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Living in a hot city: thermal justice through green open space provision

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Jakarta's environmental problems, the increasing temperature, and the intensifying urban heat island effect (UHIE) add weight to the deteriorating quality of life in the city. Nevertheless, chronic exposure to heat, especially experienced by inhabitants in tropical cities, receives less attention. It is often seen as a low-onset event that requires no immediate action and is not as noticeable and apparent as other heat events, such as heat waves. This slow onset environmental hazard disproportionately affects the population in the lower socio-economic condition. With their low access to cooling infrastructure, the disadvantaged people of Jakarta live and work in an environment prone to extreme heat exposure. Poor urban planning and design contribute to the intensifying urban heat in Jakarta and exacerbate the impacts of heat by providing mitigating and managing urban heat in the city. Using the Multiple Stream Framework (MSF) lenses, we analyse how and why the issue of urban heat is currently being prioritized in Jakarta and how the provision of green open space contributes to thermal justice in Jakarta. The issue is examined by analyzing urban planning policy through government strategy documents and interviews with key stakeholders. The findings reveal that while there is a growing awareness of urban heat issues in Jakarta, they are often overshadowed by other strategic issues in the policy arena. The research underscores the significance of incorporating urban heat issues into urban policy agendas and promoting equitable distribution of green open space in Jakarta.

KEYWORDS

urban heat, Jakarta, green open space (GOS), Multiple Stream Framework, thermal justice

1. Introduction

Urban heat has become a widely discussed topic in recent years. Studies on 39 global cities from 1961 to 2010 suggest an average temperature increase of around 0.12–0.45°C per decade (Alcoforado, 2006; Rosenzweig et al., 2015). Open spaces can increase thermal comfort in the cities, into housing, industrial and transport use, emitting additional heat into the atmosphere (Sharmin et al., 2015; Lee et al., 2017). Moreover, the climate-change-associated heating of the cities is intensified by the Urban Heat Island Effect (UHIE) (Fong et al., 2020), a phenomenon where the urban or metropolitan area has higher temperatures compared to the surrounding suburban or rural areas. The temperature difference is caused by the heat being unable to be reflected in the atmosphere and, instead, being retained in the built environment during the day before the heat is released back to the atmosphere during night-time. Heat and pollution are trapped within the narrow streets of tall buildings (Pakarnseree et al., 2018). Densely built-up areas have high thermal inertia or the degree to which the materials of the building release back the heat that it absorbs during the day (Pandey et al., 2014). Poor city planning contributes to the intensifying urban heat, especially

from the additional heat exposure from UHIE (Sari, 2021). The intensive development of anthropogenic activity and city urban expansion exacerbates this effect. Built area, especially those that are made from concrete, asphalt and other impervious material that has poor thermal behavior, absorbs the heat emitted by daily solar radiation, industrial activities, vehicle use and other source of anthropogenic heat (Sharmin et al., 2015; Lee et al., 2017).

The increasing temperature in the cities is a disaster imminent to the quality of life of urban citizens. With cities becoming hotter, the potential impacts comprise reduced thermal comfort (Mohan et al., 2020) that can lead to disturbed rest and sleep (Bajani and Das, 2020), acute and chronic health impairments (Méndez-Lázaro et al., 2018; Khare et al., 2021), reduced productivity (Oppermann et al., 2021), increased energy expenditure due to the dependence on mechanical cooling devices (Arifwidodo and Chandrasiri, 2015; Takkanon, 2017), and worsened environmental problems, such as air pollution and flooding (Syamsudin and Lestari, 2017; O'Lenick et al., 2019). Cities in tropical climates experienced the worst impact of the increasing urban temperature, especially during the dry season. With lower total rainfall during the dry season, the intensity of the UHIE can reach up to 6°C (Amorim and Dubreuil, 2017). Lee et al. (2017) explained that urban inhabitants in tropical climates endure higher UHIE intensity as the exposure is all year long and since the average temperature and higher humidity limit man's physiological ability to evaporate or sweat and lower the human thermoregulation capacities.

In a study in Kuala Lumpur, urban citizens are exposed to "slight heat stress" constantly throughout the year, and over time may cause serious problems (Fong et al., 2020). Although tropical citizens develop physical adaptations to heat that increase tolerance for hot environments (Magalhães et al., 2010), high acclimatization does not reduce the risk of heat-related illness (Heidari et al., 2020). One cannot rely on personal heat acclimatization to adapt to the city's continuous increase and intensity of heat. Heidari et al. (2020) note that despite our physiology achieving complete adaptation in a week or two, heat acclimatization is temporary and can gradually disappear if not maintained by continuous heat exposure or a sedentary lifestyle. Therefore, the potentially disastrous impact highlights the importance of sufficient urban heat mitigation and adaptation in tropical cities.

The impacts of urban heat are often distributed unequally, coined as thermal injustice in this study. Studies have shown that income tends to negatively correlate with heat stress prevalence (Mitchell and Chakraborty, 2015; Jagarnath et al., 2020), a manifestation of what Mitchell and Chakraborty (2015) called the "climate gap." In the USA, for example, the poorest 10% of neighborhoods in urban regions experience 2.2°C temperatures higher than the wealthiest 10% in the same region (Dialesandro et al., 2021). Low-income neighborhoods have inadequate adaptive capacity and physical and social resources to mitigate the effect of heat exposure (Heaviside et al., 2017; Voelkel et al., 2018). They commonly lack access to cooling infrastructure (Mabon and Shih, 2019), which includes public cooling facilities, residential air conditioning, and green open space or vegetation (Voelkel et al., 2018; Dialesandro et al., 2021). Low-income households tend to lack assets and access to electricity, which makes cooling devices such as fans and air-conditioners unaffordable (Mitchell et al., 2021). In addition, the residents in poor neighborhoods often live in inadequate housing situations, sometimes constructed illegally, and lack access to canopy cover for shade, and green open space may be the most severely affected by heat (Reckien et al., 2018; Pereira et al., 2021; Saverino et al., 2021). This population also tends to have low-skilled jobs or informal work with substandard social and physical protection, including from chronic exposure to extreme heat (Oppermann et al., 2021).

Using the lens of the Multiple Stream Framework and Jakarta as a case study, this paper aims to understand to what extent the urban heat and thermal justice issues are tackled in a tropical city. Although we acknowledge the role of vehicle exhausts (Darmanto et al., 2019; Pörtner et al., 2022) and air conditioning (Arifwidodo and Chandrasiri, 2015) in intensifying urban heat, green infrastructure is selected as a primary adaptation strategy in dissecting thermal justice in Jakarta. Green infrastructure, such as green open space, urban parks, urban forests, green corridors, green roofs, green walls, etc., has a significant role in cooling the urban environment and directly improving thermal comfort (Xu et al., 2022). Low-income neighborhoods would greatly benefit from green open space provision in their area due to their limited capacity for individual or household cooling. Hence, promoting equal distribution of green infrastructure would be an adoptable nature-based solution to mitigate urban heat and improve thermal justice.

However, urban planning, including the decision of location and design of green open space, is often inequitable (Mabon and Shih, 2018; Sari et al., 2020). Studies show that disadvantaged communities suffer due to green gentrification, displacement and forced eviction (Wolch et al., 2014; Meilasari-Sugiana et al., 2018; Rigolon and Németh, 2018; Colven, 2019). Thus, this study highlights green infrastructure, specifically green open space, as a proxy for thermal justice among Jakarta's citizens (Hoover et al., 2021).

While the role of green open space in mitigating urban heat is known (Myeong, 2010; Chapman et al., 2017; Rushayati et al., 2018; Aboelata and Sodoudi, 2019; Sari, 2021), studies commonly focus on acute heat events, such as heatwaves. This research contributes to the literature on thermal justice in chronic heat with unique risk characteristics. In this ' hidden disaster', people may consider heat a daily phenomenon and thus be relatively unprepared to mitigate its impact (Oppermann et al., 2017). Moreover, to our knowledge, studies applying the Multiple Stream Framework (MSF) to dissect agenda setting specifically on urban heat issue is limited. MSF also helps examine the role of a range of factors, such as the problem, the policies, and the political condition (known as the three streams in MSF), that contribute to the materialization of a specific issue (Setijaningrum and Rahardian, 2022). Thus, the lens of MSF can help analyse how and why urban heat is currently being prioritized in Jakarta and how the provision of green open space contributes to thermal justice in Jakarta.

2. Literature review

2.1. Urban heat, green infrastructure, and thermal justice

Mabon and Shih (2019) highlight the importance of better city-level urban heat mitigation, as the lack of action toward this can result in greater exposure to extreme heat, especially

for marginalized groups. However, in the current condition of developing Jakarta, the pressure in the conversion of land use for economic development significantly exacerbates urban temperature and increased heat stress events (Li et al., 2020). Abundant studies show how land use change in Jakarta is a significant factor that contributes to the increase in urban temperature (Lestari et al., 2015; Prasasti et al., 2015; Raya and Hasibuan, 2020; Putra et al., 2021). There is an urgent need to limit the expansion of urban development areas that usually sacrifice the agricultural and green areas (Khamchiangta and Dhakal, 2020). The depleting green open space due to land use change suggests that policy and strategy of increasing urban parks, gardens and other green open spaces are crucial in mitigating the city's intensifying urban heat.

Green Open Space and vegetation are effective tools to cool urban areas due to their evapotranspiration capacity (Chapman et al., 2017). The air temperature in a built-up area surrounded by vegetation can have a 2.4°C lower temperature than its surroundings (Rushayati et al., 2018). Tree coverage of 50% in an area is the most effective way to cool the area significantly, and the cooling effect of a park or other green open space can be experienced to a range of 360 m (Myeong, 2010; Aboelata and Sodoudi, 2019). Vegetation also provides shading to the area below the trees (Sari, 2021), giving people physical protection from the heat and making it pleasant to do activities under the shade. The shades in green open space also increase the thermal acceptable period for urban inhabitants doing activities outdoors (Heidari et al., 2020). Sharma et al. (2016) suggests that even if a green initiative such as a green roof or green wall can only slightly improve surrounding temperature when implemented widely throughout the city, the potential benefits are massive (Lehmann, 2014; Sharma et al., 2016). In Bangkok, the depleting green open space due to increased built-up areas has increased the Urban Heat Island Effect intensity from 11.91°C in 1991 to 16.21°C in 2016 (Khamchiangta and Dhakal, 2020). Following the rising temperature of Bangkok, Arifwidodo and Chandrasiri (2015) noted an increase in air conditioner (AC) uses, especially in a residential area, with electricity bill rises at the household level due to the high use of AC, putting additional pressure on the energy system.

Studies on other hot-humid Asian cities suggest that green open space distribution in the city may suggest inequality of urban planning in providing relief for climate-related disasters, including intensifying urban heat. Poor access to green open spaces is often experienced by neighborhoods with higher ethnic minorities and households with low socioeconomic status (Richardson et al., 2010; Dai, 2011). In Mumbai, 1.7% of the urban land area consists of urban parks, and the urban parks are even more sparse and smaller in the city center, which typically has a higher population density (Hwang et al., 2020). Zhang et al. (2021) found the challenge of distributional justice in urban parks in Hong Kong, where areas with predominantly ethnic minorities have more limited access to urban parks with active facilities and supporting amenities. Another study in Hong Kong also found that socially vulnerable groups have higher heat vulnerability due to the area's insufficient parks or other greening initiatives (Mallick and Yang, 2015).

In Shanghai, equitable access to green open space is observed between foreign and Chinese citizens and between the blue-collar and white-collar dominant population (Wang et al., 2021). While in Taipei, Mabon (2020) found there is a challenge in delivering equitable green open space due to land conflict where the Government prioritizes urban growth over green open space protection. The pattern of unjust distribution of green open space resulted in a higher risk of heat stress for vulnerable communities, such as in Bangkok, where Arifwidodo and Chandrasiri (2020) reported that the socioeconomic condition and urban environment were the significant factors that determine urban heat stress that eventually affect the wellbeing of the urban inhabitants. Marks and Connell (2023) argue that the increased vulnerability to urban heat also came from how the urban heat mitigation in Bangkok urban area lacks the approach of environmental justice lens, which caused the lack of justice in the environmental quality of Bangkok, where the low-income communities hardly contribute to this problem, yet are the most vulnerable.

This study focuses on the distributive justice of green open space in Jakarta. Distributive justice ensures equality in allocating environmental advantages and risks (Corburn, 2017). In this context, allocating green open space in Jakarta alleviates urban heat's impact (Suharko, 2020). Green open space can cool down and regulate the microclimate of a neighborhood, lowering the need for more costly cooling tools such as fans or air conditioners (Arifwidodo and Chandrasiri, 2015). Thus, the distributive justice of green open space becomes critical in mitigating urban heat for Jakarta's most socio-economically disadvantaged neighborhoods (Mabon and Shih, 2018). With the Government setting the target of 30% of green open space provision in Jakarta, it is crucial to see whether this goal includes distributive justice awareness, ensuring everyone equal access to green open space as cooling infrastructure, thus achieving thermal justice.

2.2. Theoretical framework: multiple stream framework

The Multiple Streams Framework (MSF) was first introduced by Kingdon and Stano (1984) to explain how an issue becomes an issue in the first place (Hoefer, 2022). According to Kingdon, in agenda setting, there are three separate streams: problem, policy and politics:

- The Problem Stream: An issue can only be recognized as an important political agenda when the government comprehends it as a "real" problem crucial to be solved (Liname, 2022). Sufficient understanding and awareness of the issue are imperative for the public to perceive the issue as urgent. Thus, a problem can only be recognized when it attracts the concern and attention of policymakers and the public (Schmieder et al., 2021).
- The Policy Stream: As part of solving the issue, the government must implement a set of policies, strategies, and programs. Here, experts, academics, and practitioners are critical in identifying, assessing, and selecting feasible solutions to the problems (Farley et al., 2007; Béland and Howlett, 2016).
- The Politics Stream: This stream explains the political condition of the city that predisposes the adoption of the issue

(Clement and Crutzen, 2021). It describes how a particular problem goes through the formal process of policymaking and legislative decision-making (Schmieder et al., 2021); for example, through the executive or legislative turnover, a swing in the national "mood" that favors the issue, a campaign by interest groups or public protest of the issue that put the government under pressure to take action. Moreover, natural disasters or socio-economic turmoil can also accelerate the opening of policy windows that encourage the adoption of the political agenda (Mockrin et al., 2018).

These three streams need to come together at a critical time (Hoefer, 2022). An idea is adopted when it reaches the "state of readiness" when the issue is aligned with the shifting context and public expectation (Dudley, 2013). Agenda adoption occurs during an opening of the policy window—the moment the three streams aggregate (Howlett, 2019). The policy window can be limited to a noticeably brief period, mainly depending on the appropriate political conditions, as the Politics Stream suggested (Béland and Howlett, 2016; Clement and Crutzen, 2021; Liname, 2022). When a problem is coupled with a solution and faces a supportive political climate, the agenda can be pushed forward for further assessment and implementation (Ebrey et al., 2020). Thus, the development of the policy is not a spontaneous or automatic response to a problem but surfaces due to a complex and contingent process of the three streams.

We selected MSF because this framework has been widely used to describe why governments pay (or do not pay) attention to a particular issue or political agenda and act (or do not act) toward it (Kingdon, 1994). MSF is useful to explain how specific issues come to fruition when various problems compete for attention (Jones et al., 2016). As political discussion regarding heat is limited in Jakarta, MSF would be able to help us understand why. This approach also helps to understand a decision-making process that is neither comprehensively rational nor linear (Cairney and Jones, 2016). Dudley (2013) argues that MSF is beneficial to recognize whether a specific issue has reached a state of- readiness for the convergence of the three streams; when an issue is identified as a problem (Problem Stream), a feasible and well-developed policy proposal of solution is available (Policy Stream) and the political context or climate is conducive or supportive for the adoption of the proposed policy (Politics Stream).

Another primary advantage of MSF is its ability to interpret the ambiguous conditions of policy making where there is abundant information, with a diverse interpretation of problems and solutions at one time, which creates the competition for multitudes of problems in the prioritization of development (Jones et al., 2016; Suprayoga et al., 2020).

MSF is a well-known policy analysis framework widely used to understand how issues are included or eliminated from the policy agenda and how actions are chosen over others. It is a well-respected approach to analyzing the policy-making process in various sectors and countries (Hoefer, 2022). Compared to other frameworks, such as the Institutional-process Approach and Policy Feedback Effect (Bloomfield and Schleifer, 2017; Smith, 2020), MSF offers a holistic perspective that helps understand how varied factors affect policymaking (explained by the three streams), making it ideal for examining multifaceted issues like urban heat and thermal justice.

Moreover, this study also recognizes the role of policy entrepreneurs -individuals or groups who push an issue or a political agenda forward. They cultivate their resources and network into the issue they bring in hopes of developing a specific policy (Harlow et al., 2018). The policy entrepreneurs may come internally from government agencies, academics, private institutions, non-government organizations, etc. The policy entrepreneur is essential in joining the three streams by linking the problem and the solutions or policy stream and bringing the issue to the right political opportunities (Cairney, 2018).

3. Case study: chronic heat exposure in Jakarta and the urban poor

Jakarta serves not only as Indonesia's largest city but also as the nation's central government. With an area of 653 km^2, The Jakarta Metropolitan Area accommodates over 12 million population with an average population density of 16.000 people per km^2 (Putra et al., 2021). Jakarta faces multiple threats to liveability due to its geographic and socio-economic context. Being the nation's capital city and economic hub makes the city a magnet for migrant workers, attracting a high volume of urbanization of people from all around the country. The expanding population pressures the demand for housing, transport, other social infrastructure, and other facilities to support their livelihood in the city (Martinez and Masron, 2020). The pressure in the conversion of land use for economic development significantly exacerbates urban temperature and increased heat stress events (Li et al., 2020).

Studies show how land use change in Jakarta significantly contributes to the increase in urban temperature (Li et al., 2020). In Jakarta, urban built-up area increased by 35% between 1989 and 2013 (Widyasamratri et al., 2019). In addition, there is a decrease of almost 7% of vegetation area and 16% of other green open space. Lestari et al. (2015) found that industrial activity also contributes to the depleting green open space, an expansion of 440 Ha of industrial areas recorded in Jakarta between 1997 and 2012. Putra et al. (2021) recorded that the hotter spots in Jakarta could reach up to 34°C, especially in the western part of the city. Raya and Hasibuan (2020) documented that 92% of Jakarta's area has a Land Surface Temperature of 30°C, while Rushayati et al. (2018) recorded that 52% of Jakarta's urban area are typically 36°C in temperature. In addition, industrial activity, recorded by Lestari et al. (2015) showed an increase of up to 5.1°C in the area. Suppose no mitigation or heat management takes place in Jakarta. In that case, it is projected that within 100 years, Jakarta may experience 2.5°C increase in temperature which threatens the quality of life of its inhabitants.

This environmental hazard disproportionately affects the marginalized populations of Jakarta. 60–70% of Jakarta urban poor live in informal settlements that lack access to public amenities and services (Meilasari-Sugiana et al., 2018; Colven, 2019). The quality of built-up areas in informal settlements tends to be denser in space and population, built to poor standards and with materials with higher heat or thermal retention (Wonorahardjo et al., 2020). Densely populated settlements also tend to lack green open space and tree shade, exacerbating the effects of UHIE (Van Der Hoeven and Wandl, 2015; Amorim, 2020). As many as 880 out of 1,694 areas (51.95%) have limited access to green open

space in Jakarta, classified as high-density areas (Indriyani and Widaningrum, 2021). Sari et al. (2020) found that only 27 of 65 (41.54%) urban communities have the minimum green open space availability standard. In Jakarta, the central area with the highest population density has smaller and more sparse green open space (Hwang et al., 2020). The same study also noted that even though there are more prominent and denser patches of green open space in the outskirts of Jakarta, these green open spaces are unmanaged, usually physically inaccessible, and underutilized. The green open spaces in the outer skirt of Jakarta are usually unprotected as it is seen as future land pockets for development (Kusno, 2011). Kusno (2011) noted that green open space provision tends to accrue in more affluent neighborhoods in the Jakarta Metropolitan Area, as the reclamation of green open space often led by private sector developers, repeatedly resulting in the eviction of urban poor or slum areas. This is an unfortunate reality, considering that access to green open space or other green infrastructure significantly lowers densely populated neighborhoods and improves the thermal quality, according to a study in five Jakarta's municipalities that implemented *Gang Hijau Program* or Greening Alleyway Program (Anggrahita et al., 2020).

Climate change has been put high as one of Indonesia's pressing environmental challenges (Triyanti et al., 2023). Following the fall of President Suharto's authoritarian regime in 1998, Indonesia has transitioned from a centralized to a more decentralized and democratic system, including in environmental governance. Although the central government's involvement remains critical, Indonesia's decentralization system has given subnational governments more leeway in directing development in their respective territories. This issue of climate change becomes more crucial in Jakarta as the central government does not pay special attention to the role of cities and the urban sector in climate mitigation (Resosudarmo et al., 2013; Gouldson et al., 2016). Given its special autonomy arrangements, the province of Jakarta wields a single autonomy, unlike other regions where greater autonomy lies at the municipal (kota and kabupaten) level. As a result, it is envisaged that under the country's emerging governance system, environmental, including climate, issues will be of great interest to and thus addressed by subnational governments or Jakarta's provincial government.

Jakarta has exhibited climate commitment since the late 2000's, parallel to the central government's, mainly when Indonesia hosted the thirteenth session of the Conference of the Parties (COP-13) in 2007. After joining C40—a global network of mayors of the world's leading cities—in 2007, Jakarta announced its GHG emission reduction target of 30% by 2030 at COP-15. Jakarta is also considered a pioneering province in the climate agenda, having been among the first to adopt a Regional Action Plan on GHG Emission Reduction (RAD-GRK). Climate change is also addressed in the city's two primary planning documents: Jakarta Spatial Plan (RTRW) 2010–2030 and Jakarta Long-term Development Plan (RPJPD) 2005–2025. However, despite covering a diverse range of areas, climate change has long been regarded as a responsibility of one division of the Jakarta Provincial Government, namely the Provincial Environmental Agency, which has hampered the city's climate agenda from being implemented optimally (Anggraini et al., 2011). When Jakarta's Climate Disaster Mitigation and Adaptation Team was founded in 2020, the problem of sectoral silos was partially solved. However, it remains to be seen how this task force has coped with sectoral silos and addressed different climate areas pertinent to Jakarta. Multiple factors may influence the efficacy of such a task force and the implementation climate agenda more generally in Indonesia's decentralization system. Some have observed that the urban climate agenda might shift frequently in response to the electoral cycle (Lederer et al., 2020, p. 111-113). Others have noted that many cities in the Global South lack the institutional, financial, and technical capacity to shift their development trajectory toward a more sustainable course (Gouldson et al., 2016).

TABLE 1 Interview participants.

Classification of respondents	Actors
Government actors	Environmental protection agency, spatial planning and public works agency, transportation agency, regional planning agency, former jakarta resilience city *ad hoc* program
Practicing experts	TGUPP (an expert team appointed by the governor), Indonesia's Urban Planning Association, urban planning consultant
Academics	Landscape architects, researchers
Non-governmental organizations and urban activists	WRI (World Resource Institute), ICLEI (International Council for Local Environment Initiatives), Climate Hub
Urban citizens	Jakarta's citizens

4. Methods

This paper dissects Jakarta's urban heat and thermal justice issues. Jakarta was selected as a case study because of the Urban Heat Island Effect (UHIE) intensity it has been experiencing, its climate vulnerability, diverse urban landscape, rapid urbanization, and the existing social inequities. Studies have shown how the changing land use with trends in depleting green open space, contributed to the increase in urban temperature and further intensify the Urban Heat Island Effect in Jakarta (Lestari et al., 2015; Prasasti et al., 2015; Raya and Hasibuan, 2020; Putra et al., 2021). These existing studies also emphasize the importance of green open space in mitigating the increase in urban temperature. However, these previous studies do not discuss how the green open space were distributed or touch on the environmental justice aspect of green open space as cooling infrastructure. Thus, the discussion on thermal justice in Jakarta is still limited. The results will also be valuable as a reflection of other tropical cities in LMICs that experience heat all year round. We operationalised the notion of thermal justice as inequities in the distribution of green infrastructure, including urban parks, trees, green corridors, urban forests, and other types of green open space. The themes are shown in Table 1.

Between April and May 2022, 30 Jakarta's stakeholders related to the urban heat and green infrastructure issues were interviewed to gain multiple perspectives on the discourse of urban heat and thermal justice issues in Jakarta's urban agenda. The participants included government actors, an expert team appointed by the governor, non-governmental organizations and urban activists, and academicians (see Table 1). Some participants were interviewed

TABLE 2 Identified themes in the qualitative analysis.

Themes	Description
Problem stream	
Issue awareness	Understanding, perception, and the sense of urgency of urban heat and thermal justice issues (including its impact and mitigation strategies)
Competing issue	The competition of urban heat and thermal justice issues with other strategic issues in the policy arena (for example: flood, solid waste, etc.)
Intersecting issue	Urban heat and thermal justice issues are part of or related to other issues (e.g., climate change mitigation, quality of life)
Framing	The angle of looking at urban heat and thermal justice issues
Policy stream	
Policy entrepreneur	The presence (or absence) of actors pushing the urban heat and thermal justice issues into the policy arena
Agenda setting	The process by which issues or problems move from being relatively unnoticed or low-priority to being included on the public or policy agenda for consideration and action by decision-makers.
Policy implementation	The level of and challenges of policy implementation
Politics stream	
Governor's tenure	The effect of the 5-year tenure of the political leader toward policy sustainability
Political commitment	The presence (or absence) of political commitment in regards of urban heat and thermal justice issues

based on the recommendations of the participants previously interviewed. The interview question topics are presented in the Appendix 1. While the full list of interview participants code along with their roles and affiliated institution are presented in Appendix 3.

The interviews were recorded and transcribed. The transcripts were assessed using nine themes built upon the Multiple Stream Framework (see Table 2). To triangulate the interview results, we conducted a qualitative document analysis (QDA) to systematically analyse the policy documents related to urban heat and green infrastructure (Bowen, 2009). The list of policy documents from the public domain is shown in Appendix 2, including provincial regulations and official planning documents. Similar themes developed from the interview and emerging themes during the QDA were used to guide the analysis (see Table 2). The study was conducted using QDA Miner Lite® software.

5. Result: Jakarta's urban heat issue and thermal justice in the lens of MSF

5.1. Jakarta urban heat and thermal justice in the problem stream

The general awareness of the government and the public on urban heat in Jakarta is low. People living in Jakarta have low perceptions of the threat of urban heat. High temperatures in Jakarta are seen as part of the everyday living conditions: *"Well, in tropical countries like Indonesia, heat is not a problem (seen as a normal part of life), we have yet to see serious impact or effect."* (Government Actor, Spatial Planning and Public Works, Agency, 8). A Jakarta citizen argues that heat is just part of Jakarta's life, *"Well, it is common to feel hot in Jakarta. We get used to it; it is part of our daily living in Jakarta (with hot climate). It is what it is; I do not think we should complain. There is not much we can do anyway."* (Urban Citizen, 34). Another citizen also assumes that heat is just a natural state of Jakarta's environment that cannot be changed, "*Of course, it is ideal if Jakarta is not as hot as this, but what can we say, it is the natural condition of Jakarta (being in a hot climatic area). We cannot change nature, right? It is the given condition (from God), out of our (as human) control* (Urban Citizen, 35)." A higher degree of heat acclimatization significantly contributes to the lack of understanding and awareness of the risk of chronic exposure to heat. A participant suggested that *"Indonesian people, as inhabitants in a tropical climate, do have a higher tolerance to heat. We are acclimatized to the higher temperature. Most of us can still feel comfortable at 32°C."* (Academics in Building Technology, 29).

Furthermore, they tend to underestimate the health impact of heat. The statement of participants indicates this, for example: "*There is no real threat that we can see of urban heat…"* (Government Actors, Environmental Protection Agency, 25), or *"I do not think the heat exposure is a big deal. It is not pleasant; it is uncomfortable being this hot (in Jakarta), but there are still things I can do to minimize the damage, such as wearing sunblock."* (Urban Citizen, 33). One participant compared the threat posed by urban heat to other disaster events, such as floods: *"Flood for example has direct economic impact that is why it perceived as a more urgent and important (compared to urban heat)."* (Practicing Experts, Indonesia's Urban Planning Association, 15).

Through the interview of various Jakarta city stakeholders, the urban heat issue in Jakarta has yet to become urgent in its urban planning. One participant mentioned, *"I would say the perception of the issue is low; there is limited awareness of the urban heat problems, thus we cannot find direct or explicit programs related to urban heat in the planning documents or our regulations"* (Government Actors, Transportation Agency, 11). The main explanation for this is that urban heat related to climate change is considered as a slow-onset event: *"...urban heat, I would say that it is still a minor issue in Jakarta. As climate change is a slow onset change, so it is not clear how we can initially act."* (Academics, Population Researcher, 21). The increasing temperature and intensifying UHIE is recognized as a risk and threat to the quality of life in the distant future that does not require immediate action. Another cause is that with all the competing issues in the metropolitan area, the concern of increasing intensity of urban heat in Jakarta is not included in the critical strategic issues. One participant stated the increasing temperature and intensifying UHIE is recognized as a risk and threat to the quality of life in the distant future that does not require immediate action. *"It has yet to be a mainstream discourse, the issue of urban heat. It is not being prioritized as there are not any major impact. It is a minor issue compared to other environmental damage that Jakarta is experiencing, such as flooding for example."* (Government Actors, Jakarta Resiliency Program, 27).

This suggests that more imminent and visible disasters, such as flooding, take center stage.

Government officials indicate that thermal comfort is part of the city's measure of its quality of life, which is an important concern for the government. The thermal comfort issues have also been explicitly stated in the policy documents. Governor Regulation 24/2021 on Management and Protection of Trees said, "*Ecological benefit of trees include pollutant absorbers to clean the air from particles that pollute the air; temperature and humidity control; controlling floods and natural disasters; reduce the impact of climate change. . . .*" Even more, the Jakarta's Development Plan 2023–2026 even links green open space to create thermal comfort: *"Provision of green open space serves to improve air quality; create thermal comfort; increase the carrying capacity of the land; and serves as disaster mitigation areas."* There are programs such as the development of green parks and green corridors, referring to the objectives of offsetting carbon emissions in Jakarta. However, focus on carbon emissions policy seemed to focus more on the transportation sector. A participant mentioned, *"Our transportation program (shift from private vehicle and use of public transport) is seen as a more urgent matter since it is perceived as one of the most significant causes of carbon emission to Jakarta."* (NGO and Urban Activists, ICLEI, 19).

The government assumes that through the programs from "Low Carbon Development" agenda, which the DKI Jakarta Government is prioritizing, thermal comfort can also be attained as a positive externality. "Low Carbon Development" is part of Jakarta's Governor Strategy that directs Jakarta's future urban development to increase the city's resiliency. This is further elaborated in Jakarta Governor's Regulation No. 90 of 2021 with more detail on activities and programs for mitigation and adaptation to climate change. This strategy focuses on several sectors, such as Energy Management, Waste Management, Industrial Activities and Land Use and Green Open Space Management.

A participant mentioned, "*we believe that transportation sector is one of the main contributors to Jakarta's high emission that leads to the increasing temperature, thus we would also hope that by improving the public transport, we can ultimately mitigate the urban heat in the future."* (Practicing Experts, TGUPP, 4a). However, some stakeholders acknowledge the potential usefulness of green infrastructure provision to reduce the impact of heat: *"Although not directly related, the provision of green open space, in the end of the day, can provide urban heat mitigation"* (Academics in Architecture, 28). A participant mentioned green buildings to improve thermal comfort: *"We hope that through our other Climate mitigation and adaptation program, such as the green building, eventually, it can also improve the thermal comfort*" (Government Actors, Spatial Planning and Public Works Agency, 8).

Regarding the distributive justice aspect of the green open space distribution, planning documents and policies in Jakarta ensures that the distribution of services should be equally accessible to everyone, and the planning process includes all related stakeholders' participation. Clause 14 of the Governor Regulation 9/2022 on Green Open Space Masterplan determines criteria for locating and utilizing green open space: *". . . disaster vulnerability, ease of procurement of GOS, affordability and accessibility, the need for green open space per person, availability of existing green open space."* The notion of justice is also highlighted in Clause 6 of the Governor Regulation 24/2021 on Management and the Protection of Trees, which mentions the "...even distribution of trees" as a success parameter for managing urban vegetation. A participant suggested that *"the green open space masterplan (Governor's Regulation No. 9 of 2022) helps to ensure that green open spaces are accessible and available until the neighborhood level. We take an approach of justice in providing parks, green corridors, etc., as everyone deserves access to these public goods."* (Academics in Architecture, 28). However, the just distribution of green open space often conflicts with other basic needs. An interviewee conveyed a competition between housing and green open space, *"As Jakarta become more urbanized, we still need land for housing, thus sometimes we sacrifice green area for the population needs"* (Government Actors, Environmental Protection Agency, 1a).

Stakeholders also acknowledged the importance of prioritizing vulnerable communities in the development, among others, because *"...they are the most affected and harder to bounce back if affected by disaster (less resilient)."* (NGO and Urban Activists, Climate Hub, 14). However, a participant admitted that *"...there is still limited framework that includes the vulnerable communities, whether it's in the planning process or planning goals."* (Government Actors, Jakarta Resiliency Program, 27). Moreover, in the implementation, vulnerable populations often face marginalization. One interviewee said, *"Ideally, we can map vulnerabilities so that goals and objectives are in accordance with that. Yet, we do not measure our success based on whether we can protect the vulnerable communities. The identification, measure and mapping of vulnerabilities are still limited or too simplified. The most socio-economically vulnerable group still are the most marginalized in the development (of Jakarta)."* (NGO and Urban Activists, ICLEI, 19). Improvement of the environmental quality of the living area for the lower socio-economic groups is secondary to economic development. The statements of some participants show this: *"Usually we see vulnerabilities only if economic development (growth) is at risk. We still need to promote social justice in environmental issues*" (Academics in Population Research, 21) and *"It is a challenge to create a just environmental quality, as we only see vulnerability if it can be monetised/quantified in economic terms. Physical vulnerabilities are still invisible"* (Practicing Experts, Indonesia's Urban Planning Association, 15). This evidence suggests that vulnerable populations are still left behind in public policy, including providing green open space.

5.2. Jakarta urban heat and thermal justice in the policy stream

There are limited strategies in Jakarta's urban planning agenda related to urban heat and the management and mitigation of intensifying urban heat. The most common approach to this issue in Jakarta is through recognizing the rising global temperature and the effort to have lower carbon development by minimizing emissions from city development. The Governor Regulation 90/2021 refers to the Climate Resilient and Low Carbon Development Plan to include mitigation in Green House Gas

reduction and offset and adaptation in reducing the community's vulnerability to the impacts of climate change. As a participant elaborated, *"We have targeted to lower 30% of carbon emission by 2030, with net-zero emission in 2050. This is our climate resilience plan that hopefully can address various environmental problems in Jakarta"* (Practicing Experts, TGUPP, 2a). Another mentioned: *"...for green building program, the concern is to lower the energy consumption to lower the emission or climate impact, creating better quality for the living environment." (*NGO and Urban Activists, Climate Hub, 14). Environmental conservation, lowering greenhouse gas emission and flood management become the priority objectives of the provision of green infrastructure in the 2030 Jakarta's Detailed Spatial Planning Document (*Rencana Detail Tata Ruang* – RDTR), a planning document that provide detailed and specific guideline up to the neighborhood scale.

Even so, Jakarta has a quite extensive green open spaces policy. The Governor Regulation 24/2021 on Management and Preservation of Trees pushed for better vegetation management through the planning, data collection, mapping, planting, maintenance, protection, and usage of trees to optimize their ecological and aesthetic function. This acknowledges trees as a critical part of the green infrastructure that requires attention in Jakarta's urban planning, management, and protection. A participant emphasized the significance of trees and parks in addressing environmental challenges in Jakarta: *"Now we have Governor Regulation on the management of trees and parks so that it can serves the various needs of Jakarta's environmental challenges."* (Practicing Experts, TGUPP, 2a).

At the moment, Jakarta has a Green Open Space Masterplan, *"We help design the green and blue indexing and green infrastructure masterplan in Jakarta (Green Open Space Masterplan). Green indexing help to overcome Jakarta's limitation to provide green space through alternative green infrastructure, such as green wall, paving block, vertical garden etc., so we measure vegetation stratification. The Green Open Space Masterplan ensure that greenery is not only about quantity but also quality, e.g., green football fields has less ecological value compared to parks with trees, even though it is smaller in size"* (Academics in Architecture, 28). Governor Regulation 90/2021 on Climate Resilient and Low Carbon Development Plan considers developing parks and expanding green open spaces as a mitigative action to absorb carbon emissions. This Governor's Regulation allows for a broader interpretation and variety of green infrastructure. Now, not only forests and parks are accounted for as green open spaces but also green roofs, green corridors, riverbanks greening, green walls, etc. This extends the significant potential of vegetation to curb the negative impact of urban heat.

Clause 12 of the Governor Regulation No 49 of 2021 on Provision and Management of Urban Parks explicitly targets the improvement of air quality and thermal comfort of the microclimate: *"Good design of urban parks include its ability to function to … improve microclimate condition; improving air quality and as a pollutant absorbing area."* The role of vegetation and green infrastructure in improving thermal comfort and overcoming the Urban Heat Island Effect (UHIE) is also recognized in the 2023–2026 Jakarta's Development Plan. One participant mentioned, *"We have Governor Instruction No. 66 of 2019 that pushes the improvement of air quality, we advocate for better park design with optimal ecological value such as thermal comfort. We also push for better green open space management, such as trees, parks, and urban forest, which is critical for local environmental quality, manifested in Governor Regulation No. 24 of 2022 and No. 49 of2021"* (NGO and Urban Activists, Cities 4 Forest, 26a). However, thermal comfort objectives are not always mentioned in related regulations. For example, the Governor Regulation 9/2022 on Green Open Space Masterplan indicates various ecological benefits as the objectives but does not mention improving urban thermal comfort.

In terms of equality, justice and equality are mainstreamed in the Jakarta Development Plan 2023–2026: "*One of the main strategies in Jakarta Development Plan 2023–2026 is justice, equality, and* unbiased." (Jakarta Development Plan 2023–2026). The existing policies have acknowledged the presence of population groups vulnerable to climate hazards. The Government Regulation No. 90 of2021 on Climate Resilient and Low Carbon Development Plan acknowledges there are 57% of the total urban villages or *kelurahan* has moderate vulnerability to climate-related disaster, and about 65 *kelurahan* (24%) are classified as having a high to extremely high vulnerability to climate disasters. Jakarta's Mid-term Development Plan 2017–2022 stated: *"Climate change happening globally has a significant impact on regional development and urban poor communities. Jakarta is a city that has a high level of vulnerability to the impacts and risks of climate change."*

To address this, the Government established Program Kampung Iklim or Proklim (*Climate Kampong Program*), as *"one initiative to tackle climate change disaster at the neighborhood level that involves the public/local community."* (Government Actors, Environmental Protection Agency, 1a). The collaborative governance of Jakarta also pushed for participation as one participant mentioned, *"Ideally, in the collaborative governance, we should invite everyone, including those with no authority but need their voice to be heart. Only in this kind of forum legitimate consensus can be achieved."* (Government Actors, Jakarta Resilient City Program, 27)

Specific to green open spaces, Clause 11 of the Spatial Planning of Jakarta 2030 highlights the importance of distributive justice by mentioning *"increase the quantity and quality of green open space that is spread throughout the city/regency"* as a strategy to improve land use management. The Governor Regulation 24/2021 aims to provide *quality parks that all people in DKI Jakarta Province can use"* (Clause 3)" in all levels, including neighborhoods' level (*Taman Rukun* and *Taman Warga*), urban village level (*Taman Lingkungan*), subdistrict level (*Taman Wilayah*), and administrative city level (*Taman Kota*).

Although already formally recognized, Jakarta's government's priority in ensuring equality of infrastructure and service is not coupled with a strategy and clear programs with transparent budgetary. One interviewee suggested, *"...even if the regulations suggest that we must ensure distributive justice (to provide green open space), they are not implemented well. It is not thorough and strong enough. Environmental protection strategies have limited power to make changes or curb green open space degradation. This is reflected with how we budget our development; it is still garnered toward short gain of economic growth not toward protecting what is important, our limited green open space There is yet a strong political will for this issue. The governors do not have a strong concern on the provision*

of green open space. High land price and limited budget are always used as justification for this lack of prioritization. This is a ridiculous excuse, taking in to account that Jakarta has the biggest budget, even larger than many Ministry departments. They still do not see the importance of green open space for Jakarta's environmental issue, including in mitigating the urban heat." (Academics in Urban Studies, 30).

Additionally, no explicit plans and actions mean no measurable outcomes and targets to assess and evaluate the progress and success of just and equal strategies and policies. Notably, there are no measures on how this initiative is equally distributed to the disadvantaged neighborhood. The commitment to protect the vulnerable groups has not been translated into a commitment to ensure fair and just planning provision of green open spaces. Further, no direct framework ensures the equal distribution of the green open space. As a result, this outcome-based equality often is not as triumphant as the policy documents suggest.

Open green spaces are often exclusive to high-income residential areas. A participant mentioned, *"In terms of regulation, we are on the right track on lowering the environmental impact, but mostly this effort is being outsourced to private entities, such as providing parks as part of the green building and green neighborhood initiatives. The private developers are the ones that understand the (economic) value of being sustainable long term. They also have the capital for the initial investment, as green infrastructure is pricey. They can implement this green value in their planned neighborhoods, look at Bintaro or Bumi Serpong Damai (both are examples of developer-initiated neighborhoods in Jakarta's periphery area). Of course, our government does not have the capital or human capacity to retrofit existing neighborhoods, let alone the vulnerable areas."* (Academics in Building Technology, 29).

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5.3. Jakarta urban heat and thermal justice in the politics stream

The Provincial Government of Jakarta has yet to take the urban heat as an urgent problem and threat to the city's liveability. An interviewee points out that the term urban heat has not been mainstreamed during political discussion yet: *"Mainstreaming is important but still a challenge. Only when everyone is aware of the issue, that then it becomes a common goal with clear division of responsibilities of each stakeholder in achieving the goals. The political commitment is intricately connected with an incentive scheme. Only with internal and external motivation of the issue, that each responsible authority is determined to reach the goals."* (Government Actors, Provincial Development Planning Agency, 6). Thus, improvement of thermal quality is merely an expected externality from related low-carbon strategies that the city is implementing right now, if at all.

The political commitment to address urban heat issues is lacking, mainly because it has not been a concern for the political leaders, leading to a low awareness of urban heat issues. The stakeholders interviewed are primarily on the same page regarding the importance of leadership in securing a point into the political agenda: *"It is also critical that the leader has awareness of the issue, as the leader power tends to design the reality (of policy being implemented)"* (NGO and Urban Activists, Climate Hub, 14) and

"Leadership plays a big role in ensuring that an issue is taken seriously." (NGO and Urban Activists, Cities 4 Forest, 26a). One participant further emphasized that without the leader committing to urban heat, it is difficult for lower-level government actors to address that: *"the leader has important role in accelerating the process of an issue into the policy discussion, the lower echelon has limited power and capacity for this."* (Academics in Architecture,28). Unfortunately, urban heat and many other environmental issues are often trumped by other Jakarta's development goals. As one participant mentioned, *"we have yet a governor that put climate or environmental issue as top priority, though there is a trend toward more awareness of this issue. The challenge is that the choice to protect the environmental quality is not a populist way of governing. Our governor tends to opt for populist development goals"* (Academics in Urban Studies, 30).

Several challenges hinder the inclusion of urban heat issues in the political agenda. Firstly, the cross-sectoral nature of the issue and the challenges of working together. It is acknowledged that urban heat is a complex issue requiring intensive cooperation among stakeholders: *"when we talk about environmental problem, we still think one dimensionally, we directly think of the Jakarta's Environmental Protection Agency. When, environmental programs encompass many stakeholders/sectors"* (Practicing Experts, Indonesia's Urban Planning Association, 15). However, participants consider the immense challenge of coordination and integration between departments. One participant mentioned that *"it is a challenge to coordinate with*

many stakeholders and be on the same page in discussing an issue." (Government Actors, Provincial Development Planning Agency, 8). Another participant said, *"it is often not clear about who's responsible for an issue, lack of integration in policy making or problem solving between each level of government."* (Academics in Landscape Architecture, 23). Moreover, another participant highlighted the 'norms' of working in silos between departments in the national and sub-national levels: *"there is still a mismatched or fragmented view of the issue between national and sub-national level of government which contributes to the complication of problem solving. Each agency still works in silos"* (Academics in Population Research, 21).

Secondly, the coordination between Provincial and National governments poses challenges as well. One participant mentioned that *"…sometimes the national government has difficulties understanding our goals, as they aren't the one dealing with the local community or public."* (Government Actors, Environmental Protection Agency, 1a). To address this issue, often, the National government should be the one that puts up initiatives. A participant suggested that *"a push from the higher ups are determinant to how serious each agency takes the responsibility such as in the establishment of 'Climate Disaster Mitigation and Adaptation Team.* "(Government Actors, Provincial Development Planning Agency, 6). In the actual implementation, citizens of Jakarta were barely involved in the urban planning process; as this interviewee suggested, *"our system has yet had a framework that enables a true partnership between government, the public and related stakeholders. public participation in our case, it is still in the level of tokenism"* (Government Actors, Jakarta Resilient City Program, 27).

Thirdly, green infrastructure is considered as expensive. A participant highlighted the lack of budget by saying, *"to provide green infrastructure as in landed park will require an intensive budget, which we (Provincial Government of Jakarta) do not have enough budget for it"* (Practicing Experts, TGUPP, 2a). Even if the national government have budget allocations to deal with urban heat issues in Jakarta, the budget transfer is also challenging. One participant puts it, *"there is often a mismatched between national goals and provincial government's goals. This means that when there is an international initiative, the budget, discussion, studies etc., are only limited and ends in the national government. It does not trickle down to the subnational/provincial government. Authority and budget distribution between national and provincial government do not always go smoothly, it is still complicated or takes a lot of time"* (Government Actors, Transportation Agency, 11).

One way to tackle the financing problem is grants or loans from international donors: "*The reality is a prioritized issue usually caused by the availability of donors. Such as Jakarta with climate resilience program, it is accelerated through the push from international organizations supporting that (the climate resilience issue)."* (Practicing Experts, Indonesia's Urban Planning Association, 15). However, one participant thought that urban heat may not have been a priority yet among donors. The reason is, as the same participant further said, "*...an issue prioritization is also related whether it can be monetised. Urban heat, in Indonesia, is yet to be quantified*" (Practicing Experts, Indonesia's Urban Planning Association, 15). In many other sectors, private sector involvement often serves as a way out to address the limited public budget. However, in the case of providing green open space, private sector involvement often increases the inequality of access to green open space. One participant stated, *"big players of private developers are highly aware of the green building, green neighborhood issue. They take it seriously because they see the economic value in the long term, despite the massive initial investment. On the other hand, the government does not have this financial capacity and limited human resource. Thus, effort to retrofit of improve the thermal quality of other areas (other than planned areas by private developers) may be limited. We can see improvement of green building in Government buildings, but not in the household level or neighborhood in the lower socio-economic groups"* (Academics in Building Technology, 29).

Fourth, the short term of the governor's office mismatches the delayed impact of slow-onset heat events. Thus, slow-onset environmental challenges, such as increasing urban heat are pushed out by other political agendas for the city. With many competing urban problems in Jakarta, the government must select and prioritize its human and financial resources to several top priorities. There is no incentive to prioritize and channel resources for urban heat issues in Jakarta. Working in an already *"limited human resources and capacity to handle (environmental) issues"* (Academics in Landscape Architecture, 23), the officials also *"...working within the 5 years of election timeline. The challenge is to translate this 5-year government tenure into sustainable policies that the Jakarta's bureaucrats can fulfill in the long term"* (Practicing Experts, TGUPP, 2a). Moreover, one participant noted the importance of changing leadership to program sustainability: *"the everchanging leadership also impact how sustainable a program is; if the people/authority change, the programs may not be continuously implemented"* (Academics in Urban Studies, 30).

Fifth, there is a lack of public awareness and demand to address the urban heat issue in Jakarta. The push from the public on a particular case might be one way to catalyze an issue into government concern. Interviewees suggested ways to raise the awareness of the urban heat issue in Jakarta, for example, by making the issue 'viral': *"Some regulation requires a push from the public (issue being viral in social media) for the government to take action. The Government is responsive to viral discussion in social media, such as the protest of tree removal in Cikini, this event pushed forward the Governor's Regulation No 24 on Trees Protection and Management"* (NGO and Urban Activists, Cities 4 Forest, 26b). Another way is to wait for a window of opportunity to appear even if it is unfortunate: *"There has to be a big heat event, that goes beyond our threshold of heat, may be then the issue will gain traction in the public. The public do have a lot of power to push the government to take action immediately"* (Academics in Urban Studies, 30). Another participant highlights the push from international organizations as a powerful influence to raise an issue: *"Additional support from international organization can accelerate the program, take the climate resilience initiative for example"* (Government Actors, Jakarta Resilient City Program, 27).

5.4. Policy entrepreneurs in Jakarta urban heat and thermal justice issue

In the Multiple Stream Framework, the role of the Policy Entrepreneur is critical in either promoting the issue or pushing the agenda into the political sphere. The stakeholders agreed upon the

importance of policy entrepreneurs: *"A champion in government agencies/department is important to push the issue forward so that it gains traction and being implemented"* (Government Actors, Provincial Development Planning Agency, 6) and *"The work of a champion that facilitate this collaborative medium is critical, to create a common goal. this takes a while to put everyone in the same boat"* (Government Actors, Jakarta Resilient City Program, 27).

An *ad hoc* collaborative climate action platform called the Climate Disaster Mitigation and Adaptation Team (MABI) was formed through Governor Regulation No. 96 of 2020. It included government agencies, public organizations, knowledge institutions and NGOs, thus creating a formal collective effort to tackle climate-related disasters in Jakarta. This platform divided the responsibilities between the various stakeholders into smaller task units (*Kelompok Kerja* or *Pokja*) such as Mitigation and Adaptation, Research and Development, Citizen Engagement, and Funding and Partnership. *"With MABI and its POKJA, we are hoping that the authorities involved can focus on the climate issue"* (Government Actors, Jakarta Resilient City Program, 27). However, this platform does not include communities or organizations that are concerned about urban heat. Furthermore, the lack of involvement of vulnerable community representatives in this platform suggested that the government did not take justice in environmental protection yet.

The participants highlighted the roles of academia and non-governmental organizations (NGO) in pushing an agenda: *"NGO usually help promote the issue and act as consultant in solving the problems"* (Government Actors, Environmental Protection Agency, 1a). Scientific evidence is a necessary ammunition to prompt government's actions. As a participant inquired, *"academics and NGOs should approach the government to raise this issue of urban heat, we (the government) have yet seen the studies, thus the lack of awareness in our government"* (Government Actor, Environmental Protection Agency, 25). NGO and academia are also influential in providing technical assistance. One participant mentioned, *"Our main role (as supporting NGO) is to help the government to reach that Paris Agreement of capping the temperature increase of 1.5 C, through technical assistance and capacity building."* (NGO and Urban Activists, C40, 20). Another role the NGO has is to serve as an advocate for marginalized population. One participant highlighted, *"the vulnerable communities, those in the poverty line, are more prone to environmental disaster, thus Climate Hub (NGO) tries to work on this neighborhood level. We are designate team to reach the vulnerable communities and discuss the issue. This is not part of the government's program"* (NGO and Urban Activists, Climate Hub, 14).

However, being a policy entrepreneur also is not an easy task. The policy entrepreneurs need to *"approach government with this issue of urban heat, with a practical solution that they can easily adopt, quick wins. Only then the issue can be taken seriously by the government"* (Academics in Architecture, 28). One participant admitted that *"indeed, policy entrepreneur requires high endurance to promote an issue to the government (as it requires a lot of time and energy to promote an issue)" (*Academics in Architecture, 28). Often, policy entrepreneurs are restricted by tenure. One Interviewee said *"I once initiated a grand design, with one of the objectives to mitigate the effect of urban heat, but it is left unfinished, after my departure from my position in Jakarta's government "(*Government Actors, Jakarta Resilient City Program, 27).

6. Discussion

Compared to other environmental issues, such as flooding, the chronic urban heat issue failed to rise and has yet to be recognized as an environmental or public health disaster in the policy agenda of Jakarta. With Jakarta being in the tropical region, the higher temperature was taken as part of the living conditions and inhabitants' daily life in tropical climates. Studies on urban heat primarily extend to the risk assessment and policy on short-term heat events such as heatwaves, while the gradual increase in temperature and chronic exposure, such as the case in tropical cities, are overlooked (Méndez-Lázaro et al., 2018; Oppermann et al., 2021). Therefore, the risk of the impact of urban heat in tropical regions may become "invisible" to the public and authorities, compared to more prominent heat events, with more apparent and tangible effects on public health, such as heat waves (Oppermann et al., 2017, 2021).

Even if there is some awareness of this issue, it may not be to the level of awareness where the government understand the course of action that needs to be taken. Data and information on urban heat management and mitigation must be quantified into measurable indicators that policymakers are familiar with Xu et al. (2017). The limited research and data on chronic urban heat may contribute to this low awareness. Runhaar et al. (2018) describe the disparity between the presence of data and knowledge on an issue and the translation of that awareness into policy and action as the "implementation gap."

The predominant direction of urban planning in Jakarta is focused more on lowering environmental impact in terms of flooding, pollution, and carbon footprint, mainly through regulating industrial activities, building sustainable transport systems and increasing the green infrastructure throughout the city. Various green infrastructure for flood management strategies is perceived as a solution that, in the long term, can also help improve the thermal comfort in the area, or as Farley et al. (2007) termed the "spillover effect," where various policy solutions are applied to overcome multiple problems. Improvement of thermal quality is only seen as an expected externality from related environmental strategies the city is implementing. This is not always negative, as other environmental issues can serve as a policy window to include urban heat issues into the policy agenda. As urban heat issue is highly related to other urban challenges, such as climate change and air quality, a comprehensive and integrated strategy may be helpful in tackling multiple urban environmental challenges (Shahmohamadi et al., 2010; Salleh et al., 2013; Lanza and Stone Jr, 2016; Ranagalage et al., 2018; Richards and Edwards, 2018; Marando et al., 2019), including urban heat.

Interviews, including with the national government actors, showed a limited sense of urgency to address the urban heat issue without it, no immediate actions are taken to resolve the problem (Zimmermann and Brettschneider, 2011). The lack of priority of urban heat issues at the national level partly explains why Jakarta has not prioritized this issue. Regional and city planning priorities in Indonesia are heavily influenced by the development

priorities set in the national development guideline by the National Development Planning Agency or Bappenas. The lack of a direct mandate from a higher government level also means a lack of legal and financial support or political commitment to address the issue (Di Giulio et al., 2018).

In addition, the relatively short tenure of the governor compared to the slow effect of chronic heat in urban areas causes the issue to be pushed out from the priority agenda of Jakarta. Competing interests and pressing issues widen the gap between discourse and political realities (Di Giulio et al., 2018). The lack of attention on the urban heat issue is also observed on how the government responds to extreme heat events. In May 2022, extreme heat reaching 36°C in Jakarta Metropolitan Area not followed by warning or cautionary alert to the threat of heat-related illnesses (Arnani, 2022). Meteorological, Climatological, and Geophysical Agency (BMKG) did not consider this event a heat wave and issued lenient suggestions to reduce outdoor activity and boost hydration.

Improvement of green open space provision is one of the most powerful tools that urban planners and city policymakers in hot-humid climate cities can use to reduce the severity of urban heat and cool the area in the vicinity (Wong and Yu, 2005). It is essential as open green space may be the only cooling infrastructure that is affordable and accessible to vulnerable population (Mabon and Shih, 2018). Anggrahita et al. (2020) showed that the "Gang Hijau" program, or greening a densely populated neighborhood, successfully lowered the ambient temperature to 2°C, creating a better microclimate in the area and improving thermal comfort. Although Jakarta already had extensive policies on green open spaces and their just distribution, the frame of green open space to mitigate urban heat is limitedly discussed by policymakers and other stakeholders. Mitigating urban heat and improving the thermal comfort of Jakarta's metropolitan area is only seen as an expected long-term positive externality of different climate-related strategies.

The Green Open Space Masterplan in Jakarta ensures equal access to green open space as small as the neighborhood level. The master plan then may become a vital tool to address the inequality in heat exposure in urban areas that disproportionately affect the lower socio-economic neighborhood (Mabon and Shih, 2021). Through these policy instruments, the governments not only push for the increased quantity of the Green Open Space area but also the quality of the space that benefits the quality of the citizens' lives. However, the existence of regulations that impose the importance of equality in providing green open space is not enough to ensure its implementation.

In this case, environmental justice has yet to translate into long-term financial mobilization and institutional support to address the equity that ensures that the poor neighborhood benefits from urban heat mitigation (Reckien et al., 2018). The pressure of urban development in Jakarta often wins over the importance of providing green open space in the land use competition. For example, Endangsih et al. (2022) showed that green open space takes <10% of the land in transit-oriented areas with denser populations. More severe cases often happen in dense and poor neighborhoods, as Putri et al. (2019) noted that the pressure to convert land for industrial and trading centers often depletes green open space in slum areas. As a result, green open space is seen as a nice-to-have rather than a necessity and a human right. Further, green open space often capitalizes as luxury goods in the real estate market, and only the higher-income population can pay the premium (Koo et al., 2019).

The ecological benefit of green infrastructure becomes public goods enjoyed only in more affluent neighborhoods. Environmental protection effort, such as the provision of Green Open Space in cities, often lacks discussion about fairness in terms of the distribution of benefits (Pham et al., 2012; Mabon and Shih, 2018). City governments usually measure the ratio or the number of green open spaces, or "just green enough," with limited consideration of how evenly distributed they are throughout the city (Wolch et al., 2014). The lack of a systematic map to document the urban heat exposure and vulnerabilities by neighborhood or certain socio-demographic groups in Jakarta may contribute to the lack of problematisation of this issue (Reckien et al., 2018).

Runhaar et al. (2018) suggest that the organizational structure, practice, and ways of collaboration, both internal and external, that are not functioning well often serve as the primary inhibitor to having a shared understanding of a complex issue. Mitigating urban heat in cities requires secure public financing and strong ownership. Without the government's visionary, regulatory and institutional support, the management, and mitigation of urban heat in urban planning policies are downplayed. Additionally, fragmentation of authority and responsibility between each department or between the national and provincial governments also exacerbates the bureaucratic challenges of tackling complex issues such as urban heat.

This institutional gap may be a primary barrier toward adopting initiatives addressing urban heat issues (Uittenbroek et al., 2013). This means no local actors push the case forward at the national government level -or vice versa. Low-risk perception and limited policy and institutional support at the higher government level, the lack of urgency trickles down to the provincial government, the public and other stakeholders. This translates to having no substantial push in the urban heat management and mitigation effort. Leiserowitz (2006) suggests that in this case, an issue lacks a sense of urgency and will continue to be a low priority in urban planning policies.

We then compare urban heat with Jakarta's flooding problem to produce recommendations for bringing urban heat to the policy and political arena. Iswahyudi et al. (2021) analyzed how the River Concretisation Policy (RCP) as part of the flood management strategy has been successfully implemented in Jakarta using MSF. Iswahyudi et al. (2021) analyzed how the River Concretisation Policy (RCP) was successfully implemented in Jakarta as part of the flood management strategy. Flooding events that come annually in Jakarta received substantial attention from the media, the public and the government. The reason may be because the impact of the flood is perceived to be more tangible, and the economic calamity of the flood events is well-documented. The high awareness and understanding of the impact mean the issue matures in the problem stream. Studies on flood management issues in Indonesia are also widespread (for example, Abidin et al., 2015; Padawangi and Douglass, 2015; Budiyono et al., 2017; Richards and Edwards, 2018; Dwirahmadi et al., 2019), resulting in more robust and confidence in problem-solving options in the policy streams.

Additionally, in the political stream, floods gain wider attention. Every rainy season, there is continuous discussion and

debate on how the flood problem is never fully solved in Jakarta. Governor electoral in Jakarta always cover flooding as a political debate among the candidates - the winner grabs the voters' attention through his flood management vision (Iswahyudi et al., 2021). In the RCP case, the three streams came together and peaked with the opening of window policy through election time.

Based on our findings, we proposed recommendations as follows. First, to build evidence for pushing urban heat agenda and informed decision making. One interviewee explains that the lack of visibility of the urban heat issue may have roots in the absence of visible or tangible data on its impact and may have an economic or social impact on the city. Urban heat data and information can be quantified into measurable indicators that policymakers are familiar with. For example, Xu et al. (2022) proposed a mathematical model of hospital admission based on the combined effect of weather conditions on the incidence of heat-related illnesses over 20 years in Singapore; this informed the policymakers of the urgency of the health impact of heat and pushed them to act.

Moreover, getting policymakers to take note of "the problem" must fit the existing context, for example, how it translates to current events and implementation of similar issues. To do this, appropriate framing of the issue is required. Properly framing an issue can support "problematisation" by providing common ground/goals to the policymakers (Gironés et al., 2020). Framing an issue narrative can provide a perspective of continuity of other issues, linking it to current events that inform policymakers (Dudley, 2013). The urban heat issue in Jakarta can "piggyback" other related environmental issues, for example, coupling urban heat management with carbon emission, energy consumption, health issues related to heat waves and warming temperatures under changing climate, or social equity issue of the green space spatial distribution (Uittenbroek et al., 2014; Van Der Hoeven and Wandl, 2015; Villanueva-Solis, 2017; Hong et al., 2019). The effort to reduce the effect of urban heat can be coupled and incorporated into the strategy to improve the quality and quantity of the green infrastructure in Jakarta. As the issue is correlated and highly related to other urban challenges, such as climate change, air quality etc.; a comprehensive and integrated strategy may tackle multiple urban environmental challenges, such as natural conservation, climate change adaptation, energy efficiency and flood management (Shahmohamadi et al., 2010; Salleh et al., 2013; Lanza and Stone Jr, 2016; Sharma et al., 2016; Ranagalage et al., 2018; Richards and Edwards, 2018; Marando et al., 2019). Various green infrastructure can also improve the area's thermal comfort, thus increasing heat resilience (Sharifi and Boland, 2018). Oppermann et al., 2017 state that a clear route for strengthening the "problematisation" of urban heat is through the connection between the disciplinary and governance domains of public health and epidemiology on the one hand, with occupational health and thermal physiology on the other. With limited resources and capital as one hindrance to adopting a particular political agenda, this strategy can help address the urban heat issue promptly (Harlow et al., 2018).

Wang et al. (2021) illustrate the importance of knowledge of the urban heat issue. Regardless of the growing global research and attention on public health concerns due to severe heat, there is limited research on the health impact of severe heat in an already hot and humid climate such as in Indonesia, which may correlate with the lack of awareness on the effect of heat exposure for citizens of Jakarta, which may contribute to the lack of risk perception of the negative impact of severe heat. Improving the general public's awareness of the urban heat issue not only help the urban inhabitants to make informed decisions in protecting themselves against urban heat exposure and helps push the government to take significant action that improves the city's thermal comfort. The power of public pressure has also influenced city priority programs. For example, the case of Governor Regulation No. 24 of 2021 on Trees Management was triggered by an urban renewal project in one of Jakarta's train stations that includes the removal of many old and native trees around the existing station. This removal was controversial, attracted many protests by local citizens and briefly went viral on social media (Ikhsanudin and Safitri, 2019). Thus, the Governor Regulation was established to map, profile, manage and protect trees in Jakarta after the public pressure on this issue (Lova, 2019). This proves that public awareness is essential to push the stakeholders to take action toward coping with the urban heat issue in Jakarta.

Despite a limited urban heat agenda, sustainable development has been mainstreamed into urban planning, with a current addition on lowering carbon footprint. Frame the issue to the current sustainable development agenda that aligns with the existing budget priorities may work. Policy entrepreneurs are later crucial in "softening up," where the solution proposals are brought to relevant stakeholders who favor the initiatives (Farley et al., 2007). Coalitions with similar visions from the public health sector, occupational health, and environmental agencies will improve the receptivity to policy solutions (Cairney, 2018; Lesch and McCambridge, 2021). To come up with specific local policies and strategies, integrative engagement between stakeholders is critical as it makes room for discussion of various views from different stakeholders with different experiences, affect, and risk perceptions on the issue, which translates scientific data and information into relevant and usable terms that policymakers and urban planners use are essential to create adaptation pertinent to the local area (Van der Linden, 2014; De Groot-Reichwein et al., 2018). Various engagement channels and the existing climate resilience ad hoc team are imperative to voice their concerns and build alliances to push forward an urban agenda.

7. Conclusion

In the context of Jakarta's year-round hot temperatures, this study examines how Jakarta failed to incorporate urban heat issues into the urban policy agenda and ensure equal distribution of green open space as a crucial means of mitigating heat and cooling metropolitan areas. We consider heat and thermal justice issues as blind spots in Jakarta's urban policy setting. Chronic heat events are overlooked, and green open space policy implementations in Jakarta did not use the thermal justice angle. We identified barriers to including heat issues in the policy from our data and compared it to another study that uses MSF for analyzing environmental issues. Our findings transcend the specific issue of Jakarta and have theoretical significance. When addressing urban heat concerns, we emphasize the necessity of

"problematisation"—an approach that requires framing of an issue as urgent and essential in daily urban life. In addition, we advocate for the strategic coupling of urban heat concerns with recognized and critical environmental issues. Thus, the policy discourse can leverage extant environmental agendas, gaining momentum and fostering cross-disciplinary collaboration. We also advocate for the formation of alliances that include vulnerable community representatives. Such coalitions can bridge the chasm between policy formulation and the lived experiences of those most adversely affected by urban heat disparities. Our research extends beyond Jakarta by providing a framework for addressing urban heat and thermal justice issues in diverse urban settings. This framework requires strategic alignment with existing environmental priorities and the cultivation of coalitions advocating for inclusiveness and comprehensive policy solutions. Thus, our study adds to the theoretical understanding of policy inertia or change and provides a broader perspective on the challenges in different urban contexts.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

Conceptualization: RU, SA, and GI. Methodology and formal analysis: RU. Writing: RU, SA, and AN. Funding acquisition: SA and AN. Supervision and project management: AN. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fhumd.2023.1237515/full#supplementary-material

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