehicles, congestion, air pollution, and health problems (Song et al., 2017). Pedestrians must be considered in urban planning. Technically, city roads must consider the need to support pedestrians, including people with disabilities (Sari et al., 2020). A successful sustainable city prioritizes humans by integrating the transportation system with urban planning and urban development (ITDP, 2014). One of which is implementing TOD (Transit Oriented Development). TOD is an urban development concept characterized by adequate accessibility, the presence of mix-used buildings near transit facilities, and is equipped with pedestrian facilities (Hasibuan et al., 2014a). TOD aims to reduce private vehicle ownership and use, improve the efficiency in riding and activities, create a comfortable, safe, joyful, and walkable green environment (Hasibuan et al., 2014b). One of the essential components in easily accessible urban planning is walkability (Singh et al., 2017).

Walkability study in a TOD area is very important because pedestrian pathway is a crucial component in the urban design of TOD area (Vale, 2015). Walking does not only reduce congestion and has a low environmental impact, but also has social and recreational values, and boosts mental and physical health (El-zemrany and Kandil, 2019). In addition, it becomes very important to conduct research related to walkability, considering the continuously increasing carbon emission, traffic and crowdedness, the lack of integrated and intermodal transportation system that resulted in decreasing health index (Hellberg et al., 2021; Reisi et al., 2019;). Therefore, walkability is increasingly valued due to these mentioned reasons (Southworth, 2005). Pedestrian pathway considered as an evidence of successful urban planning (Prima and Prayogi, 2020).

The importance of sustainable city is mentioned in the 11th Sustainable Development Goals (SDGs), that is, *"Make cities inclusive, safe, resilient and sustainable"* (United Nations, 2015). These matters can encourage urban communities to do more walking, cycling, and using public transportation as a routine. Walking and cycling are seen as important

components in an integrated intermodal transportation system to provide transportation options for tourists and to provide comfort, security and safety from home to destination (Southworth, 2005). Walking is often become the main mode of transportation from half of human journey in urban areas all over the world (Lo, 2009). Aside from the important roles in providing urban mobility, walking is still often being ignored in urban research and planning processes (Telega et al., 2021). The integrated transportation master plan in Jakarta notes that walking consists of 38% of trips, but walking is in the last option of 21 existing modes of transportation (Pacific Consultants International and ALMEC Corporation 2004). Urban planning that ignores pedestrian can cause a less efficient and less sustainable transportation system. Transportation system that only optimize motor vehicle, inadequate traffic movement, and an impassable built environment contributes to most traffic accidents. ITDP (2014) states that the safety level of pedestrian is still relatively low due to the lack of pedestrian infrastructure, so that causing 65% of the total traffic accident victims are pedestrians.

Research on walkability has been conducted a lot before. Walkability itself can be studied from several fields of science such as health concerning physical activity from walking (El-zemrany and Kandil, 2019; Isiagi et al., 2021; Rebecchi et al., 2019; Usón and Fernandez-Anez, 2020), behavioral studies (Battista and Manaugh, 2019; Cambra and Moura, 2020; Frank et al., 2005; Hatamzadeh et al., 2017; Lee and Dean, 2018; Prima and Prayogi, 2020), urban design (Meetiyagoda, 2018;Ortega et al., 2020; Ujang and Muslim, 2014), and transportation planning (Al-Thani and Furlan, 2020; Gonzalez-Urango et al., 2020; Middleton, 2021). In Indonesia, research on walkability has also been conducted in Surabaya, Jakarta, and Banjarmasin (Sari et al., 2020; Afkara and Kusuma, 2020; Tanan and Darmoyono, 2017). However, research on walkability is only generally conducted in metropolitan cities. This statement is supported by the research of Bartzokas-Tsiompras et al. (2020) which state that research on walkability has only been conducted in the city downtown and is still rare to be conducted in secondary downtown or satellite city. Therefore, this research attempts to fill the gaps in the literature concerning walkability study in secondary downtown and chooses Bogor City as the locus in this research, because Bogor City has a strategic location near to Capital city of Jakarta. Brisbane City and Bogor City have similar condition regarding (1) the topography characteristic, (2) car-oriented city development, and (3) suburban city. Brisbane City is crossed by the Brisbane River, the largest and longest river in South East Queensland, flowing down from Mount Stanley to Moreton Bay (Hung et al., 2016). Bogor City is located in the feet of Mount Salak and Mount Gede Pangrango, and crossed by two large rivers, namely Ciliwung and Cisadane River.

An article titled "Urban Walkability Profiles in Brisbane" written by Hellberg et al. (2021) discusses the walkability profiles in Brisbane, Australia, primarily on how the urban physical conditions affect social attitudes in walking. Brisbane is a compact and intuitively planned city; hence, it facilitates its population to mobile by walking, supported by means of transportation on land, water, and trains. The second article titled "The Pedestrians' Stories: Towards Walkable Cities in Indonesia" written by Tanan and Tungga (2021) elaborates the process of providing walkable pedestrian facilities in Indonesia, primarily regarding the implementation of policies and green programs in Banjarmasin and Bogor. This paper reviews the walkability condition and policies concerning pedestrian facilities in Brisbane, Australia and Bogor, Indonesia.

2. DATA AND METHODS

This review employed a case study, i.e., a qualitative descriptive approach, where data were analyzed and the results are arranged descriptively. The method used is a literature review with a comparative analysis, i.e., searching for similarities, differences, advantages, and disadvantages of the compared objects. The objects are urban policies in prioritizing humans to realize a walkable and sustainable city in Australia and Indonesia. The case study was conducted in Brisbane, Australia, and Bogor, Indonesia. These locations were selected due to their similar physical characteristics, i.e., an undulating and hilly topography (Hellberg et al., 2021 and Source: https://en-au.topographic-map.com/map-zz3b3/Brisbane/).

This analysis aimed to observe the policies that encourage a walkable city and the implementation. Data used in this review were walkability articles in Brisbane, Australia, and Bogor, Indonesia, and other supporting articles with studies in various locations. Walkability assessment in Australia employed walkability indicators and pedestrian analysis associated with age, gender, social status, education, traveling time (minutes), distance (kilometer), and transportation modes used to arrive at destinations. Meanwhile, the walkability assessment in Bogor used the Global Walkability Index (GWI), incorporating several physical factors and pedestrian facilities.

3. RESULTS AND DISCUSSION

3.1 Walkability Implementation in Brisbane, Australia

Brisbane, Australia, is the third most car-dependent city in Australia, with an average car traveling distance of 6,467 km per year per capita. The Brisbane population is estimated to grow from 1.9 million people in 2012 to 4 million in 2056, with a population density of 314 people/km^2 (Hellberg et al., 2021; Kirkpatrick et al., 2013). Brisbane's physical condition is relatively complex, with undulating topography with physical feature borders (Figure 1). Therefore, limiting urban expansion spaces. The average regional altitude of Brisbane is 48 m, with a maximum altitude of 422 m and a

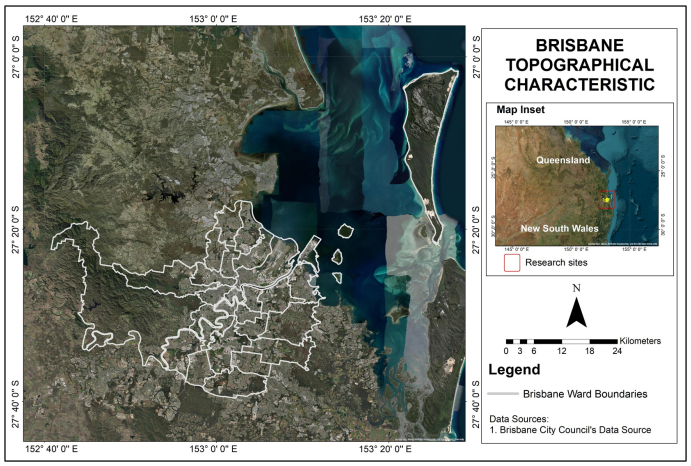

Figure 1. Topographical Characteristic of Brisbane
Source: Brisbane City Council's Data Source (2023)

Figure 2. Pedestrian Pathway Condition in Brisbane
Source: https://www.mustdobrisbane.com/outdoors/walks/city

minimum altitude of 0 m above sea level (Source: https://en-au.topographic-map.com/map-zz3b3/Brisbane/).

Physical conditions followed by the population growth projection demonstrate the importance of sustainable urban planning in Brisbane. High car dependency in Brisbane implicates the high obese level (O'Hare, 2006). The Australian government issued a strategic program of Supportive Environments for Active Living (SEAL) in 2001 to improve physical activities by walking.

In their study, Hellberg et al. (2021) compared primary transportation modes used by the Brisbane community (with respondent groups of workers and students) if they could only choose one mode. The results revealed that workers and students opted to walk (22%) and continue their journey by train (78%). The social desire to walk in Brisbane follows one of the urban planning objectives, i.e., a walkable city. The TOD-based urban design model implementation in Brisbane is considered able to handle urban challenges, such as massive private vehicle uses, air pollution, and other urban issues. Walkability implementation highly affects the proximity to business centers, proximity to bus and train transportation systems, population density, and land use (Figure 2) (López Baeza et al., 2021; Hellberg et al., 2021; Ortega et al., 2020). Areas with high pedestrian activities are mixed-used areas with equal distribution of residence and office functions, as found in Kelvin Grove, Bowen Hills, Fortitude Valley, Indooroopilly, St Lucia, and South Brisbane. A similar result was suggested in a walkability study in Madrid, where roads with the highest walkability value were discovered in areas with commercial activities, cultural activities, town squares, and areas with excellent public transportation coverage, e.g., subway trains and buses (Ortega et al., 2020).

Previously, TOD and walkability concepts were debated through their challenging implementation to be actualized and the benefits to improve urban life quality. However, it is evident that such concepts can reduce car dependency and traffic accidents (O'Hare, 2006; Mccrea and Walters, 2012). Brisbane people who did not own private vehicles or users of public transportation before TOD policy implementation in 2005 was 8% and increased in 2008 to 15% (Yang and Pojani, 2017). This increase shows the government commitment to implementing sustainable urban development.

Concerns on urban sustainability have continued to increase in the last few decades since urban walkability has been planned, and walking is acknowledged as a crucial urban transportation mode (Southworth, 2005). Walkability review from an article titled "Urban Walkability Profiles in Brisbane" written by Hellberg et al. (2021) revealed that indicators determining Brisbane community behavior to walk are distance to destination (59%), traveling time (14%), hot weather (19%), roads with various altitudes (4%), lack of paths (3%), and lack of green areas (1%). The data show social perspective in walking in Brisbane. From the data, people do not consider safety as an issue in walking, as reviewed in other studies (Lo, 2009; Meetiyagoda, 2018; Rebecchi et al., 2019). ITDP (2014) asserted that pedestrian safety level is relatively low due to the minimal pedestrian facilities, causing 65% of total traffic accidents to be pedestrians.

3.2 Walkability Implementation in Bogor, Indonesia

In 2011, the Indonesian government issued the Green City Program to implement Law No. 26 of 2007 concerning Spatial Planning. The Green City Development Program (P2KH) is the responsibility of the Ministry of Public Works and Public Housing (PUPR), aiming to realize environmentally friendly cities related to eight attributes presented in Table 1 (Direktorat Jenderal Cipta Karya Kementerian PUPR, 2016). This program supports sustainable developments considering economic, social, and ecological aspects

Table 1. Green City Attributes from P2KH in Indonesia

Attribute	Description
Green planning and design	City and region planning that focuses on the capacity to manage resources efficiently and balancing nature and built environment
Green open space	Green open space that provides safety, comfort, and aesthetic quality for urban and regional area
Green community	Communities concerning environmental and socio-cultural issues
Green waste	Management of 3R (reuse, reduce, recycle) by government, private sector, and community
Green energy	Renewable energy that balancing development in city or region
Green transportation	Transportation system that causes environment externality
Green building	Sustainable building design and construction
Green water	Water management: water absorption management and reduce peak of runoff for natural resources

Source: Direktorat Jenderal Cipta Karya Kementerian PUPR, 2016

(Tanan and Darmoyono, 2017). For the ecological aspect, Green City development must boost pedestrian facility integrity with open spaces with a 30% percentage. Pedestrian facilities should open opportunities to harmonize physical and economic developments and provide spaces for urban social interactions.

One of the priorities of Bogor City in RPJMD 2019-2024 is development growth and equity following the environmental capacity by considering safe, effective, efficient, and environmentally friendly population mobilization (RPJMD Kota Bogor 2019-2024). One of the methods is improving pedestrian facility quality in Bogor. This issue follows the green transportation point mentioned in P2KH, i.e., realizing green transportation by connecting non-motor vehicles and walking activities (Tanan and Tungga, 2021). Indonesia ranks the lowest in walking activities with average steps of 3,513, lower than Malaysia and the Philippines (Althoff et al., 2017). Urban people in Indonesia is generally put walking as a secondary transportation mode (Althoff et al., 2017; Tanan and Tungga, 2021). Becoming a walkable city is a challenge for most cities, especially in Indonesia, that must be solved by improving pedestrian quality.

The cause of the low average step count in Indonesia is insufficient pedestrian facilities. The pedestrian facility quality at Sudirman Road of Bogor City (Figure 3(b)) is divided into three clusters, i.e., (1) surrounding the Istana Bogor with the best walkability condition, (2) the calm and comfortable open green space, and (3) commercial areas with the poorest walkability condition since most pedestrians are used for parking vehicles (Tanan and Tungga, 2021). In general, pedestrian facilities at Sudirman Road of Bogor City are poor for people with special needs, elderlies, children, and pregnant women (16.5% of respondents). Also, Bogor people perceived no safe crossing facilities (19.8% of respondents) and unsafe rider behaviors (15.8% of respondents).

3.3 Walkability Comparison of Brisbane and Bogor

Pedestrian facility provision is a part of traffic policy solutions at many government levels, i.e., province, regency, city, and the local community. Brisbane, Australia, generally has similar physical conditions to Bogor, i.e., an undulating and hilly topography with car-based spatial planning, both in the central and suburb areas.

This section will discuss issues related to and can be applied as environmental policies from the study comparison of Australia and Indonesia. In implementing a review, it is necessary to consider the review similarities, differences, and limitations as the policy development model in other regions. The following are the review advantages:

a) From the cost aspect, walkable pedestrian infrastructure construction requires enormous construction and maintenance costs to continue improving pedestrian interest to walk. However, the environmental function and esthetics are better.

b) Walkability is acknowledged as an essential element to achieving a sustainable city contributing to a resilient community.

The limitations in walkability implementation are as follow:

a) Urban activities that tend to concentrate in the central area are leading to insufficient pedestrian facilities. Pedestrian facility development should be prioritized in activity centers in the central area and in other areas. Some literature mentions that the pedestrian path quality in the suburbs is lower than in the central area, measured by the walkability index (Hooi and Pojani, 2020; Wang et al., 2016).

b) The study area topography with an undulating and hilly is a challenge to implement the walkability concept.

From the observation on walkability planning in Australia and Indonesia, many measures must be performed in improving pedestrian facility conditions. Increased threats from climate change should encourage artificial environmental function improvement to minimize carbon emissions from

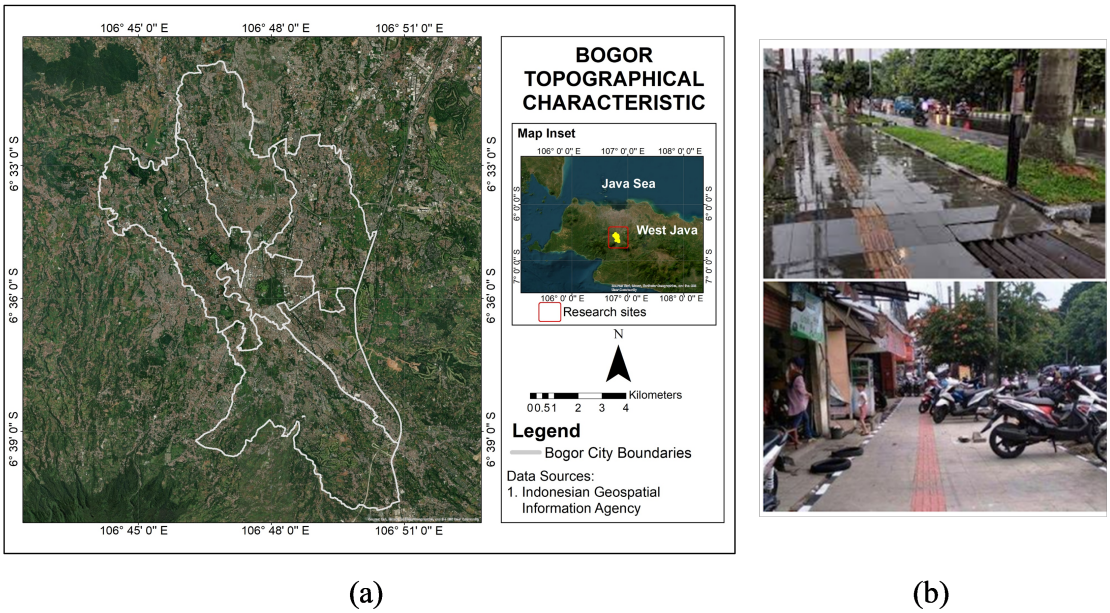

Figure 3. Topography Map of Bogor City (a) and Pedestrian Facility at Sudirman Road (b)
Sources: Indonesian Geospatial Information Agency 2019 and https://www.radarbogor.id/2021/11/07/

motor vehicles.

4. CONCLUSIONS

Urban planning with the walkability concept can be used to improve the social desire to walk. The walkability concept implemented in Brisbane demonstrates the effectiveness of urban problems, such as dependency on motor vehicles, congestion, air pollution, and health problems. Bogor City has repaired the pedestrian facilities; however, Bogor people remain to put walking as a secondary transportation mode due to their high dependency on motor vehicles. Improvements in walkability and walking activities will develop an area economically and socially; therefore, producing long-term significant positive impacts. Plans and policies on pedestrians should prioritize pedestrians. The government must realize a livable, productive, and sustainable city following Law No. 26 of 2007 on Spatial Planning. Policies regarding walkability can be used as a fundamental affecting urban people's behavior to walk to achieve the shared goal, i.e., sustainable city. Becoming a sustainable and walkable city is a challenge for most cities, particularly in Indonesia, that must be solved by repairing and improving policies on walking.

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