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Informal adaptation to flooding in North Jakarta, Indonesia

Adam Madigliani Prana [a,b,c,*], Rita Dionisio [d], Angela Curl [e], Deirdre Hart [f], Christopher Gomez [g], Heri Apriyanto [a], Hermawan Prasetya [h]

[a] Research Center for Sustainable Production System and Life Cycle Assessment, National Research and Innovation Agency (BRIN), Republic of Indonesia
[b] The Ministry of Spatial Planning and Agrarian Affairs/The National Land Agency, Republic of Indonesia
[c] Tarumanagara University, Republic of Indonesia
[d] The University of Waikato, New Zealand
[e] The University of Otago, New Zealand
[f] The University of Canterbury, New Zealand
[g] Kobe University, Japan
[h] Directorate of Economy, Employment, and Regional Development Policy, National Research and Innovation Agency (BRIN), Republic of Indonesia

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ABSTRACT

In the face of intensifying floods exacerbated by climate change, especially in coastal cities, there is a pressing global demand for effective flood risk governance and adaptation strategies. Such strategies are often informed by indigenous knowledge, aiming for a life in harmony with water and utilising amphibious living concepts to minimise flood impacts, preserving homes and livelihoods. In Indonesia, however, like in many nations in the majority world, these strategies tend to compete with and indeed to be dominated by imported technocratic, top-down, and inflexible planning approaches oriented on principles of the kind of 'classical planning' that had its hey-day in the Western world in the early decades following World War II. Like many nations in the majority world, Indonesia has long imported and continues to apply Western technocratic, top-down, and inflexible classical planning approaches. This paper criticises existing practices for failing to yield contextual development strategies that address site-specific urban issues and fall short of meeting the needs of the majority of the population. We explore the extent to which informal settlements, or kampungs of North Jakarta, can incorporate principles of flood adaptation incorporating local, livelihood, and indigenous knowledge. Fishers for instance reclaim land using shell mounds and construct stilt houses, ensuring coastal floods do not enter their homes and that water does not stagnate but can instead quickly drain due to the permeable land surface. Often, however, planning authorities in Jakarta have classified such flood-adapted built environments as illegal slums necessitating removal instead of adopting and encouraging the further development of site-specific settlement strategies generated by the community. This paper then argues that authorities in Jakarta, and potentially in other cities within the majority world, should consider adopting planning approaches that are more adaptive, flexible, and collaborative to pave the way for inclusive development founded on the experience and the aspirations of the community, including those who are marginalized.

1. Introduction

Flood aggravation in Jakarta has many causes. Flood hazard in the city is driven by land subsidence, changes in river discharges, relative and absolute sea level rise, and loss of ground permeability (Garschagen et al., 2018). Land subsidence occurs due to several factors. These include groundwater extractions, not least from industrial activities, and massive ground surface loading from high-density real estate development and other construction (Abidin et al., 2011). As a paper on inundations in Jakarta has pointed out:

> The city was sinking … because in large part there was an inadequate potable water supply to Jakarta residents, which requires many buildings to draw water from the underground aquifers. (Mohsin, 2015, p. 45)

Climate change is amplifying the severity of floods in coastal areas worldwide, demanding effective approaches to flood risk management (Barnett et al., 2014; Hegger et al., 2014). Flood risk governance,

* Corresponding author at: Research Center for Sustainable Production System and Life Cycle Assessment, National Research and Innovation Agency (BRIN), Republic of Indonesia.

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entailing the societal understanding and management of flood risks, is crucial for efficient flood risk management. It comprises risk identification, strategy development, and monitoring interventions (Birkmann & von Teichman, 2010; Driessen et al., 2016). North Jakarta is one of the most flood vulnerable areas of the city due to its low topography infused with impacts of informal urbanisation (Fakultas Geografi Universitas Gajah Mada (2007)), which can increase risks of coastal inundation and erosion. Community and urban resilience literature suggests that local and indigenous knowledge are vital to activate transitional stages that link response to hazards in order to build thriving communities (Liao et al., 2016; Shava et al., 2010). This signifies a shift from traditional engineering-based solutions towards more adaptive strategies, acknowledging floods as natural elements of urban ecosystems. Instead of diverting water flows from urban areas, flood management can include strategies to welcome water within urban environs, coexisting with communities and their activities (see Hartmann & Albrecht, 2014; Mees et al., 2016).

This research sets out to demonstrate that this can be achieved in North Jakarta, while minimising adverse consequences of flooding; a concept referred to as flood adaptation. Flood adaptation, rooted in local wisdom on living harmoniously with water, emphasises amphibious settlement forms that can reduce flood damage while allowing people to maintain their livelihoods (Liao, 2014). Spatial planning is vital to support flood adaptation in cities, as it facilitates urban development conducted by public and private sectors (see Y Budiyono et al., 2015; Roth & Winnubst, 2014; Saleh et al., 2009). Spatial planning in this context can be referred to as formal planning, which according to Wu and Zhang (2022) is usually led by the government in a structured and formal way through a series of laws, government rules, and regulations. This contrasts with informal planning, which is typically carried out spontaneously by villagers based on informal institutions, social networks, and beliefs (Wu & Zhang, 2022).

Effective flood risk management seeks to involve a wide range of stakeholders as increased social inequality is a critical challenge, contributing to the gap between majority and minority worlds (Walker & Burningham, 2011). The application of local knowledge to support flood adaptation approaches is not always straightforward. Traditional approaches have been undermined by the adverse effects of a globalised culture (Tomlinson, 1999; Williams et al., 2014), and local knowledge of flood adaptation is endangered, or challenging to implement. In the context of Jakarta, in Indonesia, this can be given effect through mechanisms such as public participation and stakeholder engagement, but, as Damayanti and Syarifuddin (2020) have shown, the dominant approaches take a top-down approach.

Spatial planning is a crucial element of climate resilience, equipping cities and urban communities with strategies, policies, and mechanisms that can facilitate mitigation to flood threats, and reduction of vulnerabilities. Yet this can only be achieved when there are people involved leading multiple pathways to the social and cultural constructs of resilience (Jacobs, 2016; Joseph, 2013). Urban and community resilience means incrementally boosting the capacity of urban systems, communities, and individuals interconnected with the climate, to endure and thrive in the wake of climate-related disturbances (see Adger, Arnell, et al., 2005; Cutter et al., 2014; Meerow et al., 2016). The urgency for urban climate resilience planning is particularly pronounced in the majority world, where informal settlements are highly susceptible to hazards due to lack of sufficient infrastructure and services (Dodman & Satterthwaite, 2008). This can be addressed by strategies focusing on community-based responses and capacity building, aimed at boosting adaptive capabilities to deal with climate impacts (Chelleri et al., 2015).

The term ‘majority world’ is chosen because it rejects terms that frame most people in the world as other. Unlike this, and according to Dados and Connell (2012), the term ‘global south’ is used to label low-income countries that are politically and culturally marginalised. As a metaphor for underdevelopment, this term references a history of inequality of living standards, colonialism, and neo-imperialism (Dados & Connell, 2012). Similarly, the term ‘third world’, which refers to impoverished countries, is also used to generalise countries as deficient (Balaram, 2001).

Punch (2003) states that the term ‘majority world’ acknowledges that the majority of the world’s poverty, lifestyles, landmasses, and population are situated in Asia, Africa, and Latin America. According to Balaram (2001), the term majority world categorises a group of nation by emphasising population size, which can be an appropriate approach when labelling countries. It is used to refer to what was previously called the global south (Punch, 2003), the third world (Balaram, 2001) or the developing world (Alam, 2008). It is important to recognise that like the terms developing/developed world, third/first world, and global south/north, the term majority/minority world is still problematic as a binary term that fails to recognise the importance and diversity of places and peoples.

As Watson (2009b) has pointed out, planning methodologies originating from Europe and the United States in the early 20th century have continued to hold sway in many majority world countries well into the 21st century. Under the heading of rational planning or zoning, the associated strategies were focused on intricate land-use blueprints depicting an envisaged urban state at a specific point in time. In many majority world countries, the legacy of this technocratic approach persists as a colonial legacy to this very day. The associated regulatory systems dictate land usage types and prescribe any potential alterations in line with a master plan. Departures from this plan are acceptable, provided they abide by the regulations. This kind of master plan usually mirrors early urban Eurocentric notions where modernisation takes place in the form of radical displacement of informal settlements, the introduction of green open spaces, and the erection of high-rise structures (Watson, 2009b). As Koizumi (2009, p. 7) explains, “the theory of rational comprehensive planning is now known as the classical planning theory. According to this theory, a vision for a city is developed in static form using a comprehensive and technical approach, and the objective is achieving the goal. The characteristics of this theory are comprehensiveness, linearity, objectivity, and absoluteness”.

Watson (2009b) maintains that regulatory planning, as an adopted form of urban management, is primarily committed to fostering Western civic society ideals. Consequently, it is ill-equipped to manage common challenges faced by majority world countries, including rapid population growth, increasing poverty, drastic environmental change, and the limited capacity of governments to maintain urban infrastructure. Furthermore, colonial-era master plans tend to be reinstated by majority world governments, without due consideration for complex contemporary urban issues. Such regulatory systems (or zoning) were originally implemented to realise specific urban visions conceived during periods of colonial rule and tailored to suit colonial conditions (Watson, 2009b). The frequent adoption of this approach, particularly by the private sector, often incites middle-to-high income individuals and corporations to safeguard their property values, while effectively inhibiting the development of legal middle-to-low-income communities within cities (see Hall, 1988; Lategan & Cilliers, 2017; Watson, 2009a). These Western urban ideals have given rise to elitist urban legislation, whereby middle-to-low income communities are compelled to live outside the law (Fernandes, 2003; Payne, 2005). Many cities in Asia, Africa, and Latin America – majority world countries with inherited colonial regulatory planning systems – have standard planning and building regulations that are unsuitable for the vast majority of the population (Devas, 2001).

This Eurocentric vision in planning has resulted in a dichotomy whereby urban forms deemed ‘modern’ are categorised as formal, and those not meeting the criteria for ‘modernity’ are classified as informal (Kamete, 2013). Government entities often further define the term ‘informal’ as undesirable, disorderly, unlawful, or necessitating remedy, even labelling settlements that do not meet ‘modern’ criteria as slums (Revell, 2010). Many post-colonial administrations seem inclined to maintain this approach, even establishing planning systems and land

management strategies that are more stringent than those employed during colonial times (Njoh, 2017). Some authorities in majority world countries equate 'development' with urbanisation and industrialisation, often systematically disregarding indigenous knowledge and traditional values, viewing Western-style developments as the ultimate aim. The thinking of many policy makers in these areas may be 'colonised,' constraining their ability to envisage alternative development paths that might better suit their regions and the lifestyle of their inhabitants (Liu et al., 2020). In Indonesia, settlements inhabited by impoverished communities that do not adhere to Western-derived ideal standards are predisposed to eviction, as demonstrated in the cases of riverside dwellings in Jakarta, Solo, and Surabaya (Padawangi, 2019).

Gregory et al. (2011) state that planning is the product of the modernity and modernism movements, stemming from colonial or minority countries, particularly in Europe. The hierarchical duality of 'self and other' shaped the building blocks of Eurocentric modernity. The East is defined as peripheral or other, while the West represents the centre (Mohanty, 1988). Therefore, it is not surprising that spatial planning, as a system, has been designed to suit the context of the minority world as the centre of interest and may not be capable of addressing the diverse challenges of majority countries, which are labelled as 'other'.

According to Oliveira et al. (2019), majority world countries need policy innovations that address their long-standing urban and social problems. This innovation has to focus on rebuilding the policies adopted from the minority world into a local and contextual system that is able to address the typical challenges of majority world countries. Such innovative policies may then be partially transferable to other countries that have similar social contexts and urban issues (Oliveira et al., 2019), recognising the transfer limitations highlighted by Dolowitz and Marsh (2000) in their policy transfer framework.

This research assumes that the current planning policies of Jakarta, which are highly influenced by minority world concepts and contexts, need to be revised to fit the physical and social contexts of Jakarta. The colonialism and post-colonialism attached to spatial planning needs to be reconsidered and local city settings and majority world contexts need to be put forward. The importance and diversity of places and people need to be recognised in Jakarta's planning policies, and participatory planning can play a significant role in actualising this idea. This is because public participation in planning may incorporate community aspirations into planning policies.

> Public participation in planning relates to the involvement of the public in urban and regional planning processes and encompasses many types of participatory practices that aim to enable a better understanding of residents' genuine spatial needs, perceptions and desires (i.e., local knowledge) and to catalyse the incorporation of local knowledge into planning decision-making processes. (Berman, 2016, p. 1)

Subsequently, this research chooses to use terms that support putting the interests of the people of Jakarta at the centre of considerations when making policy. In line with the arguments presented above, the concept of employing planning policies to foster development that realises climate resilience in Jakarta and Indonesia more broadly may face a variety of challenges. According to Purwanto et al. (2017), the utility of the regulatory or rational planning system in addressing urban issues in Indonesia, such as environmental health concerns and substandard buildings, may be questionable. The main issues with this planning system stem from its top-down orientation, its presumption of complete planner knowledge, and its failure to allow residents to participate in the process of making about their living environments (Purwanto et al., 2017). Some academics (Fekade, 2000; Todes, 2012; van der Molen, 2015; Watson, 2009b) contend that conventional urban planning strategies and master planning systems, characterised by top-down, expert-led approaches, struggle to foster sustainable livelihoods or respond to social and economic shifts amidst burgeoning populations in majority world nations. The enforcement of master planning, with its land-use rules and controls, can exacerbate urban problems and fail to adequately address pressing urban issues such as spatial fragmentation, informal development, rapid urbanisation, inequality, and poverty (e.g. Fekade, 2000; Todes, 2012; van der Molen, 2015; Watson, 2009b).

The premise of this research, as previously articulated, is to promote bottom-up planning policies by fostering a more participatory approach to spatial plan formulation, a phenomenon that is gaining traction globally. According to Boelens and De Roo (2016), classical planning that is technocratic in nature, characterising Western planning similarly to that of the majority world countries, is ill-suited to address the non-linearity, volatility, and fragmentation present within contemporary society. Additionally, classical planning struggles to connect with issues of justice, equality, and democratic accountability. Therefore, a reorientation of planning practice is necessary, shifting from classical technocratic approaches towards methods that are more adaptive, flexible, and collaborative, embracing the uncertainties of the modern world. Since the 1980 s, planners have posited that the future of planning lies in engaging with the complex, non-linear, and unpredictable nature of societal development, rather than attempting to control it through rigid plans (Boelens & De Roo, 2016). In line with this, collaborative planning as elaborated by individuals like Healey (1997) and Forester (2013), has gained prominence in the theory and practice of the planning world as a response to the suboptimal outcomes of classical planning in fostering site specific and inclusive urban development.

There is a Communicative Turn in Planning Theory, characterised by an increasing emphasis on the value of communication in both theory and practice of planning, moving away from previously dominant theories that prioritised urban form concepts and comprehensive rational decision-making (Huxley & Yiftachel, 2000). Regrettably, the planning approach in Jakarta and across Indonesian cities has yet to transition from classical to collaborative models, despite the clear need for such a shift to adequately address existing urban challenges. Participatory planning has indeed been promoted by the Indonesian government, but this has been limited to low levels of community engagement, mainly consultations, and more lamentably, these processes tend to be merely ceremonial without involving all societal strata (Prana, 2021). A thorough discussion on this subject can be found in Section 3.

This research focuses on examining the extent to which the concept of flood adaptation, which allows room for water in urban areas, can be supported by spatial planning and realised in a majority world megacity such as Jakarta. Meanwhile, the potential uses of local knowledge to support flood adaptation approaches are not straightforward to recognise in the policy and spatial planning contexts. The context of kampungs in Northern Jakarta is that they are often located in environmentally sensitive areas, sometimes lacking clarity on governance structures that support collaboration with the community for flood risk management. This research aims to illustrate the implementation of such possibilities in Jakarta, where local and indigenous knowledge interconnect.

The findings of this qualitative research show that kampung communities can adapt to floods in the built environment by applying local, livelihood, and indigenous knowledge. Flood adaptation, however, can be jeopardised by top-down planning policies centred on imported urban ideals, without regard for local knowledge and collaborative community processes.

The aforementioned conclusions, are elaborated in Section 6, have been developed through a series of stages. Section 2, the literature review, offers a comprehensive understanding of flood adaptation approaches and delves into the historical management of floods in Jakarta. Section 3, titled 'Study Areas', provides an in-depth analysis by examining Jakarta's Western-influenced spatial planning approach and its policy dynamics, particularly in relation to the circumstances of the majority world. This section concludes by elucidating the rationale

behind the study location selection, anchored in social and environmental considerations. In Section 4, we discuss our methodology, detailing how our qualitative research approach ensures that the data collected from the field genuinely represents the actual on-ground situations. Section 5 showcases field findings from five flood-impacted kampungs in North Jakarta, focusing on flood adaptation implementation and its correlation with urban planning policies. Finally, Section 6 illustrates how these field findings can enhance one's understanding of flood adaptation, especially in relation to the dynamics of flood management approaches in the majority world, which tends to adopt specific spatial policy orientations.

2. Review of literature

2.1. Flood adaptation, local knowledge and community resilience

This section delves into the multifaceted concept of urban resilience, particularly in the context of environmental and climate challenges. It underscores the invaluable contributions of indigenous and local knowledge systems in fostering community resilience, drawing attention to adaptive architectural strategies such as the stilt housing prevalent in parts of Asia. The narrative further elucidates the dual nature of floods, highlighting their potential benefits alongside their challenges, and underscores the emerging significance of amphibious urbanism in contemporary city planning. The discussion culminates by emphasising the harmonious integration of scientific, local, and traditional knowledge in formulating effective climate change adaptation strategies.

In the face of environmental degradation and climate change, urban resilience is a term used by a wide range of grey and research literature to describe the capacity of places, systems, communities and citizens to withstand, adapt to, and thrive amidst disruptions (Adger & Brown, 2009; Cretney, 2014; Davidson, 2010). Intensifying weather extremes, and coastal, urban hazards exacerbate existing societal inequalities (Schipanski et al., 2016). Various research in the arena of urban resilience recognises that this field is highly disjointed, with a recent shift in some literature towards the recognition of indigenous and local knowledge (Lam et al., 2020). Community resilience must be seen as a process that recognises the scaffolding of various stages, where one phase activates the next. Community resilience fosters and happens where social cohesion is possible, strengthening local capacities, and leveraging local knowledge of risks and promoting more contextual, inclusive, and sustainable adaptation strategies (Cutter et al., 2014). As argued by Wilson (2012), community and urban resilience are more than a target, referring to the pathways in which communities incrementally build everyday capabilities to enhance thriving abilities in times of adversity. Barnett et al. (2014) argue that adaptation is a chained pathway in which each stage can serve to activate the next.

Berkes et al. (2008); Sterling et al. (2017) argue that local and indigenous communities have a rich body of knowledge and understanding of their local environments, derived from generations of interactions and experiences. These local or traditional knowledge systems can contribute significantly to community resilience and are increasingly recognised as a vital component in resilient community development (Berkes et al., 2008; Tengö et al., 2017). Many cities in the world have an urban structure formed around natural or artificial water structures: resources for clean water, water as a defence resource or as a transportation mode, and features to contain storm water (Shannon, 2008). According to Evers (2015), in parts of Asia, indigenous Austronesian communities living in coastal Southeast Asia embody water-community linkages in their traditions. They adapt to flooding and geophysical conditions by constructing their houses on stilts, elevating them above the flood-prone muddy ground. This stilt house design, common in countries like Indonesia, Malaysia, Cambodia, Vietnam, and Singapore, also enhances airflow quality and mitigates insect problems in dwellings (Evers, 2015).

Positive management of human interactions with floods can enable coexistence within settlements. Floods, unlike other natural hazards, can bring economic and environmental benefits, especially in tropical regions. Seasonal flooding, for instance, enriches farmlands with alluvium, boosts wild fishery resources, purges sulphate soils of salts and toxins, eradicates pests, and replenishes groundwater (Liao et al., 2016). Cuny (1991) describes how floods can deposit sandbars as a seed for producing barrier islands, which can help minimise tropical storm surges and enlarge the land territory. The mud from floods can be used for construction, as topsoil, and for landfill (Cuny, 1991). Floods have exerted influence upon human existence for millennia and have ultimately sculpted the cultural landscapes and traditions of societies, propelling advancements in environmental management techniques (Swyngedouw, 2004).

The idea of accepting more water into the city aligns with the flood adaptation paradigm. According to Birkmann (2011); Mashi et al. (2020), the flood adaptation paradigm helps prevent flood damage by allowing water to enter the city, as opposed to restricting it and then having problems when the barriers break. Flood adaptation can be embodied through amphibious built forms that allow flooding to enter the city while minimising damage (Few et al., 2007). Amphibious urbanism, which encourages flood-tolerant lifestyles and embraces living with floods, bolsters city resilience in fluctuating hydrological conditions, thereby potentially reducing the adverse impacts of flooding (Liao et al., 2016).

There are many examples of communities living with floods, manifested through the small-scale efforts of property owners, often in rural village areas in majority world countries (Pham et al., 2022). All coastal and river delta areas are, however, unique to their geographical contexts. In Jakarta, such lifestyles include living in houses on stilts and using footbridges or boats to maintain mobility during flooding (Wohl, 2000). Liao et al. (2016) state that modern cities cultivating harmony with water need to acknowledge the socio-economic benefits of flooding as a natural city dynamic. This perspective is encapsulated in the development of amphibious urbanism, illustrated in Singapore's biophilic design for instance. Climate change adaptation is pertinent to several domains of knowledge, namely scientific knowledge, local insight, and traditional wisdom (Khatibi et al., 2021).

2.2. Flood adaptation and water governance in Jakarta

This section considers the extent to which flood adaptation approaches in Jakarta have been discussed or defined in prior research. It further identifies the flood management strategies that have been implemented in the city since the colonial era. The discussion culminates in outlining the specific research objectives concerning approaches to flooding in Jakarta.

Spatial planning in Jakarta has policy pathways to incorporate communities' local knowledge when creating flood-adapted built environments. Indonesia is prone to many forms of natural hazard events, including flooding, due to its geographical conditions (Maknun and Busono (2016). Communities have accumulated local knowledge about how to face natural events in their areas. Indigenous community members commonly maintain such knowledge and implement it in their environments (Maknun & Busono, 2016).

According to Simarmata and Krishnan (2018), Putra et al. (2019), and Marfai et al. (2015), flood adaptation approaches can be found in the kampungs or informal settlements in Jakarta. Putra et al. (2019) state that physical interventions in the kampungs are undertaken through the development of brick or wooden embankments that hold back seawater, while social actions are realised through the implementation of environmental clean-up programmes. Marfai et al. (2015) state that physical strategies include the elevation of house levels and the development of small dykes to prevent water from entering the settlements. Non-physical strategies are usually in the form of community movements like collectively cleaning the drainage channels and rivers (Marfai et al., 2015).

Simarmata and Krishnan (2018) state that the kampung communities in the north of Jakarta are vulnerable to floods because they have limited assets, economic means and access to resources. However, some people in these communities have undertaken flood adaptation strategies that help them survive floods. One of these is to manage floodwater by rearranging their living spaces. Some kampung inhabitants continuously increase the height of the floor in their houses to minimise the amount of water that can enter them during flooding. However, such inhabitants do not have enough capacity to also elevate their roof heights; hence, this intervention causes the space in houses to progressively shrink. Another strategy is to create hanging wooden storage for cooking and electrical equipment, attached on the wall at a specific height to ensure they were not inundated during flooding (Simarmata & Krishnan, 2018).

Jakarta is an example of a coastal megacity in the majority world, with a colonial past that changed the course of history and water running through the city. Historical spatial planning policies constitute a hurdle in the realisation of a built environment that harmonises with water in the city. These policies tend to promote flood management approaches that fundamentally contradict flood adaptation. The predominance of Western scientific flood solutions in Jakarta has prevailed from the Dutch colonial period through to today. The earliest substantial flood event recorded in historical documents occurred in 1621, three years after the advent of the Dutch colonial period (Gunawan, 2010). As a response, the construction of canals was undertaken within the inner walled district of Batavia, the name for Jakarta during the Dutch East India Company era (Octavianti & Charles, 2018). These canals served as a vital mode of transport during that era (Abeyasekere, 1987). The colonial administration persistently developed these waterways, constructing more than five canals across Batavia's 1.3 km^2 expanse within the initial 30 years of occupation (Putri & Rahmanti, 2010).

Ever since then, flood mitigation in Jakarta has predominantly relied on engineering-driven solutions. The genesis of structured spatial planning and flood management in Indonesia, which underscores infrastructure-oriented measures, can be traced back to the colonial era. According to Meulder (2013), these planning approaches, originated in the Low Countries (including the Netherlands, Belgium, and Luxembourg), and were in a form of a flowchart, with canals delineating the functionality and structure of the mercantile city plan in Jakarta. However, imported approaches turned out to be ineffective, given that the original waterways in Jakarta did not exhibit the placid characteristics of rivers in the Low Countries, but are instead dynamic and seasonal. The significant fluctuations in water movements in the tropical climate bear large volumes of sediment and trigger torrents of polluted water from muddy waterways with limited capacity, making canal maintenance a formidable task. This incongruity between water course planning and environmental characteristics exacerbated the incidence of floods leading to more disastrous outcomes. The malaria epidemic during the colonial period illustrated this trend (Meulder (2013)).

As noted by Octavianti and Charles (2018), the strategy of foregrounding infrastructural measures to counter flooding has endured up to the present day. Jakarta is furnished with a flood control infrastructure network, which the government anticipates will be effective in forestalling flood hazards. A myriad of factors contribute to the continuance of a flood management approach in Jakarta that stresses water control. A pivotal factor is the compatibility of substantial infrastructure development with Jakarta's brief political cycles, as this approach produces prompt and conspicuous results (Octavianti & Charles, 2018). However, these engineering-focused solutions appear to offer insufficient remedies for competently managing flood hazards. According to Brinkman and Hartman (2008), this situation occurs due to land subsidence in Jakarta that changes the city's topography and reduces the effectiveness of canals in managing water flow. As such, the restoration of canals to their original design is encouraged through the Jakarta Emergency Dredging Initiative (JEDI) project, anticipated to accommodate more water during heavy rainfalls (Brinkman & Hartman, 2008).

Crawford et al. (2023) argue that the majority world, home to most humans and other living beings, faces significant climate injustice. Regions in the majority world endure the harshest impacts of climate change despite their relatively minor contribution to global warming. The voices of those most affected by this injustice need to be amplified. Globally, communities possess diverse knowledges, traditions, and approaches that are crucial in understanding and responding to climate change. These include the potential for innovative and sustainable solutions rooted in local contexts and cultures (Crawford et al., 2023). Previous studies have stated that kampung communities in Jakarta adapt to flooding through interventions that include raising the floor heights of houses and creating dykes in front of homes at a height above flood level, these actions as yet have only been applied on a small scale as they can only provide short-term solutions in helping reduce flood damage. Property-scale embankments and raised water-impermeable road-level surfaces made by communities can easily be surpassed by floodwater since the height of inundation continuously increases due to climate change.

This study examines the capacity of residents in Jakarta's informal settlements to establish contemporary amphibious settlement forms. It also delves into potential macro-scale development strategies that could offer mid-term flood adaptation solutions. The flood adaptation approach under investigation operates on scales from neighbourhood to regional, embracing a paradigm that prioritises accommodating water rather than evading it. The integration of spaces for water absorption with amphibious building forms might serve as a viable macro-scale, mid-term flood adaptation strategy. This is based on the premise that when the groundwater table is sufficiently deep below the surface, settlements with porous ground surfaces can mitigate the rise in floodwater levels and prevent water ingress into homes. Furthermore, this study explores the impacts of globalisation, spatial planning, and financial considerations on long-term interventions, aiming to provide a comprehensive understanding of their applicability across Jakarta.

3. Study areas

DKI Jakarta Province, that is, the City of Jakarta, the capital of Indonesia, is subdivided into five municipalities—Central, North, South, East, and West—and one administrative regency, Kepulauan Seribu Regency. Jakarta's land area, at 662 km^2, is very restricted. In 2016 its population was around 10,277,000 (DKI Jakarta Province Central Bureau of Statistics, 2017a), and relatively dense at 15,524 people/km^2. This section begins with an examination of Jakarta's prevailing spatial planning approach and the various dynamics of its policy implementation. The chapter concludes with a rationale detailing the selection of the study location, based on various considerations related to social and environmental circumstances. The discussion in this section provides a more comprehensive perspective on the situation in Jakarta, focusing on the challenges of spatial planning. This follows a detailed examination in the Section 2.2 of the city's flood management challenges. The information presented in this section also lays the foundation for the research methodology to be discussed in Section 4.

As a unified nation, the Republic of Indonesia adopts the same approach towards spatial policy in all its cities and districts. Consequently, understanding the country's spatial planning system is pivotal to grasping the urban planning approach in Jakarta. In Indonesia, the urban planning system has evolved since the early 20th century colonial era through several forms of governance, each with its unique geographical focus and objectives. Prior to the current Spatial Planning Law 26/2007 of Indonesia, which aims to guide various public and private developments in urban and rural zones, at least three consecutive planning policies were instituted across different periods. The Dutch colonial administration established a system in 1926 centred on guiding industrial expansion. The post-colonial regime in 1948 was concerned with enhancing residential environments in Java, while the New Order

regime in 1992 sought to extend this focus beyond Java (see Hudalah & Woltjer, 2007; Niessen, 1999; Presiden Republik Indonesia, 2007; Winarso & Firman, 2002).

The current Indonesian planning system, as outlined by the Spatial Planning Law 26/2007 (Presiden Republik Indonesia, 2007), is modelled on the philosophy underpinning land-use management systems found in North America. This method relies heavily on the implementation of rigid zoning regulations and codes to oversee development and growth (Hudalah & Woltjer, 2007). As stipulated in the Spatial Planning Law 26/2007 (Presiden Republik Indonesia, 2007) spatial planning is viewed as the materialisation of spatial patterns and structures. In this context, spatial pattern refers to the assignment and dispersion of space for conservation and development purposes. Simultaneously, spatial structure denotes the architecture of residential centres and infrastructure network systems that function to facilitate the economic and social activities of a society.

A notable divergence between the existing Indonesian spatial planning law and its predecessors is the inclusion of a legal enforcement mechanism in the updated system. Rukmana (2015) recounts that in implementing the regulatory and master planning system in Indonesia, the government evaluated the majority of land uses across the country to ascertain compliance with the regulations outlined in the spatial plans, ultimately discovering most were not in adherence. The government posited that this was due to the lack of sanctions for breaches in Spatial Planning Law 24/1992, resulting in a lack of impetus for individuals to follow the rules. The absence of such penalties enabled government officials to grant specific exemptions, which, in turn, undermined regulatory efficacy and fostered noncompliance (Rukmana, 2015).

As reported by Rukmana (2015), the Indonesian government anticipated that integrating a law enforcement scheme into Spatial Planning Law 26/2007 would remedy this ineffectiveness. In addition to the enforcement mechanism and provisions to amplify control over development, the 2007 legislation also introduced new methods, such as planning permits, zoning laws, and the implementation of both rewards and penalties for compliance and noncompliance, respectively. However, several experts, including government officials from the Ministry of Public Works and the National Development Planning Agency, contend that enforcing Spatial Planning Law 26/2007 is unlikely to significantly change the efficacy of spatial planning regulations in Indonesian cities. This is because in practice, to ensure development conforms to planning objectives, fostering community awareness and compliance with spatial planning regulations is more crucial than instilling fear. There exists a threat of imprisonment for those who violate spatial planning policies; however, the enforcement of laws in Indonesia is relatively weak, which means that in practice, many developments do not adhere to spatial planning. Consequently, building community awareness to encourage sustainable environments through the implementation of spatial planning may be more crucial, as it is founded on voluntariness and can yield more significant and widespread effects. Specifically, in the Greater Jakarta region, the inclusion of penalties for spatial plan infringements has failed to ensure sanctions are imposed on local governments and landowners who transform green spaces into residential and commercial properties (Rukmana, 2015).

As outlined at the beginning of this paper, the urban planning approach in Jakarta reflects the implementation of classical planning theory. It has also been explained that this top-down and rigid approach tends to produce non-inclusive spatial plans that fail to provide site-specific solutions. Healey (1998) argues that planning approaches focused on strict regulations and top-down methodologies need to be improved by incorporating broader collaborative and participatory methods. She emphasises the importance of involving various stakeholders, including the community, in the planning process to resolve conflicts and promote better place quality. The goal is to create a more sustainable, responsive, and inclusive system that can better address contemporary needs and challenges in the context of a 'stakeholder society' (Healey, 1998).

Collaborative planning also has a significant role in promoting flood adaptation. Knowledge of flood adaptation that is rooted in local wisdom of indigenous communities (Liao et al., 2016) has the potential to be enhanced through participatory planning processes. This is because, as stated by Berman (2016), an authentic public participation process can be a tool for integrating local knowledge into spatial planning. In Indonesia, the application of participatory mechanisms has changed from time to time alongside changes to the government's system. Sjaifudian (2002) stated that in the new order regime (1965–1998), development planning in Indonesia was claimed by the officials to be participatory, a statement limited in meaning because these participatory processes only involved business people, academics, local bureaucrats, and middle- and upper-class citizens.

Widianingsih and Morrell (2007) argue that in the new order regime, there has been a change in planning from being purely top-down during the 1960 s into a combination of bottom-up and top-down planning approaches. Soltani et al. (2012) state that bottom-up planning means each group of citizens has the opportunity to be involved in the process of spatial planning policy formulation. This is different from top-down planning where the emphasis is on processes that are undertaken by the governments with the joint contribution of the citizens (Soltani et al., 2012).

In 1982, the central government enacted a ministerial decree about bottom-up planning processes, regulating that development planning be conducted from the kelurahan or village, as the lowest level of government administration, going up to the higher levels of the municipality or district. However, since the authority to decide and execute such processes remained with the central government and collaboration with grassroots was limited, the integration of views and aspirations of communities in spatial planning remained scarce. Therefore, in 2005, according to an Indonesian NGO activist, the government-initiated participatory planning was not functioning successfully (Widianingsih & Morrell, 2007).

Since 1997, regime changes have transformed the Indonesian government from an authoritarian to a more democratic administration. The changes made to the spatial planning system reflect the new Indonesian government. Unlike the previous Spatial Planning Law 24/1992 that mirrored an authoritarian administration and was not suitable for a decentralised government, the new Spatial Planning Law 26/2007 supports the enactment of operational government regulations aligned with spatial planning laws that allow for more participation (Rukmana, 2015).

The Regulation of the Minister of Public Works on the Spatial Planning Preparation Guidelines (17/2009) stipulates that community involvement is required at almost all steps of the spatial planning process. In the preparation stage, the community receives information about the government's initial data analysis and is able to review the spatial planning regulations and other related policies. During the information and data collection processes, communities are asked to contribute by sharing information, input, and opinions and identifying any spatial planning problems. The government then conducts internal analyses without community involvement to compile a development concept. When this is ready, the community is asked to share its views and aspirations on the resulting planning policy and strategy formulation. Finally, the community can convey any objections to the spatial plan draft document before the government passes it into law.

This shows that participatory planning in Indonesia includes public consultation. In general, in public consultation processes, the community's role is limited to providing information that is needed by the government to prepare spatial plans and then being asked for their views on these plans. Referring to the ladder of citizen participation developed by Arnstein (1969), Indonesian participatory planning emphasises public consultation as the only means of participation, and this is at the *tokenism* level of involvement, which is limited to informing, consulting, and placating. While tokenistic participation has greater community involvement level than *non-participation*, it is still at a lower level of

social involvement than *citizen power,* which prioritises partnerships, delegated power, and citizen leadership.

Conversely, Brody et al. (2003) divide public participation approaches into two: *one-way communication* and *collaborative*; the public consultation participatory planning process in Indonesia falls into the one-way communication category. Brody et al.'s (2003) description of public hearing processes reflects Indonesian participatory planning, while true collaborative approaches consist of providing opportunities for the community to collaborate and contribute to the development of plans with the planning staff through charrettes and community forum workshops.

According to Berman (2016), these two participatory planning methods are distinct since consultation uses *unilateral* or *unidirectional procedures*, and authentic participation implies a *collaborative process*. The public consultation processes applied in Indonesia, as a participatory planning mechanism, can be classified as unilateral procedures. Public consultation remains oriented top-down and discretionary—controlled by the government, which often only allows public hearings.

In terms of the integration of local knowledge into spatial planning, as focused on in this study, public consultation, as a participatory planning mechanism in Indonesia, might be ineffective in realising such integration. Berman (2016) argues that public consultation as a participatory mechanism is limited in incorporating local knowledge into planning, because public consultation can only capture superficial information from communities. He adds that public consultation may trigger distrust between the government and the communities due to a lack of transparency in the discussion stages, which may obscure manipulative communication throughout such processes.

Damayanti and Syarifuddin (2020) identify that the current participatory planning approach in Indonesia cannot properly involve communities in the planning process and is also unable to promote settlements that can address community needs. This is due to several factors. The public consultation meetings only include village leaders, who are closely aligned with the authorities, as participants. The participatory processes are also merely symbolic and do not have a mechanism that ensures communities can be involved at every stage of development (Damayanti & Syarifuddin, 2020).

3.1. Flooding situation in the city and determination of case study area

This section provides an in-depth examination of the flood situation in Jakarta, outlining the frequency and magnitude of occurrences, the spatial distribution including the most affected areas and communities, and the resultant damages. The rationale for the research location selection is explained at the conclusion of this section, grounded in the previously detailed flood circumstances and information pertaining to communities possessing indigenous knowledge on flood adaptation.

In Jakarta, flooding is an annual event during the rainy season, with more extensive flooding that inflicts significant damage occurring approximately every five years (Adi, 2014). The city's rainy season typically extends from December to March (Hendiarti, 2011). Table 1 provides a detailed account of the destruction caused by recent large floods in the city. It is anticipated that the city will face further severe flooding in coming years. The consistent land subsidence exacerbates the rising flood inundation volumes in the city (Moe et al., 2016). The combined impact of sea-level rise and land subsidence is expected to extend the potential flood-prone area of the city, with water depths of 1 m or more, to 110.5 km^2 over the next century or by 2050 (Dwirahmadi et al., 2019, p. 2).

Climate change and modifications to land use have contributed to increased frequency of severe flooding incidents in Jakarta (Kure et al., 2014). The breadth of these inundations throughout the city has also seen a marked rise, with approximately 61, 90, and 159 sites affected in 1992, 1996, and 2002, respectively (Asdak & Supian, 2018). Hanson et al. (2011) projected that by 2070, Jakarta will rank globally as the 20th most vulnerable city out of 136 port cities concerning population and infrastructure exposed to coastal flooding. By 2050, it is expected to rank 11th in terms of predicted annual losses due to flooding. Within Southeast Asia, this standing is below Ho Chi Minh City, at 9th, and above Bangkok, at 18th (Hallegatte et al., 2013).

In Jakarta, the adverse effects of flooding mostly affect the city's informal and impoverished districts or kampungs (Texier, 2008). Approximately a quarter of Jakarta's population living in deprived communities are in North Jakarta (DKI Jakarta Province Central Bureau of Statistics, 2017a). Besides being home to the city's greatest concentration of the poor, northern Jakarta, as described by Tambunan (2017), is also the area with the highest potential for flooding. Alongside the combined problems of poverty and flooding, North Jakarta is also culturally rich. For example, Jakarta's coastal area, located in the North Jakarta municipality, is where the majority of Jakarta's indigenous population, the Betawi, live (Schefold & Nas, 2014). The unique culture in North Jakarta kampungs attracts international tourists who come to see how local culture can thrive under challenging urban conditions (Prasetyanti, 2015).

Communities in Northern Jakarta are therefore able to support the research objective of exploring how spatial planning and local knowledge can influence flood management approaches and the flood situation in Jakarta. The culturally rich kampungs of North Jakarta are potentially home to forms of local knowledge about flood adaptation, reflecting that Indonesian societies, in general, have a culture that emphasises maintaining harmony between nature and human beings (Kartika, 2016). We chose five kampungs in North Jakarta as case study areas (Fig. 1). For the identification of flood-affected areas, this research used a 2015 flood report from the Jakarta Province Disaster Management Agency (BPBD DKI Jakarta) as a reference. This flood data, showing flood extent in the sub-village units, was used because the 2015 flood was the most recent major flood event in Jakarta at the time fieldwork began. As illustrated by Schrier et al. (2017), the 2015 event inundated more than a fifth of Jakarta to depths of 40 to 100 cm.

United Nations HABITAT (2015) states that a residential area can be considered an informal settlement when specific criteria are met: (i) a residential area that is inhabited by people who do not have security of tenure for the land or dwelling they inhabit; (ii) the form of settlement can vary, ranging from squatting to informal rental housing; (iii) informal settlement neighbourhoods are often cut off from city infrastructure and basic services; and (iv) informal settlements often include illegal housing that does not comply with building and planning regulations, and is located in environmentally and/or geographically vulnerable areas (United Nations HABITAT, 2015). As defined by the

Table 1
Jakarta's recent flooding history.

Year	Total Damage Cost Estimate (USD)	Other Recorded Flood Impacts	Reference
2002	1510,000,000	Caused 48 fatalities and 276,333 people had to be evacuated.	Bappenas (2007); andNuraini (2020)
2007	890,000,000	One of the most severe floods on record. Caused the closure of many roads and rail lines, including the highway to the international airport, and the displacement of over half a million people.	Adi (2014);Bappenas (2007); and Y.Budiyono et al. (2015)
2013	562,008,750	Disruption of the function and transmission of damaged power plant equipment; 14 fatalities.	Adi (2014) and own professional observations and experience

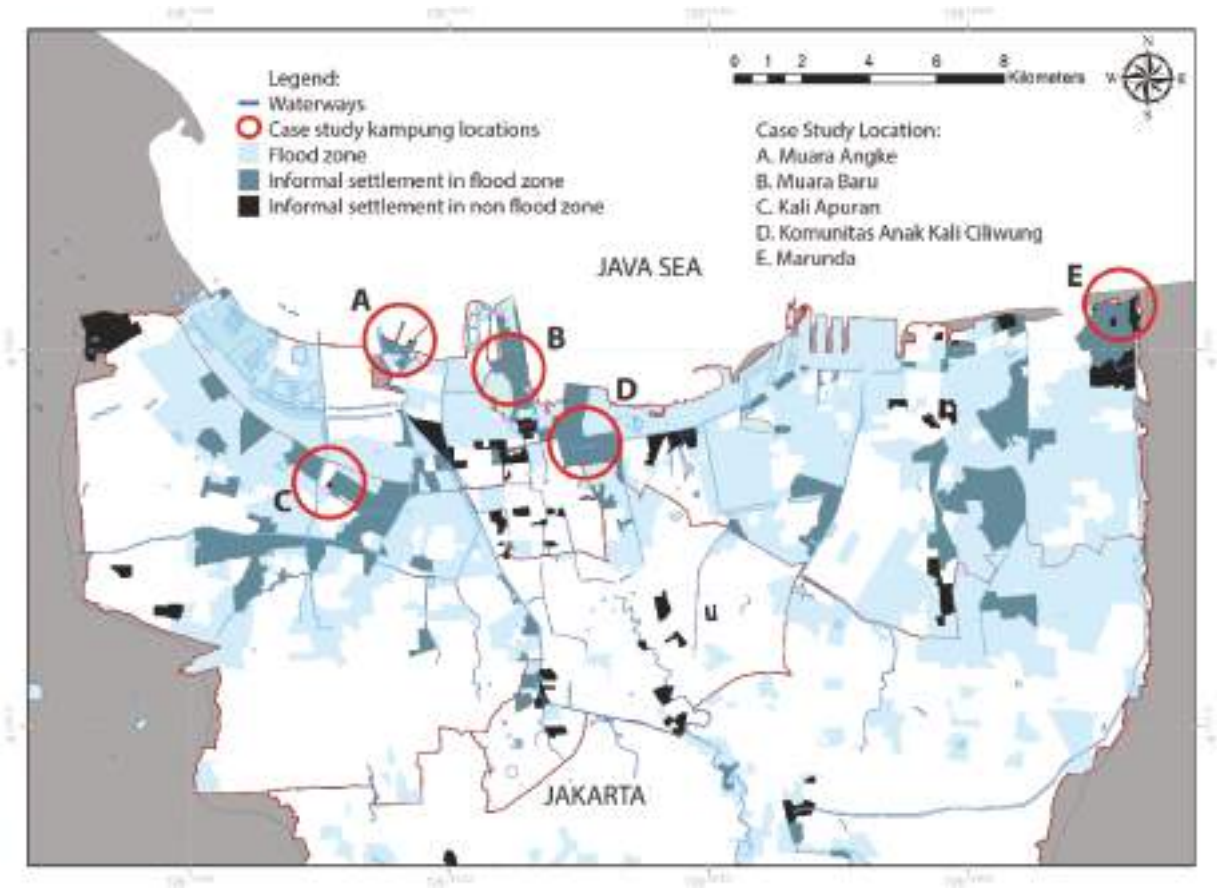

Fig. 1. Nested maps showing the case study locations, informal settlements, and flooding-affected areas in northern Jakarta. Flood areas are identified based on the Jakarta Province Disaster Management Agency's (BPBD DKI Jakarta) 2015 flood report. Kampung or informal settlement areas are identified based on Jakarta's Central Bureau of Statistics (BPS) data 2017.

United Nations HABITAT (2015), the term 'slum' is given to an area that has worse conditions than other informal settlements and, hence, the inhabitants are under a higher level of threat of eviction.

> Slums are the most deprived and excluded form of informal settlements characterised by poverty and large agglomerations of dilapidated housing often located in the most hazardous urban land. In addition to tenure insecurity, slum dwellers lack formal supply of basic infrastructure and services, public space and green areas, and are constantly exposed to eviction, disease and violence (United Nations HABITAT, 2015, p. 1).

In reference to the above definitions, the case study areas can be categorised as either slums or informal settlements. Section 5 provides a more detailed description of the built environments of the case study urban villages—the kampungs—and depicts how both types of settlement conditions can be found within them.

As illustrated earlier in this paper, we emphasise recognising the importance and diversity of people and places. We also reject the hierarchical duality of self and others that shaped the building blocks of western modernity, which tend not to be beneficial for urban developments in the majority world. The term 'slum' may not necessarily suit such perspectives due to its depiction of otherness.

> [S]lum was discursively construed as well as touristically staged and experienced as 'the other side of the city', and as the 'place of the "Other"'. At the same time … this ascribed 'Other' had often been a lot more than just the 'economic "Other"'—the slum was more than just the 'place of poverty'. The slum was also a surface for the projection of a societal 'Other'. (Steinbrink et al., 2012, p. 3)

Nonetheless, the term 'slum', and others including 'deprived' or 'poverty', cannot be avoided in this research. These terms, which are commonly used in studies on development in the majority world, are needed to describe the condition of the case study areas of this research. However, we try to replace such otherness-oriented terms with phrases that recognise the importance of people and places whenever possible. We prioritise 'kampung' or 'informal settlement' over 'slum', and 'communities' over 'slum settlers'. This section has explained how the study areas were selected. The next part indicates the methods of this research.

4. Methods

This research adopts a qualitative research methodology using a case study approach. This research focuses on how kampung communities face flood events using flood adaptation interventions. The research aims include observing the tools, resources and mechanisms local communities already deploy, which may assist more sustainable forms of water governance. Considerations of spatial planning practices in relation to the experiences of kampung residents also feature prominently in this research. There were sometimes sensitive issues involved in the development approach undertaken by the communities on floodplains. Therefore, ethical issues including anonymity and confidentiality (Clifford et al., 2016) needed to be accommodated. The participants needed to be assured that the information they provided would be protected by a reliable data protection system. In this study, the development of the detailed questions used for the data collection method was based on the literature, and the lists of questions were approved by the University of Canterbury's Human Ethics Committee.

We used semi-structured interviews and observations. The participants were members of flood-affected communities. They mainly work in informal sectors with no fixed working hours and could not be met several times at scheduled meetings. Bernard (2011) considers the semi-structured interview an effective method to understand the perspectives of interviewees who we can only meet once. The interviews were undertaken using a participatory design approach, where, according to Sanders and Stappers (2008), participants are given greater agency and space for initiative in roles where they contribute expertise and engage in activities of information sharing, ideation, and conceptualisation during the early design stages. Interviews offer deeper insights of local knowledge, enhanced conversation control, and flexibility (Creswell, 2014). This was a key consideration for favouring this method over other qualitative techniques such as focus groups, which, as pointed out by Krueger (2014), can be influenced by group dynamics and conformity effects, pose logistical challenges and higher costs, and produce data that is challenging to analyse due to the complexity of interactions.

Ten residents were chosen, two from each of the five kampungs in North Jakarta that serve as our case study areas. These individuals, recommended by fellow kampung inhabitants, were chosen for their comprehensive understanding of their respective kampungs in terms of history, geography, and culture. Most often, these interviewees were esteemed elders, community figures, or village chiefs. Regarding the data collection process, the researcher initially introduced themself on a personal basis, going door-to-door amongst the kampung residents. In instances where neighbourhood residents were hesitant towards researchers, this study partnered with the Rujak Center for Urban Studies, an NGO with deep ties from their work in North Jakarta's slum upgrading. Their involvement effectively bridged access to the community, highlighting the research's benefits. Those residents who agreed to participate in the study were asked to sign a consent form. Each interview session lasted around one hour, covering topics like perceptions on their current flood situation in the context of their kampungs, how planning policies affected their lives, and flood adaptation efforts.

During the data collection phase, we endeavoured to acquire information pertaining to the community and the environment participants inhabit, encompassing not only the present but also the past and projections for the future. This approach is grounded in insights gleaned from prior studies such as those conducted by Gunderson (2001), Adger, Hughes, et al. (2005); Pelling and Manuel-Navarrete (2011). Drawing from such studies, it is discernible that the concept of flood adaptation is intimately intertwined with co-evolution, which refers to the mutual development between societies and their environments. This perspective acknowledges the interconnectedness between human activities and environmental processes, including flood risks. Thus, effective flood adaptation strategies should consider these interrelationships, leading to the resilience and sustainability of human–environment systems. This approach necessitates a deep understanding of the complex dynamics between human activities, environmental processes, and the social, economic, and institutional structures that shape them (Adger, Hughes, et al., 2005; Gunderson, 2001; Pelling & Manuel-Navarrete, 2011).

We also draw on structured observations. Specific social–temporal conditions of concern can be interpreted through observations that emphasise direct experience (Kearns, 2016). As stated by Lindlof and Taylor (2017), in structured observations only certain kinds of behaviour, events, or situations are watched by an observer. With this method, primary data collection can be contributed to through the observer's own assumptions about the perceived behaviour, situation, or event, since structured observations do not involve questions or interventions (Yin, 2013).

Initially, we observed and made notes concerning the building and the environmental modifications made by the kampung communities to reduce flooding in the case study areas. As evidence, we took video recordings and photographs showing their efforts. Besides examining physical phenomena, we also made observations about the communities' activities in the case study locations related to flood adaptation, avoiding direct interference and instead watching and taking field notes from a distance. Liamputtong and Serry (2013) argue that photography in combination with attention paid by the observer can enable details to be noticed. The results of observations can be amalgamated with other field exercises to achieve better case understanding (Yin, 2013).

This section has illustrated how the research methodology has been tailored to the circumstances of the study area, as identified in earlier sections. For instance, the participants are not only those engaged in informal employment but also those who might be considered in breach of spatial planning policies, necessitating the confidentiality of their identities. Section 5 will present the findings.

5. Results

In this section, an understanding of flooding in the case study areas and how it can be adapted to is constructed from a discussion of the relationships between the communities' lifestyles, dwelling cultures, built environment forms, and flood situations, both in the past (Section 5.1) and at present (Section 5.2). We discuss the findings to demonstrate the extent to which flood-adapted built environments, based on local knowledge and values, are and can be developed in the case study kampungs. We then discuss spatial planning and globalisation as factors that need to be taken into account if flood-adapted settlements are pursued on a wider scale in the future (Section 5.3). Some of the large kampungs examined in this study are further divided into several neighbourhoods. See Table 2 for a list of their neighbourhood names and other data of the informal settlements including year established, kampung type and number of interviewees per kampung.

5.1. Past flooding, the built environment, and community adaptation memories

The discussion in this section commences with an explanation as to why communities inhabit their respective settlements. This is followed by a discourse concerning their past lifestyles and how such dynamics relate to the process of flood adaptation.

5.1.1. Why did the early settlers decide to settle in the case study kampungs?

Kampungs in this study can be classified into two types: the older ones established from the colonial era to the 1960 s and the more recent ones founded from the 1980 s onwards. Based on discussions with residents of the older kampungs, such as Kampung Marunda (seaside) and Kampung Anak Kali Ciliwung (riverside), the kampung founders chose these locations for their ability to provide food and support their livelihoods as fishers, fish sellers, and ship craftsmen.

Table 2
List of the kampung study areas, year of establishment, and number of interviewees per kampung.

Kampung Type	Kampung Name	Neigbourhood Name	Year Established	Number of Interviewees per kampung
Seaside	Muara Angke	Kerang Ijo, Tembok Bolong, and Baru	2010 s	2
Seaside	Muara Baru	Elektro, Marlina, and Gedung Pompa	1970 s	2
Riverside	Anak Kali Ciliwung	Tongkol, Lodan, and Kerapu	1960 s	2
Seaside	Marunda	-	Dutch colonial era	2
Riverside	Kali Apuran	-	1980 s	2

Settlements were established on swampy ground and around pond areas along the river banks and coasts as well as directly on the water. The kampung settlements were built on the ecologically sensitive riparian areas since those areas offered resources that were needed by the kampung settlers.

> This village has been around since the Dutch colonial era… I have lived here since I was born in 1976. My parents chose to live here because this [estuary area] was suitable for their occupation as fishers … The old people here said that in the old days they were not worried about food since fish were abundant and their farming activities were supported by plenty of fertile land. (Quote 1, CM 7, 42 y male factory worker and seaside kampung dweller)

> This kampung was founded in the 1960 s. The section of Ciliwung River where this kampung is situated was the trading centre at that time. In the past, the inhabitants of this kampung were ship craftsmen who fixed broken trading ships. At that time, the kampung's ship docks were integrated into the port nearby. That means many fish sellers also lived here. (Quote 2, CM 5, 19 y female student and riverside kampung dweller)

We found that the reason why previous generations established the newer kampungs such as Kampung Muara Angke, Kampung Muara Baru, and Kampung Kali Apuran were slightly different to the older ones. Previously, the main reason for the founding of the kampungs was the natural wealth offered by the wetland areas. As the following quotes demonstrate, the newer kampungs were established by victims of eviction and by the homeless who found that the wetland area was the only place that they could occupy. The kampung settlers came from many areas across Indonesia including islands of Sulawesi and Sumatra.

> [Up] until the 80 s, this area was a swamp and pond. This kampung started to be built in 1986… At that time the early settlers of this kampung chose to live here because this area was a no man's land and they could stay here for free … Many of my neighbours are not from around here [Jakarta]. Their parents who first came to live in this kampung can be from Makassar, Lampung, or other cities around Indonesia. (Quote 3, CM 9, 52 y male mechanic and riverside kampung dweller)

> In the early 2010 s, as victims of eviction, the communities here were trying to find [a place not only to] shelter from the rain and heat but that also had potential to provide a new livelihood. And so we came to this pond and seaside area. We realise that now we are in the same situation where we inhabit an area that is considered illegal under the government's [spatial planning] regulations. However, we think living in this kampung is the best solution for now since the government has not noticed this area much yet. (Quote 4, CM 1, 37 y female fisher and seaside kampung dweller)

These quotes also imply that land in the city is getting harder to come by; hence, the kampung communities have to inhabit the wetland areas. According to the DKI Jakarta Province Central Bureau of Statistics (2017b), informal settlements are created in Jakarta when the city space is no longer able to accommodate the increasing population. An in-depth explanation of the informal settlement situation in the case study area and how this relates to flooding there can be found in Sections 5.2 and 5.3.

In Jakarta, the occupation of vacant areas leading to informal settlements, as seen in the case study kampungs, is a common phenomenon. According to the DKI Jakarta Province DKI Jakarta Province Central Bureau of Statistics (2017b), the number of informal settlements continues to grow. The government of Jakarta identifies informal settlement areas based on the Rukun Warga (RW), a city administrative unit at the next to lowest level that consists of several neighbourhood associations or Rukun Tetangga (RT) (DKI Jakarta Province Central Bureau of Statistics, 2017a). As can be seen in Fig. 2, from 2013 to 2017, the number of RW increased by 34 in North Jakarta and by 298 in Jakarta as a whole, to reach a total of 89 and 521 respectively.

DKI Jakarta Province Central Bureau of Statistics (2017b) highlights that despite ongoing development of new settlements in Jakarta, informal settlements persistently rise due to affordability issues, leaving kampung communities no choice but to stay in informal habitats. This government report indicates that the city is experiencing continued population growth that it cannot accommodate (DKI Jakarta Province Central Bureau of Statistics, 2017b).

5.1.2. *Kampungs in the past*

Our research suggests that the initial formation of kampungs in the case study areas, by earlier generations, did not exacerbate flooding since the settlers utilised traditional environmental knowledge to harmonise with water, effectively adapting to flooding. We found that the initial kampung settlements on the riverside and seaside areas were less well designed to allow their inhabitants to have high-intensity contact with the water. In the past, in response to a watery environment, the community built stilt houses on natural ground surfaces, including sand, or even directly over ponds and rivers.

> In response to high tide water that covers all of the kampung areas, back then all of the houses were stilt houses. This included not only houses located right next to the river but also those situated in the

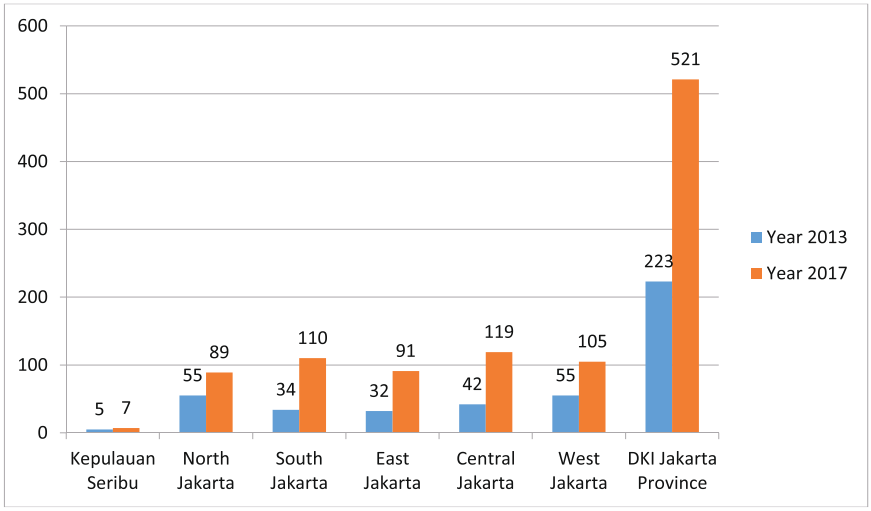

Fig. 2. Number of informal settlements, or Rukun Warga (RW), in Jakarta in 2013 and 2017 (DKI Jakarta Province Central Bureau of Statistics, 2017b).

middle of a neighbourhood and far from the river. (Quote 5, CM 7, 42 y male factory worker and seaside kampung dweller)

In the 1970 s to 1980 s, this area was built along a wooden dock [located above the river and on the riverside]. Unlike today, in the past, the house configuration was rowhouses facing each other with wooden bridges connecting every house. Our old house design supported our daily activities back then, which mainly used boats as a mode of transportation and as a means of earning a living. (Quote 6, CM 6, 36 y male activist and craftsman and riverside kampung dweller)

These quotes illustrate that the water-oriented lifestyle in the past not only shaped the house forms in response to fluctuating water levels—the stilt houses—but also had an influence on how the people travelled. In the past, the stilt houses were connected by a network of wooden bridges elevated above the high tide level, so that when the kampungs were inundated with water the people were still able to get around within the kampung area.

Further, as shown by the following quote, communities in the past were also able to travel further during flooding because the built environment at the time was shaped to enable kampung settlers to get around by boat. This also assisted its inhabitants' activities when earning a living.

When I was a kid my house was located on the river, and we used the river as transportation because the roads had not yet been provided … Back then, almost all of the houses were located along the riverside because we were fishers who owned boats and ships. We kept our boats next to our houses [attached to the river estuary], so that if we wanted to go to the sea, we could depart directly from our house, and we could fish from our house as well. (Quote 7, CM 7, 42 y male factory worker and seaside kampung dweller)

According to this quote, the built environment form in the past allowed people to fish directly from their houses. This was possible because at that time the natural environment was in good condition with plentiful fish and low levels of pollution and other hazards. This quote reflects the opinion of all the seaside kampung settlers interviewed in this research that the kampung's natural environmental conditions in the past provided food for them.

This discussions shows that in the past, when the water provided benefits for the communities, the shape of their settlements was generally adjusted to support the links between the water environment and the inhabitants' livelihood activities. The kampung houses of the past were shaped to fit the settlers' lifestyles as influenced by their professions as fishers, fish sellers, or ship artisans. The remaining traditional stilt houses are a useful reference to reinforce this finding, giving a picture of what the past kampung built environment used to look like.

The oldest case study area, Kampung Marunda, has a historical stilt house of a sophisticated form made of high-quality wood and well-crafted carvings. In the past, the stilt houses were inhabited by all classes of society, including the rich. Fig. 3 shows this house, called Rumah si Pitung, which was owned by a wealthy person in the past. The government uses it as a museum today, and, because many activities are held there, the ground cover has been changed from the traditional sandy substrate to an impermeable ceramic surface.

From Fig. 3 it can be seen that elements of the stilt house, especially the interior, share some characteristics with a ship. For example, the room door shape in Rumah si Pitung is curved with a threshold that is elevated higher than floor level. Moreover, the floor is constructed like a

Fig. 3. The Rumah si Pitung stilt house in Kampung Marunda.

ship's deck, with gaps in the wooden boards enabling the water that enters the house to stream away. This suggests that vernacular architecture is based on the experiences of communities and society, as it is highly probable that such houses were constructed using the fisher craftsmanship of the past communities.

According to the communities, stilt houses used to exist in other case study areas, such as Kampung Muara Baru, Kampung Anak Kali Ciliwung, and Kampung Kali Apuran, but there are no remaining historic stilt houses in those areas today. These communities did not document their areas in the past. However, to get an idea of how the old settlements might have looked, we can study historical photographs of stilt houses spread across many other parts of Jakarta, including near other coastal, riverside, and wetland proximal areas (Fig. 4).

As discussed earlier, links between the communities' lifestyles and their built environment formed in the past enabled them to keep travelling through the city in the dry and wet seasons, and this helped the communities provide food for themselves. The following section will discuss in more detail how the past built environment form contributed to supporting communities to adapt to a flood environment.

5.1.3. Traditional flood adaptation

The previous section showed that in the past the communities had a settlement form that related harmoniously to water and a traditional infrastructure network that enabled them to keep moving around the kampung when it was inundated. In the past, the communities built stilt houses on the wetlands without altering the ground surface below. Therefore, if water entered their neighbourhood, it did not cause a problem because the house was higher than the water level and the natural ground conditions helped the water to be absorbed. The old kampung settlements responded to the flood water better than those that exist nowadays, both in the seaside and riverside kampungs.

> In the past, when high tide water [from the sea] came we felt safe; we did not think about it. When high tide water came, all the boats could pass through here [the sand-roads in front of the house]. Since a long time ago we have been used to flooding. When there was no high tide

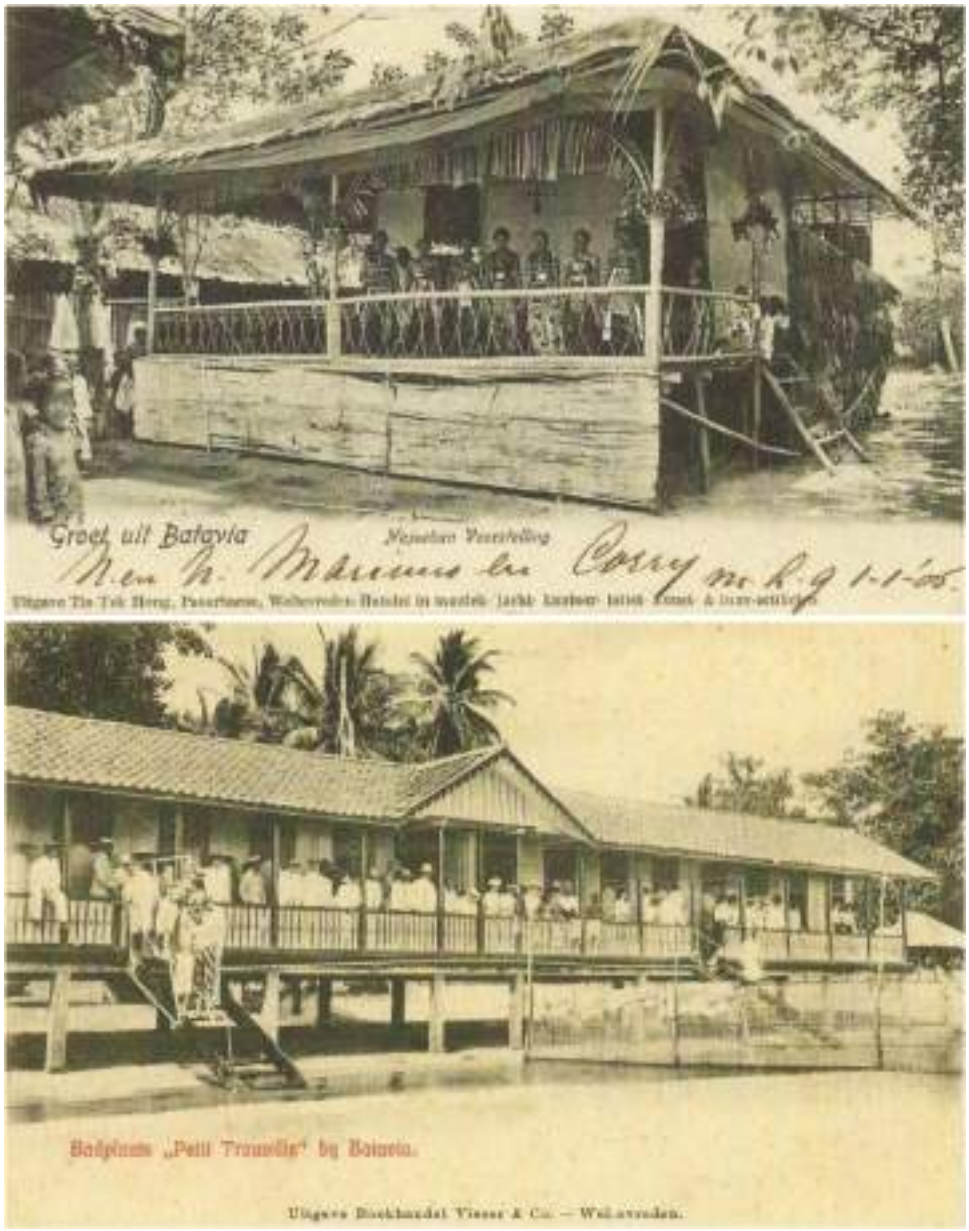

Fig. 4. Documentation of stilt houses in Jakarta during the Dutch colonial era from areas outside the present case study communities. The top picture shows a stilt house built by indigenous people of Jakarta and the bottom picture illustrates a stilt house made by the social elites (Merrillees, 2014).

> water, the sandy ground surfaces were dry, and when the high tide water came from the sea, it only took two to four hours until it receded, and everything was back to normal as usual. (Quote 8, CM 7, 42 y male factory worker and seaside kampung dweller)
>
> In the era of stilt houses, flooding did not exist [in this riverside neighbourhood] due to its location—built upon a riverbank area and a swamp with a lot of water channels. At that time, whenever water came it would be easily channelled by swamps and absorbed by the natural soil surfaces. (Quote 9, CM 9, 52 y male mechanic and riverside kampung dweller)

All interviewees in this study confirmed that traditional kampung surfaces effectively dealt with water. Seaside dwellers cited rapid absorption due to sandy ground during high tide, while riverside settlers noted that the maintenance of original ground conditions helped prevent flooding during river overflows after heavy rainfall.

5.2. Present flooding, the built environment, and contemporary flood adaptation

The previous section discussed why the early settlers chose wetland areas as their kampung locations, how the built environment form looked in the past, and how flooding was adapted to. This section examines how the communities' lifestyles today shape their built environment form, how the current forms affect the flood situation, and how communities today adapt to flooding despite their many constraints. Through these discussions, we identify the root causes of flooding problems in the case study areas and identify possible solutions that may be used as inputs for a flood adaptation strategy.

5.2.1. How kampung settlers live in their environment today

Historically, kampung livelihoods were closely tied to natural resources, with roles like fishing and ship crafting. However, inhabitants today are engaged in a wider variety of professions, primarily due to water pollution diminishing natural species, thereby making fishing non-viable. It is evident that Jakarta's swift urban development has intensified environmental degradation, marked by a decline in marine biodiversity due to the extensive construction of major infrastructure.

> We also cultivated green clams in this kampung in the past. Today, we can also catch them [although] in much fewer numbers than in the past. Maybe those that remain are the ones that survived from the wastes. As an example, in the past, many kinds of mussels, like white clam, kaco clam, and feather clam, could be caught in this area. Yet today, even catching only one of those kinds of mussels is very hard. Maybe that's also because of the development of a big port [near here] that made them lose the sand as their living habitat. (Quote 10, CM 7, 42 y male factory worker and seaside kampung dweller).

Eventually, the environmental degradation leads to livelihood transitions and changes in communities' lifestyles and means they need a new form of settlement that is not necessarily suitable for riparian conditions.

> [Therefore,] unlike my father and my grandfather who worked as fishers, I work in a factory. My parents told me that the profession of fisher is no longer promising and encouraged me to get an education so that I could work for a company. Since I use a motorcycle as my means of transportation in my daily work activities nowadays, I think that my neighbourhood now is also comfortable because the concrete road accommodates my needs in riding the bike. Sandy ground like [in] the old days could cause me difficulties in riding my motorcycle." (Quote 11, CM 7, 42 y male factory worker and seaside kampung dweller)

Each community member interviewed echoed the same sentiment, indicating a shift in professions from resource-dependent roles to others unrelated to water, such as factory work, driven by environmental pollution. This shift towards land-based activities necessitated the use of motorcycles and consequently, concrete surfaces. These changes have led to the transformation of the built environment, with ground-based brick houses replacing traditional stilt ones.

> Initially, we pile up our ground with clamshell sacks, then after a while, those clamshells will breakdown. When the clamshell has dissolved and turned to sand, then we cover it with debris of stone and concrete. After that, since the ground surfaces are no longer water permeable, we need to build a gutter to channel the water… Then we need to alter our houses from a stilt house to a brick house on land to suit our new type of land surface that is water impermeable and looks modern. (Quote 12, CM 2, 46 y male trader and seaside kampung dweller)

Fig. 5 shows how the community in Kampung Muara Angke gradually converted their ground cover from sand (Fig. 5, left) to rock debris mounds (Fig. 5, middle) and finally covering it with concrete (Fig. 5, right).

The transformation of the built environment illustrated in Quote 12 and Fig. 5 represents the ground surface alteration process of communities in both the seaside and riverside kampungs. In general, the kampung settlers initially built the ground up with layers of rock, gravel and inorganic soil on top of the natural ground surface to create a ground structure that was strong and stable. They then covered the rock or gravel with concrete and asphalt to ensure motorcycles could run smoothly on it.

This style of ground surface alteration seems to be extensive in all the kampungs in Jakarta. According to the DKI Jakarta Province Central Bureau of Statistics (2017b), of all the road surfaces in informal settlements in Jakarta, only 3% are still in their natural condition; the rest have been converted to gravel or concrete and asphalt. In North Jakarta, where the case study areas are mainly situated, about 49% of the road surfaces in informal settlements have been paved with concrete and asphalt and 43% covered with gravel, and only 6% remain in their natural condition. Fig. 6 shows the percentage of various types of ground surface applied to the roads in the informal settlements in Jakarta as a whole and for each municipality.

In the case study areas, only the Kerang Ijo neighbourhood in Kampung Muara Angke maintains natural road surfaces. Respondents expressed a preference for asphalt or concrete roads, linking them to modern living. Despite their advantages in facilitating motorbike use and preventing muddy conditions, these alterations were acknowledged by the majority to extend flooding duration after heavy rain.

In the case study kampungs, the detrimental effects of polluted seawater not only damage fishing livelihoods and generate land-oriented dwelling cultures, they also contribute to the flooding hazard. This is because the paved roads and land-based houses that replaced the vernacular fishing villages as the new built environment form were less well flood adapted, so water entering the kampungs became problematic, as illustrated in more detail in Section 5.2.2. In Section 5.2.3 ways of living in the communities that support flood adaptation interventions are examined, which, eventually, may be in harmony with the ecology of these areas.

5.2.2. Current flood situation

With the transformation of ground surfaces, the water that comes into the kampung is now a problem because it can no longer be absorbed into the ground and can enter the houses now built at the ground level. Modern built environment forms in almost all kampung neighbourhoods have led to the communities facing difficulty due to flooding in their kampungs.

> "Since the ponds were stockpiled with soil and rocks there has been no way for the water to flow, so it becomes stagnant, and then flooding happens. What makes things worse, besides dirty water inundating for quite a long period, is that now the water can enter our house. It is happening because we no longer live in the high-

Fig. 5. The transition from sand (left) to rubble (middle) to concrete substrates (right).

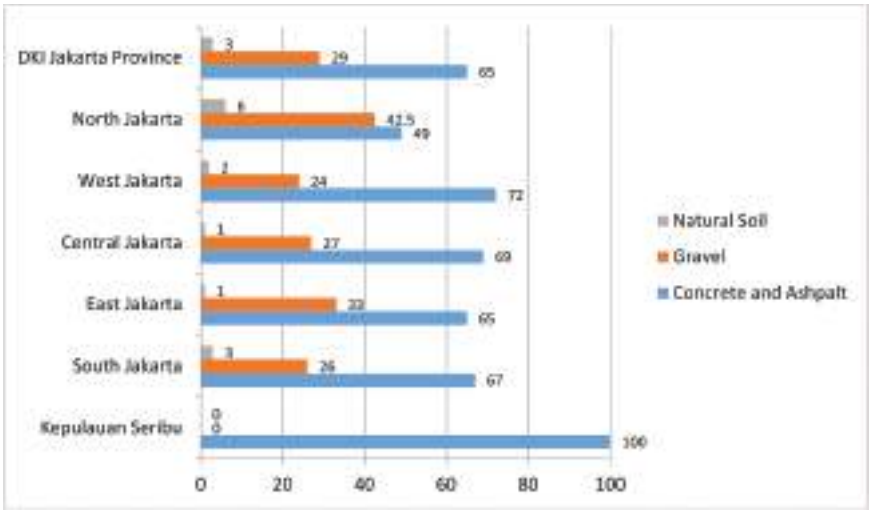

Fig. 6. Percentages of the different road surface types in Jakarta's informal settlements, by municipality (Source: DKI Jakarta Province Central Board of Statistics (BPS) 2017b).

> elevation stilt houses and our new brick house is at the same level as the ground surface. (Quote 13, CM 9, 52 y male mechanic and riverside kampung dweller)
>
> In the past, [flooding] was not a problem because my house was a stilt house, so when the high tide seawater came, the water was absorbed [into the ground]. Yet, today, due to the communities' better level of economy, they pile up [the ground] and install cement on it. Eventually, the water catchment area no longer exists. (Quote 14, CM 4, 62 y male street vendor and seaside kampung dweller)

These quotes show how the modern built environment contributes to accentuating flooding in almost all kampungs in the case study areas. Some of the participants from Kampung Muara Angke reported a different flood situation in their neighbourhoods and how it relates to the shape of their settlements. This is due to their flood adaptation approach, which will be discussed thoroughly in the next section.

Fig. 7 illustrates how modernisation of the built environment has affected flooding. Fig. 7 (left) shows a compacted rubble surface being constructed with mixed sediment sizes and no drainage channels or infrastructure, upon which ground-level brick houses are constructed. Fig. 7 (right) shows the effect of such a development, in the form of worsening flood conditions due to water circulation now being impeded.

The water-impermeable ground surface generates a worsening flooding situation, in terms of duration and depth, when the water entering the kampung is abundant. The following quotation delineates a scenario wherein the flood control infrastructure was unsuccessful precisely at a time of significant water discharge from upstream of Jakarta, resulting in prolonged water stagnation.

> [T]he worst flooding [in this kampung] was when Jakarta's great flood occurred in 2013. It not only lasted a long time but also deeply inundated our kampung. It happened due to the high tide and continuous heavy rain occurring at the same time. Even more [what made it worse] was not only the additional water discharge from the river upstream but also a pump station malfunctioning. (Quote 15, CM 4, 62 y male merchant and seaside kampung dweller)

The current flood situation eventually leads to detrimental effects on communities in the case study areas. The photographs in Fig. 8 show how severe the flooding situation can be: groceries are not spared from flooding; dirty water mixes with rubbish; children have to do their activities in the flood water.

The combination of non-diverted water with piles of rubbish in the case study areas leads to disease epidemics. Other risks also occur such as property damage and the entry of wild animals into houses.

Fig. 7. (left) A construction project transforming the settlement from a vernacular into a non-vernacular one, and (right) a water-impermeable built environment resulting from this transformation.

> There is no benefit [that we can obtain from flooding]—no fish come along, just dirt [and the house gets] dirty. Garbage and mud get in the house [and make] the walls and floor dirty. Sometimes our furniture gets damaged due to water inundation, especially electrical devices. I consider the damage to my house and the inconvenience of having to clean it as a fair consequence for living in a flood-prone area. But what makes me sad and is most burdensome to me is when my family members get sick after a flood, such as with typhoid or an infection [leptospirosis]. (Quote 16, CM 8, 27 y female farmer and seaside kampung dweller)

> I am quite lucky that my house is located in a higher [topographical] position. My neighbours [whose houses are located] at a lower level are upset because snakes often enter their house [while it is flooding]. (Quote 17, CM 10, 23 y female housewife and riverside kampung dweller)

Similar complaints about the negative impacts of flooding were also common from participants in Kampung Muara Baru, Kampung Marunda, and Kampung Kali Apuran. We found that the negative flood impacts were not felt evenly by all community members. The following quote represents a worry shared by all research participants that children have a higher risk of suffering from flood impacts due to their lack of awareness of the risks.

> [When flooding happens] we can still mostly carry out our activities, yet since there is a lot of dirty wastewater flowing, [flooding becomes] dangerous for kids. [The children] can get water fleas or even diarrhoea. You can imagine if they have to walk through the flood water for days and this happens all the time. Even worse, instead of avoiding it the children tend to see flood water as a form of amusement and play with it. (Quote 18, CM 7, 42 y male factory worker and seaside kampung dweller)

Older people may suffer higher economic losses due to their inability to get temporary replacement jobs that require them to leave their kampungs during flooding. This is because the flooding temporarily interrupts many normal jobs for kampung residents such as small shops or clam shell peeling, activities which have to halt while the flood waters are present. Those who are mobile can obtain alternative temporary employment by travelling outside the flood affected areas.

> [T]he elderly people here give up while flooding is happening; mainly they will stay at home. They cannot do their work as clam-shell peelers when the clam peeler yards are inundated. Young people like us are lucky because we can earn a living through other means, like working in a traditional market in North Jakarta. (Quote 19, CM 2, 46 y male trader and seaside kampung dweller)

This section has shown that water flow in the kampungs starts to become a problem when the communities pile up the land by reclaiming riparian areas with rock debris and covering it with concrete, thus rendering the ground surface impermeable. At the same time, communities have also replaced their wooden stilt houses with brick houses, which sit on the ground. Not only are these houses inundated, but the impermeable surfaces mean that the water spreads further into the community and floods more houses. The pooling of water ultimately creates various kinds of problems.

However, not all kampung neighbourhoods worsen flooding. The next section presents contemporary flood adaptation strategies that maintain floodplain absorption capacity and reduce flood impacts, and are adjusted to current lifestyles—different from past traditional methods.

Fig. 8. Photographs showing flood situations in Kampung Muara Baru (Rujak Centre for Urban Studies, 2018).

5.2.3. Contemporary flood adaptations

In the case study areas, residents generally take for granted the flood conditions in their kampungs and live their lives alongside the inundations. They walk in the flood water and even sleep in half-submerged beds. Flood affected communities consider flooding as an ordinary occurrence.

> The community here is used to the high tide. Every month there is always a tide. The big high tide comes every two months. The night high tide [occurs] from May to October and the day high tide is November to April. From past times flooding always happens, so we just put up with it, yet it is also uncomfortable [for us because] the water enters our houses and consequently, we have to sleep on half-submerged beds, and after the event, we have to mop the floor and clean [our house]. Whenever the water ebbs, [we] have to wash our houses with plain water several times and then mop it with a chemical liquid, otherwise we get itchy. (Quote 20, CM 8, 27 y female farmer and seaside kampung dweller)

All the community members interviewed in this study with single-storey houses gave this same information. Those with two-storey houses had a different response to flooding, as illustrated by the following quote. To ensure that flooding did not cause massive damage to their assets and to stay more comfortable during flooding, they usually keep their electronics and beds on the second floor.

> When it floods, we concentrate our activities on the second floor and because space is limited [what we are doing is] only sleeping. We put beds and electronics in the second-floor space [and if we want to] cook, [we do it] outside the house … [In general,] the community's activities are reduced, we cannot cook, cannot defecate [and] are hampered when we take a bath. [Therefore, especially] when the great flood happens, we create a public kitchen in the mosque and use the public toilet. (Quote 21, CM 10, 23 y female housewife and riverside kampung dweller)

Even though flooding is accepted by the communities and is part of their life, they still suffer continuously from it and remain hopeful for improvements in their neighbourhoods. Some kampung communities have applied flood adaptation efforts to decrease the negative impacts of flooding, as will be explained in the following section.

5.2.4. Flood adaptation in a Seaside Kampung

Flood adaptation is taking place in the Kerang Ijo neighbourhood, a seaside kampung and a part of Kampung Muara Angke, in the form of land reclamation methods and building designs. As illustrated by Table 2, and Quote 4 in Section 5.1.1, Kerang Ijo is the newest neighbourhood among the case study areas. Instead of reclaiming the riparian area with piles of compacted rubble, as in many other kampungs, residents here use clamshells as reclamation material. Even though, as in other kampungs, the natural water environment has disappeared and the ground level was raised, the flood water in this area can be quickly

absorbed due to the porousness of the clamshell-covered ground. The community in Kerang Ijo retains the stilt-house form, and high tide is below house levels. This flood-adapted built environment was shaped through livelihood-related skills and can adapt to coastal flooding.

> [When it was first created] in the early 2010 s, my stilt house was about as high as the height of my body [155 cm], and we were walking on sand. After that, we piled up the ground with clamshells to raise our higher ground elevation, and when high tide water comes we feel safer from the waves. In terms of material provision of the clamshell, we don't have any difficulty since we work as green clam farmers. Initially, we peel the clam, take its meat, and boil it, and for the clamshell waste instead of throwing the shells away, we gather them. [Then] we just dump them on to the ground and pound them. If we want to make a road, we collect them first into a sack and then pile them up. [Since] we have a ground made of clamshell fragments, [the high tide water] can easily be absorbed into the ground and the water never enters our house because we are higher up. Concerning stilt houses in these neighbourhoods, we assembled them using the same ways we used for constructing our fishing boats. (Quote 22, CM 1, 37 y female fisher and seaside kampung dweller)

As illustrated by Quote 22, many Kerang Ijo neighbourhood residents work as fishers or clam farmers. These occupations provide them with skills that help them to develop flood-adapted built environments. The kampung settlers could build stilt houses since they have skills in constructing wooden fishing boats. Meanwhile, porous ground surface reclamation techniques came about as a result of the communities' clamshell peeling and shell waste disposal activities.

Fig. 9 (top) shows the wooden fishing boats used by northern Jakarta fishing communities to sail short distances; Fig. 9 (bottom left) shows clamshell peeling; Fig. 9 (bottom right) illustrates how the clamshells are piled up as land reclamation.

As illustrated earlier, in Quotes 11 and 12 for other kampung settlements, it is hard to preserve the natural ground surface as well as the stilt-house design due to the land-oriented lifestyle in the contemporary developments, where water-permeable sandy ground is not considered suitable for the daily movements of motorcycles. Sandy surfaces are typically covered with water-impermeable concrete in other kampungs. As illustrated by Quote 22 above, this issue has been overcome in Kerang Ijo. Unlike unconsolidated sands, which are unstable under vehicle traffic, the clamshell ground surfaces here support heavy traffic due to

Fig. 9. Images showing (top) wooden fishing boats, (bottom left) clamshell farmer activity, and (bottom right) a clamshell ground surface.

community-generated road engineering. Instead of freely dumping the clamshells on the ground, the community makes a road by putting the clamshells into sacks and then stacking the sacks up (Fig. 10, left), repeating this until they feel the road is strong enough for motorcycle or even car traffic (Fig. 10, right).

This flood-adapted built environment also survives when coastal flooding is exacerbated by the failure of flood control infrastructure, which generates severe impacts. Even though the community in Kerang Ijo also experiences higher volumes of water, long inundations are not perceived as a problem affecting their area.

> Kampung Muara Angke consists of three neighbourhoods, Kerang Ijo, Tembok Bolong, and Baru … As a kampung situated near the sea, this area depends on the seawall that surrounds our kampung to block high-tide seawater … Sometimes the sea wall does not work properly, either because the wall is broken and seawater is able to pass through it or really high tide waters flow over the top of some parts of the wall. I am quite lucky to live in Kerang Ijo, with its clamshell ground surfaces. This is because even though our area was also flooded deeper than the usual seasonal high tide flooding, it did not [last] long, and the water was not dirty … There was a much worse flood situation in other neighbourhoods where ground surfaces are concrete. (Quote 23, CM 1, 37 y female fisher and seaside kampung dweller)

Kerang Ijo's flood-adapted built environment form also provides additional benefits for the community. Fig. 11 (left) shows a stilt house in Kampung Kerang Ijo. As shown in Fig. 11 (right), the community uses the space below the stilt houses for duck farming. In addition, waterborne diseases are less likely to occur in the adapted areas since inundations do not last long and the water can circulate well through the porous ground surfaces, leading to cleaner floodwaters (Fig. 12, left and middle). When a community member from a flood-adapted neighbourhood was questioned about the health risks associated with flooding, she responded that the common illnesses in her area were not from the floods but rather from consuming food with unhealthy chemicals.

> Alhamdulillah [praise be to God], even though our kampung frequently floods, there are no disease epidemics here. Rather than flooding, I think diseases come from food that contains preservatives and not from our environment. (Quote 24, CM 1, 37 y female fisher and seaside kampung dweller)

The water in an inundated area with a clamshell ground surface is clearer and cleaner (Fig. 12, left and middle) than that on a concrete ground surface, which is dark in colour from the pile of rubbish due to poor drainage (Fig. 12, right).

These findings highlight that seaside flood adaptations are tied to local knowledge and livelihood-driven community values. When coastal flooding happens, stilt houses keep residents above water, and inventive reclamation techniques based on clamshells left over from peeling operations facilitate rapid water absorption. The next section discusses how to realise a broader flood-adapted built environment in the case study areas in the future.

5.3. *Possible future scenarios to promote flood-adapted built environments in the case study areas*

Some factors need to be considered if the contemporary flood adaptation approaches are to be successfully replicated on a larger scale. This section examines external factors that contributed to the flood situation in the case study areas, and how these might be anticipated to allow and encourage communities to adapt to their flood environment.

5.3.1. *Government policies related to settlement developments*

Applying spatial planning regulations and government policies to informal settlements was the first factor that needed to be considered for flood-adapted built environments to be further developed throughout the case study areas. This was because these policies influenced the infrastructure quality of the kampungs, their built environment form, and also the current flood situation. This section discusses these policies' influence on flooding in the kampungs.

The kampungs are labelled as illegal settlements if they are situated in a conservation area or not in a residential area according to the spatial planning regulations, or if their built environment forms do not meet governmental standards for proper non-vernacular settlements. Following on from these issues, there is a common perception among the stilt-house settlers that if they change their local-value-based houses into brick houses that are considered more permanent, then their settlements' legality status issues can be resolved.

> I'm told that if our house is a stilt-house form it would be reckoned as informal by the government. Therefore, for me, our stilt houses today, standing above a sand surface, is the embodiment of an informal settlement neighbourhood. Because of this, and in order for our existence here to be recognised by the government, we have to alter our house design into a more permanent one, like a landed brick

Fig. 10. Pictures showing (left) clamshell sacks, whose high density is able to support heavy loads, and (right) a road in Kerang Ijo commonly used by motorbikes and cars.

Fig. 11. Pictures showing (left) a stilt house in Kampung Kerang Ijo, and (right) the space below a stilt house used for raising ducks.

Fig. 12. Flooding situation in Kerang Ijo (left and middle), with a clamshell ground surface, and (right) in Tembok Bolong, with a concrete ground surface.

> house … I realise this new form, later on [after the change], would be more vulnerable to flooding. But I want the government to provide a modern road and sewer system facilities for our neighbourhood like we can see in the media and in the real estate housing next to our kampung [which can survive flooding]. (Quote 32, CM 1, 37 y female fisher and seaside kampung dweller)

This quote also shows that the communities are aware that their western-based built environments may ultimately aggravate the flooding in their kampungs. They are willing to accept this risk because they harbour hopes that the government will sanction the existence of their settlements in recognition of their new form and eventually build municipal infrastructure in their kampungs.

5.3.2. Globalisation

The communities assumed that converting their settlement form to a permanent one would attract government recognition and eventually government-provided municipal infrastructure in the kampungs. The influence of globalisation may lead to self-help settlement upgrading projects that generate imported built environment forms that are not contextual to the kampungs' geographical conditions and therefore might aggravate urban challenges in such settlements.

Globalisation is the second factor, besides planning policies, that needs to be considered if flood-adaptation approaches are to be successfully replicated on a larger scale. As Quote 33 below illustrates, communities tend to see imported settlement forms as better than their local knowledge-based settlements. This perception occurs because they see the habitations projected in the media and the real-estate housing around their kampungs—profoundly influenced by a globalised ideal—as a benchmark for the ideal, formal, legal settlement. In addition, all community members interviewed complained about the high price of contemporary building materials, also a consequence of globalisation, with communities no longer able to afford to build their vernacular houses.

> Today, no one in this kampung has a house on stilts because the wood is expensive. [Almost all of] the parts for stilt houses are of wooden board. The kind of wood that withstands water is even more expensive. So instead of using a [Dolken] wood we [prefer to] use concrete. Actually, we can use bamboo, which is cheaper, but unfortunately bamboo is susceptible to water, and so we have to replace it periodically and we find that troublesome. Maybe it is a good idea to build a stilt house out of concrete since its elevation can prevent the water from getting into the house. However, a concrete stilt house must be very expensive, and we cannot afford it. (Quote 33, CM 3, 51 y male construction worker and seaside kampung dweller)

As suggested here, the high price of wood means the communities can no longer afford to build a stilt house, which requires a large amount of wood. Bamboo, a cheap building material that is structurally suitable for building stilt houses, is not used by communities due to its water susceptibility. That bamboo is susceptible to water is inconvenient since inundations in most kampungs last longer due to their natural ground surfaces having been paved. The communities were also unable to build stilt houses out of concrete because, though this material is appealing from a water durability standpoint, it is not affordable for most kampung residents.

The phenomenon where wooden stilt houses can no longer be built due to the high price of building materials occurs in almost all the case study areas. However, there is a slightly different situation in Kerang Ijo neighbourhood in Kampung Muara Baru, which has many bamboo stilt houses. The people in Kerang Ijo chose bamboo over wood due to its low cost, and, unlike in other communities, they were willing to carry out the routine maintenance bamboo stilt houses require. Kerang Ijo's bamboo stilt houses may also better withstand regular flooding because the clamshell ground surface there absorbs water faster and helps the neighbourhood avoid serious or lengthy inundations.

Just as building materials like wood are expensive for stilt houses, so are the clamshells used to form a water-permeable ground surface. Communities that obtained clamshells were able to get them through their work as clamshell peelers, but otherwise they would not have had the money to buy this material.

> In the past, the high tide seawater submerged this kampung so that it looked like a wavy ocean. However, over time this has stopped happening, since I started working as a green clam farmer. Instead of throwing away the waste clamshells [produced from peeling], I use them to pile up and level the ground … [Selling it would fetch] around 3000 rupiahs [about. 0.30 New Zealand dollars] per sack—there is a demand for clamshell and people order it. [You can imagine] how many hundreds of thousands of sacks of clamshell are required to reclaim this whole kampung. (Quote 34, CM 1, 37 y female fisher and seaside kampung dweller)

6. Discussion

The findings of this research show that kampung communities can develop contemporary vernacular settlements in order to adapt to, and coexist with, flooding. The construction of these settlements is predicated on informal planning, which Koch (2015) describes as typically involving socially shared, often unwritten rules, enforced outside officially sanctioned channels. Formal planning, entailing a structured and systematic decision-making process typically involving goal setting, identification and evaluation of alternatives, and selection of a specific course of action (Schneider et al., 2021), underpins Jakarta's spatial planning regulation. This regulation tends to favour a flood control approach alone, which proves insufficient for ensuring flood damage reduction in the city.

Kampung communities developed stilt houses atop mounds of clamshells that were permeable to water. These settlements responded to floods appropriately by securing kampung settlers from inundation and ensuring rapid flood absorption. This effort could be termed as a 'property-level adaptation', since the construction of stilt houses is undertaken by individual homeowners. Flood adaptation interventions in the kampungs were based on local wisdom and also livelihood-related knowledge. Globally, communities use their indigenous knowledge to build settlements to meet their needs for shelter as well as lifestyle (Oliver, 2007). Vernacular architecture is created by communities through a trial-and-error process over extended time periods; hence, beneficial community-environment experiences become naturally contained in the vernacular architecture (Turan, 1990; Vellinga & Asquith, 2006).

We argue that deprived communities in Jakarta have the potential to develop amphibious settlements on the neighbourhood scale through vernacular buildings, a road network capable of water absorption and open areas that are permeable to floods. Built environments coexisting with and allowing space for water can help communities in their mid-term adaptation to flooding. These findings expand the understanding of how kampungs can adapt to floods in Jakarta, as supported by Marfai et al. (2015); Putra et al. (2019); and Simarmata and Krishnan (2018). Informal settlement communities were known to adapt to floods on a household scale by preventing inundation in landed brick houses, building individual dykes, hanging furniture, and elevating the electrical system above flood levels and living areas above the ground, considered as microscale and short-term measures. The flood adaptation interventions of Kampung Muara Angke at the neighbourhood scale can be categorised as 'settlement-level adaptation'. This is due to the establishment of a road network and open spaces that are water-permeable, which are achieved through the collective efforts of all residents who are shellfish farmers, gathering shell waste and compacting it to withstand heavy loads.

Flood adaptation interventions in the case study kampungs were highly influenced by globalisation. Participants from the communities conveyed that the materials typically used for constructing traditional flood-adaptive homes, like water-resistant local timber, have moved beyond their financial reach. Drawing from Ghafouri et al., (2016), globalisation has increased traditional material costs, forcing the use of modern construction materials in vernacular settlements. Hence, integrating indigenous and non-vernacular knowledge is now crucial for optimising construction methods Ghafouri et al., (2016).

Flood adaptations within the study areas necessitate a hybrid methodology, highlighting the fusion of indigenous wisdom and contemporary knowledge and technology. This mode of construction will enable communities to adapt local knowledge to shape contemporary vernacular settlements based on the advanced building materials available in globalised economies. In the flood adapted area the use of clamshells on ground surfaces and bamboo stilt houses exemplify this hybrid method of development. Through this finding, it is possible to identify the prerequisites to flood adaptation in urban informal settlements in the majority world cities. Development of settlements need to be based on wisdom in mediating the relationship between hydrological dynamics and human activities (Birkmann, 2011; Few et al., 2007; Liao et al., 2016) and supporting hybrid development approaches.

Through hybrid development methodologies, communities have adeptly navigated the challenges of globalisation, particularly the escalating costs of building materials. This has enabled them to construct contemporary stilt houses over permeable ground surfaces, which are adaptive to flooding. Regrettably, the grasp of globalisation's influence doesn't end there. In a bid to emulate the modern aesthetics portrayed in the media, communities with a rich local knowledge of flood-adapted settlements are now inclined to modify their habitats to be ground-based, despite the inherent flood risks. This situation reflects cultural globalisation, driven by technology and communication, leads to the spread of ideas and practices, often blending or overshadowing local cultures with dominant global influences (Appadurai, 1996; Pieterse, 2019). Cultural globalisation impacts individuals, local cultures, businesses, governments, artists, and educational institutions, as global influences intertwine with local traditions, often leading to hybrid cultural forms or overshadowing of indigenous practices (Held & McGrew, 2007; Tomlinson, 1999). Indeed, globalisation has also influenced the government and its policy products related to spatial planning in Jakarta.

Planning policies in the city also influence flood adaptation. Residents in kampungs in the case study areas had to be evicted even though they could ensure that the water can permeate through flood adaptation around the waterways. Unfortunately, questions arise over government of Jakarta evictions along water bodies and riverbanks for water absorption zones, particularly when such lands often end up as luxury residences like apartments and condos (Leitner & Sheppard, 2018). This

reflects the arguments from previous studies by Hall (1988); Lategan and Cilliers (2017); Watson (2009a) on how top-down and regulatory planning policies work against middle- to low-income communities. In the majority world countries, such planning approaches tend to be used by corrupt governments to prevent the existence of deprived communities in cities and privilege the social elites (Hall, 1988; Lategan & Cilliers, 2017; Watson, 2009a). Therefore, deprived communities are coerced into breaching the regulations in order to secure housing and other basic livelihood needs (Fernandes, 2003; Payne, 2005).

This situation can also occur due to the generic urban ideals that inform planning policies. These colonial-era-inherited policies tend to label settlements that meet non-vernacular standards as formal and vernacular ones as informal if they do not meet building code standards (Kamete, 2013). This informal category is later classified as a space that is disordered, unwanted, illegal, and an urban issue that has to be fixed (Revell, 2010). In Jakarta, settlements not meeting building code standards are also often labelled as temporary housing. This designation tends to render inhabitants vulnerable to eviction, as the government deems their housing quality inadequate (Severinsen & Howden-Chapman, 2014). Urban planning policies of the city, as a reproduction of colonial practices, only accept Eurocentric house typologies, and therefore, the distinct and resourceful built environment forms of kampungs are considered as informal and needing to be cleared (Sutanudjaja, 2018).

We argue that this formal/informal dichotomy stemming from coloniality in planning can also inhibit flood adaptation in settlements by discouraging the development of vernacular settlements that can adapt to floods. Thus this research argues that flood adaptation in Jakarta can only be realised if the government decolonises its planning policies. Policies that value indigenous wisdom alongside colonial-inherited knowledge could reduce or eliminate 'illegal' labels for vernacular settlements. Eliminating the 'informal' category of buildings that cannot meet Eurocentric urban ideals could encourage more development of local-knowledge-based and flood-adapted settlements.

We recognise the importance of Eurocentric building standards promoted by planning policies as they exist to improve living conditions and promote health. Nevertheless, the findings show that communities did not have the capacity to achieve proper realisation of Eurocentric urban ideas in their settlements, and this led to flooding aggravation. This challenge frequently occurs in cities of the majority world, with their various bureaucratic, human, and financial resource characteristics. Imposing the built environment standards of the minority world in majority world settings, without some form of translation, is not an ideal approach.

> It is not reasonable to assume that the building regulatory systems in developing countries will be initiated as copies of building regulatory practice in the developed world. Human, material and financial resource constraints may make it impossible to copy the local public bureaucratic model of the developed world. (Krimgold, 2011, p. 57)

In post-colonial settings, collaborative planning practices can respond to the aspirations of indigenous people appropriately (Porter, 2006). We suggest a need for building standards and planning policies to be developed in partnership with community, so that shared goals and outcomes can be achieved while avoiding legitimising or mandating only those types of building that are incompatible with informal settlements and/or with flood-adapted buildings.

In the midst of economic and legal constraints in this era of globalisation, residents have constructed amphibious settlements. Adaptive flood settlements have grown increasingly significant, not only for their capacity to mitigate flood-induced damages but also for their potential to yield financial benefits for the inhabitants. Clamshell ground surfaces in the seaside kampungs aligned with the communities' need to dispose of mollusc-shell rubbish accumulated as a part of mussel farming activities. These findings illustrate that kampung settlers can gain economic benefits from their improved and flood-adapted built environments and have the capacity to cope with the degraded ecologies and social inequities caused by capitalist systems. This is quite unique and valuable, as flood adaptation measures commonly found around the world tend to be quite costly. According to Hudson (2020), the installation of flood-resistant doors, the elevation of electrical equipment, or the upgrading of building foundations, as 'property-level adaptation' measures, might not be affordable for most households, especially those with low income. This becomes even more complicated when 'settlement-level adaptation' that requires much larger infrastructure development costs is sought to be realised, and therefore soft loan schemes accessible to the entire community could provide a solution (Hudson, 2020).

A harmonious relationship between the settlements and water can also improve the wellbeing of the kampung communities. Flood-related diseases were subsequently reduced in the flood-adapted kampungs, which experience cleaner floodwaters and shorter inundations. Previous studies have shown that floodwaters in inland areas around Jakarta's biggest river, the Kali Ciliwung, contained high bacterial and viral concentrations (see Phanuwan et al., 2006; and Purba et al., 2018). Therefore, floods in the city often pose a risk of the rapid spread of contagious illnesses, such as influenza, diarrhoea, and skin infections (Van Voorst, 2016). Kampung Kerang Ijo is located in the coastal area, not next to the river, which may also explain why it experiences little health-related adversity when it floods.

Stilt houses, developed in conjunction with a permeable ground surface such as those in the case study areas, could be a significant adaptation strategy to the land subsidence issues of the city. Not only is this approach financially viable for informal settlers, but it also presents a sustainable environmental solution. Fakultas Geografi Universitas Gajah Mada (2007) deduced that land subsidence could instigate seawater intrusion, projected to inundate 50% of North Jakarta by 2050. Confronting this, impoverished neighbourhoods are compelled to elevate their residences and thoroughfares, an endeavour gravely straining their restricted financial circumstances (see Abidin et al., 2011; Batubara et al., 2023).

Ultimately, the findings of this study enrich the ongoing discourse on enhancing flood risk governance. The transition from a more traditional engineering-focused approach towards a more inclusive and flood adaptive strategy (Hartmann & Albrecht, 2014; Mees et al., 2016) is also necessitated in majority world cities including Jakarta. Flood risk governance can support sustainable development objectives by integrating risk and climate adaptation considerations into urban planning and development (Birkmann et al., 2010). In realising this, uniformity across sectors and governance levels, stakeholder inclusion, balancing immediate flood responses with long-term risk reduction, and ensuring equitable risk management strategies (Gilissen et al., 2016; Hegger et al., 2013; Walker & Burningham, 2011) must also be underpinned by a spirit of decolonisation and community-led development. Effective and improved flood risk governance can yield numerous benefits to society and the environment, such as minimising flood-induced losses and damages (Desai et al., 2015), and bolstering community capacities to cope with and recover from flooding (Gencer, 2017).

7. Conclusions

It was found that kampung communities can adapt to flooding in their neighbourhoods for extended periods when local knowledge and livelihood-related wisdom are used to develop contemporary vernacular settlements. This type of built environment, developed on a large scale, emphasises several ideas: the provision of spaces for water absorption and amphibious building forms or vertically oriented residential developments. Therefore, in flood-adapted kampungs, water inundation can subside rapidly, and the adverse effects of flooding can be diminished. Globalisation and top-down planning systems have a strong macroscale effect on these macroscale flood adaptation interventions. Globalisation leads to a scarcity of building materials suitable for

traditional stilt houses, like hardwood that is able to withstand and endure wet conditions, and which is now traded globally and no longer affordable to local communities. To remain flood adapted and be able to create contemporary vernacular built environments, communities have to use affordable and available building materials like bamboo and clamshells. Top-down city planning that mainly legitimises and values Eurocentric ideals of urban development discourage the development of vernacular settlements. Settlements that do not meet Eurocentric building standards and were located on conservation areas were labelled as illegal, and often the inhabitants ended up being evicted by the government. The study identifies several prerequisites for promoting flood adaptation in Jakarta. The governments need to ensure that the planning policies can support hybrid methods of development, which emphasise the use of a mix of indigenous and non-vernacular knowledge and technology. They also need to create inclusive, community-informed place-based planning policies by revisiting the formal/informal dichotomy of settlements that has resulted from colonial and market-led planning.

Declaration of Competing 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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CRediT authorship contribution statement

Prasetya Hermawan: Supervision, Writing – review & editing. **Apriyanto Heri:** Funding acquisition, Supervision, Writing – review & editing. **Gomez Christopher:** Data curation, Supervision, Validation. **Hart Deirdre:** Conceptualization, Data curation, Formal analysis, Supervision, Validation. **Curl Angela:** Data curation, Funding acquisition, Supervision, Validation, Writing – review & editing. **Dionisio Rita:** Data curation, Supervision, Validation, Writing – review & editing. **Prana Adam Madigliani:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing – original draft, Writing – review & editing.

Data Availability

Data will be made available on request.

References

Abeyasekere, S. (1987). *Jakarta: A history*. USA: Oxford University Press.

Abidin, H. Z., Andreas, H., Gumilar, I., Fukuda, Y., Pohan, Y. E., & Deguchi, T. (2011). Land subsidence of Jakarta (Indonesia) and its relation with urban development. *Natural Hazards, 59*(3), 1753.

Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change, 15*(2), 77–86.

Adger, W. N., & Brown, K. (2009). Vulnerability and resilience to environmental change: Ecological and social perspectives. *A Companion to Environmental Geography*, 109–122.

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science, 309*(5737), 1036–1039.

Adi, S. (2014). Karakterisasi Bencana Banjir Bandang Di Indonesia. *Jurnal Sains dan Teknologi Indonesia, 15*(1).

Alam, S. (2008). Majority world: Challenging the West's rhetoric of democracy. *Amerasia Journal, 34*(1), 88–98.

Appadurai, A. (1996). *Modernity at large: Cultural dimensions of globalization* (Vol. 1). U of Minnesota Press.

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of planners, 35*(4), 216–224.

Asdak, C., & Supian, S. (2018). Watershed management strategies for flood mitigation: A case study of Jakarta's flooding. *Weather and Climate extremes, 21*, 117–122.

Balaram, S. (2001). *Universal design and the majority world. Universal Design Handbook. New York, USA*: McGraw-Hill.

Bappenas. (2007). *Laporan Perkiraan Kerusakan dan Kerugian Pasca Bencana Banjir Awal Februari 2007 di Wilayah JABODETABEK* (*Jakarta, Bogor, Depok, Tangerang, dan Bekasi*).

Barnett, J., Graham, S., Mortreux, C., Fincher, R., Waters, E., & Hurlimann, A. (2014). A local coastal adaptation pathway. *Nature Climate Change, 4*(12), 1103–1108.

Batubara, B., Kooy, M., & Zwarteveen, M. (2023). Politicising land subsidence in Jakarta: How land subsidence is the outcome of uneven sociospatial and socionatural processes of capitalist urbanization. *Geoforum, 139*, Article 103689.

Berkes, F., Colding, J., & Folke, C. (2008). *Navigating social-ecological systems: Building resilience for complexity and change*. Cambridge University Press.

Berman, T. (2016). *Public participation as a tool for integrating local knowledge into spatial planning: planning, participation, and knowledge*. Springer.

Bernard, H. R. (2011). *Research methods in anthropology: Qualitative and quantitative approaches*. Rowman Altamira,.

Birkmann, J. (2011). First-and second-order adaptation to natural hazards and extreme events in the context of climate change. *Natural Hazards, 58*(2), 811–840.

Birkmann, J., Garschagen, M., Kraas, F., & Quang, N. (2010). Adaptive urban governance: New challenges for the second generation of urban adaptation strategies to climate change. *Sustainability Science, 5*, 185–206.

Birkmann, J., & von Teichman, K. (2010). Integrating disaster risk reduction and climate change adaptation: Key challenges—scales, knowledge, and norms. *Sustainability Science, 5*, 171–184.

Boelens, L., & De Roo, G. (2016). Planning of undefined becoming: First encounters of planners beyond the plan. *Planning Theory, 15*(1), 42–67.

Brinkman, J.J., & Hartman, M. (2008). Jakarta flood hazard mapping framework. *World Bank report, Jakarta.*

Brody, S. D., Godschalk, D. R., & Burby, R. J. (2003). Mandating citizen participation in plan making: Six strategic planning choices. *Journal of the American Planning Association, 69*(3), 245–264.

Budiyono, Y., Aerts, J., Brinkman, J. J., Marfai, M. A., & Ward, P. (2015). Flood risk assessment for delta mega-cities: A case study of Jakarta [Article]. *Natural Hazards, 75*(1), 389–413. https://doi.org/10.1007/s11069-014-1327-9

Budiyono, Y., Aerts, J., Tollenaar, D., & Ward, P. (2015). River flood risk in Jakarta under scenarios of future change. *Nat Hazards Earth Syst Sci Discuss, 3*, 4435–4478.

Chelleri, L., Schuetze, T., & Salvati, L. (2015). Integrating resilience with urban sustainability in neglected neighborhoods: Challenges and opportunities of transitioning to decentralized water management in Mexico City. *Habitat International, 48*, 122–130.

Clifford, N., Cope, M., Gillespie, T., & French, S. (2016). *Key methods in geography*. Sage.

Crawford, N. J., Michael, K., & Mikulewicz, M. (2023). *Climate Justice in the Majority World: Vulnerability, Resistance, and Diverse Knowledges*. Taylor & Francis.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (fourth ed.)*. Sage Publications.

Cretney, R. (2014). Resilience for whom? Emerging critical geographies of socio-ecological resilience. *Geography Compass, 8*(9), 627–640.

Cuny, F. C. (1991). Living with floods: alternatives for riverine flood mitigation. *Land Use Policy, 8*(4), 331–342.

Cutter, S. L., Ash, K. D., & Emrich, C. T. (2014). The geographies of community disaster resilience. *Global Environmental Change, 29*, 65–77.

Dados, N., & Connell, R. (2012). The global south. *Contexts, 11*(1), 12–13.

Damayanti, R., & Syarifuddin, S. (2020). The inclusiveness of community participation in village development planning in Indonesia. *Development in Practice*, 1–11.

Davidson, D. J. (2010). The applicability of the concept of resilience to social systems: some sources of optimism and nagging doubts. *Society and Natural Resources, 23*(12), 1135–1149.

Desai, B., Maskrey, A., Peduzzi, P., De Bono, A., & Herold, C. (2015). Making development sustainable: the future of disaster risk management, global assessment report on disaster risk reduction.

Devas, N. (2001). Does city governance matter for the urban poor? *International Planning Studies, 6*(4), 393–408.

DKI Jakarta Province Central Bureau of Statistics. (2017a). Jakarta in Figures. *Jakarta (ID): BPS*.

DKI Jakarta Province Central Bureau of Statistics. (2017b). North Jakarta in Figures. *Jakarta (ID): BPS*.

Dodman, D., & Satterthwaite, D. (2008). Institutional capacity, climate change adaptation and the urban poor.

Dolowitz, D. P., & Marsh, D. (2000). Learning from abroad: The role of policy transfer in contemporary policy-making. *Governance, 13*(1), 5–23.

Driessen, P. P., Hegger, D. L., Bakker, M. H., van Rijswick, H. F., & Kundzewicz, Z. W. (2016). Toward more resilient flood risk governance. *Ecology and Society, 21*, 4.

Dwirahmadi, F., Rutherford, S., Phung, D., & Chu, C. (2019). Understanding the operational concept of a flood-resilient urban community in Jakarta, Indonesia, from the perspectives of disaster risk reduction, climate change adaptation and

development agencies. *International Journal of Environmental Research and Public Health, 16*(20), 3993.
Evers, H.-D. (2015). Kampung air: Water settlements on the island of Borneo. *Journal of the Malaysian Branch of the Royal Asiatic Society, 88*(1), 79–85.
Fakultas Geografi Universitas Gajah Mada. (2007). *Pemanasan Global.* ⟨www.korantempo.com⟩. Retrieved 25 Mei from ⟨http://www.korantempo.com/korantempo/koran/2009/02/28/Metro/krn.20090228.158222.id.html⟩.
Fekade, W. (2000). Deficits of formal urban land management and informal responses under rapid urban growth, an international perspective. *Habitat International, 24*(2), 127–150.
Fernandes, E. (2003). Illegal housing: Law, property rights and urban space. *Confronting fragmentation. Housing and urban development in a democratising society*.
Few, R., Brown, K., & Tompkins, E. L. (2007). Public participation and climate change adaptation: avoiding the illusion of inclusion. *Climate Policy, 7*(1), 46–59.
Forester, J. (2013). On the theory and practice of critical pragmatism: Deliberative practice and creative negotiations. *Planning Theory, 12*(1), 5–22.
Garschagen, M., Surtiari, G. A. K., & Harb, M. (2018). Is Jakarta's new flood risk reduction strategy transformational? *Sustainability, 10*(8), 2934.
Gencer, E. (2017). How to make cities more resilient a handbook for local government leaders. *UNISDR*.
Ghafouri, M., Khan, Y. H., & Bin Ahmad, A. S. (2016). Cost of construction: How globalization impacts on vernacular houses. *ARPN Journal of Engineering and Applied Sciences, 11*(13), 8085–8093.
Gilissen, H. K., Alexander, M., Matczak, P., Pettersson, M., & Bruzzone, S. (2016). A framework for evaluating the effectiveness of flood emergency management systems in Europe. *Ecology and Society, 21*, 4.
Gregory, D., Johnston, R., Pratt, G., Watts, M., & Whatmore, S. (2011). *The dictionary of human geography*. John Wiley & Sons.
Gunawan, R. (2010). *Gagalnya sistem kanal: Pengendalian banjir Jakarta dari masa ke masa.* Penerbit Buku Kompas.
Gunderson, L. H. (2001). *Panarchy: understanding transformations in human and natural systems*. Island press.
Hall, P. (1988). *Cities of Tomorrow An Intellectual History of Urban Planning and Design in the Twentieth Century*. Oxford: Basil Blackwell.
Hallegatte, S., Green, C., Nicholls, R. J., & Corfee-Morlot, J. (2013). Future flood losses in major coastal cities. *Nature Climate Change, 3*(9), 802.
Hanson, S., Nicholls, R., Ranger, N., Hallegatte, S., Corfee-Morlot, J., Herweijer, C., & Chateau, J. (2011). A global ranking of port cities with high exposure to climate extremes. *Climatic Change, 104*(1), 89–111.
Hartmann, T., & Albrecht, J. (2014). From flood protection to flood risk management: condition-based and performance-based regulations in German water law. *Journal of Environmental Law, 26*(2), 243–268.
Healey, P. (1997). *Collaborative planning: Shaping places in fragmented societies*. UBc Press.
Healey, P. (1998). Collaborative planning in a stakeholder society. *The Town Planning Review*, 1–21.
Hegger, D. L., Driessen, P. P., Dieperink, C., Wiering, M., Raadgever, G. T., & van Rijswick, H. F. (2014). Assessing stability and dynamics in flood risk governance: an empirically illustrated research approach. *Water Resources Management, 28*, 4127–4142.
Hegger, D.L., Green, C., Driessen, P.P.J., Bakker, M.H., Dieperink, C., Crabbé, A.,. Beyers, J.-C. (2013). Flood risk management in Europe: similarities and differences between the STAR-FLOOD consortium countries.
Held, D., & McGrew, A. (2007). *Globalization/anti-globalization: Beyond the great divide*. Polity.
Hendiarti, N. (2011). Remote sensing investigation on characteristics of river discharges into Jakarta Bay.
Hudalah, D., & Woltjer, J. (2007). Spatial planning system in transitional Indonesia. *International Planning Studies, 12*(3), 291–303. https://doi.org/10.1080/13563470701640176
Hudson, P. (2020). The affordability of flood risk property-level adaptation measures. *Risk Analysis, 40*(6), 1151–1167.
Huxley, M., & Yiftachel, O. (2000). New paradigm or old myopia? Unsettling the communicative turn in planning theory. *Journal of Planning Education and Research, 19*(4), 333–342.
Jacobs, J. (2016). *The death and life of great American cities*. Vintage.
Joseph, M. (2013). *Fluid New York: Cosmopolitan urbanism and the green imagination*. Duke University Press.
Kamete, A. Y. (2013). On handling urban informality in southern Africa. *Geografiska Annaler: Series B, Human Geography, 95*(1), 17–31.
Kartika, T. (2016). Verbal communication culture and local wisdom: The value civilization of Indonesia nation. *Lingua Cultura, 10*(2), 89–93.
Kearns, R. (2016). Placing observation in the research toolkit. *Qualitative Research Methods in Human Geography*, 313–333.
Khatibi, F. S., Dedekorkut-Howes, A., Howes, M., & Torabi, E. (2021). Can public awareness, knowledge and engagement improve climate change adaptation policies? *Discover sustainability, 2*(1). https://doi.org/10.1007/s43621-021-00024-z
Koch, F. (2015). The rules of the game and how to change them: Urban planning between formal and informal practices. A Colombian case study. *International Planning Studies, 20*(4), 407–423.
Koizumi, H. (2009). Historical development of planning theory and the public realm of planning. In M. Horita, & H. Koizumi (Eds.), *Innovations in Collaborative Urban Regeneration* (pp. 3–13). Springer. https://doi.org/10.1007/978-4-431-99264-6.
Krimgold, F. (2011). Disaster risk reduction and the evolution of physical development regulation. *Environmental Hazards, 10*(1), 53–58.
Krueger, R. A. (2014). *Focus groups: A practical guide for applied research*. Sage publications.
Kure, S., Farid, M., Fukutani, Y., Muhari, A., Bricker, J. D., Udo, K., & Mano, A. (2014). Several social factors contributing to floods and characteristics of the January 2013 flood in Jakarta, Indonesia. *Journal of Japan Society of Civil Engineers, Ser Giornale, 70*(5).
Lam, D. P., Hinz, E., Lang, D., Tengö, M., Wehrden, H., & Martín-López, B. (2020). Indigenous and local knowledge in sustainability transformations research: a literature review. *Ecology and Society, 25*(1).
Lategan, L. G., & Cilliers, E. J. (2017). Considering planning approaches in the global south and learning from co-production in south africa's informal backyard rental sector. *WIT Transactions on Ecology and the Environment, 223*, 241–252.
Leitner, H., & Sheppard, E. (2018). From kampungs to condos? Contested accumulations through displacement in Jakarta. *Environment and Planning A: Economy and Space, 50*(2), 437–456.
Liamputtong, P., & Serry, T. (2013). Making sense of qualitative data. *Research Methods in health: Foundations for Evidence-Based Practice*, 365–379.
Liao, K.-H. (2014). From flood control to flood adaptation: A case study on the Lower Green River Valley and the City of Kent in King County, Washington. *Natural Hazards, 71*(1), 723–750.
Liao, K.-H., Le, T. A., & Van Nguyen, K. (2016). Urban design principles for flood resilience: Learning from the ecological wisdom of living with floods in the Vietnamese Mekong Delta. *Landscape and Urban Planning, 155*, 69–78.
Lindlof, T. R., & Taylor, B. C. (2017). *Qualitative communication research methods*. Sage publications.
Liu, A., Waliuzzaman, S., Do, H. T., Haryani, R., & Pem, S. (2020). Journeys of postdevelopment subjectivity transformation: a shared narrative of scholars from the majority world. *In The Handbook of Diverse Economies*. Edward Elgar Publishing.
Maknun, J., & Busono, T. (2016). Disaster-friendly sundanese traditional building construction. *IOP Conference Series: Materials Science and Engineering*.
Marfai, M. A., Sekaranom, A. B., & Ward, P. (2015). Community responses and adaptation strategies toward flood hazard in Jakarta, Indonesia. *Natural Hazards, 75*(2), 1127–1144.
Mashi, S., Inkani, A., Obaro, O., & Asanarimam, A. (2020). Community perception, response and adaptation strategies towards flood risk in a traditional African city. *Natural Hazards, 103*, 1727–1759.
Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. *Landscape and Urban Planning, 147*, 38–49.
Mees, H., Tempels, B., Crabbé, A., & Boelens, L. (2016). Shifting public-private responsibilities in Flemish flood risk management. Towards a co-evolutionary approach. *Land Use Policy, 57*, 23–33.
Merrillees, S. (2014). *Greetings from Jakarta: Postcards of a Capital, 1900-1950*. Equinox Publishing.
Meulder, B. d (2013). Batavia, simon stevin in the tropics. In K. Shannon, & B. de Meulder (Eds.), *Water urbanisms. East*. Park Books.
Moe, I.R., Kure, S., Januriyadi, N.F., Farid, M., Udo, K., Kazama, S., & Koshimura, S. (2016). Effect of land subsidence on flood inundation in Jakarta, Indonesia. *土木学会論文集 G (環境), 72*(5), I_283-I_289.
Mohanty, C. (1988). Under Western eyes: Feminist scholarship and colonial discourses. *Feminist Review, 30*(1), 61–88.
Mohsin, A. (2015). Jakarta under water: The 2007 flood and the debate on Jakarta's future water infrastructure. *Jurnal Wilayah dan Lingkungan, 3*(1), 39–58.
Niessen, N. (1999). *Municipal government in Indonesia: Policy, law, and practice of decentralization and urban spatial planning*. Research School CNWS, School of Asian, African, and Amerindian Studies, Universiteit Leiden.
Njoh, A. J. (2017). *Planning in contemporary Africa: The state, town planning and society in Cameroon*. Routledge,.
Nuraini, T.N. (2020). *Data banjir Jakarta 2002–2020, istana dan bundaran HI sampai terendam*. merdeka.com. Retrieved 22 December from ⟨https://www.merdeka.com/trending/data-banjir-jakarta-2002–2020-istana-dan-bundaran-hi-sampai-terendam.html#:~:text=Seperti%20banjir%202002%2C%20sejumlah%20area,terjadi%20selama%2010%20hari%20ini⟩.
Octavianti, T., & Charles, K. (2018). The evolution of Jakarta's flood policy over the past 400 years: The lock-in of infrastructural solutions. *Environment and Planning C: Politics and Space*, 2399654418813578.
Oliveira, O. P. d, Gonnet, C. O., Montero, S., & da Silva Leite, C. K. (2019). *Latin America and policy diffusion: From import to export*. Routledge.
Oliver, P. (2007). *Built to meet needs: Cultural issues in vernacular architecture*. Routledge.
Padawangi, R. (2019). Forced evictions, spatial (un) certainties and the making of exemplary centres in Indonesia. *Asia Pacific Viewpoint, 60*(1), 65–79.
Payne, G. (2005). Getting ahead of the game: A twin-track approach to improving existing slums and reducing the need for future slums. *Environment and Urbanization, 17*(1), 135–146.
Pelling, M., & Manuel-Navarrete, D. (2011). From resilience to transformation: The adaptive cycle in two Mexican urban centers. *Ecology and Society, 16*, 2.
Pham, V. Q., Pham, A. D., Anh, H., & Tuyet, C. T. A. (2022). Cultural landscape along Kone and Ha Thanh River in Quy Nhon City, Binh Dinh: Opportunities and challenges of urban development in flood adaptation. *The International Journal of Architectonic, Spatial, and Environmental Design, 17*(2), 47.
Phanuwan, C., Takizawa, S., Oguma, K., Katayama, H., Yunika, A., & Ohgaki, S. (2006). Monitoring of human enteric viruses and coliform bacteria in waters after urban flood in Jakarta, Indonesia. *Water Science and Technology, 54*(3), 203–210.
Pieterse, J. N. (2019). *Globalization and culture: Global mélange*. Rowman & Littlefield.
Porter, L. (2006). Planning in (post) colonial settings: Challenges for theory and practice. *Planning Theory & Practice, 7*(4), 383–396.
Prana, A. M. (2021). *Possibilities for community participation in a transformed spatial planning approach to flooding in Jakarta, Indonesia*. New Zealand: University of Canterbury.

Prasetyanti, R. (2015). Slum kampong tourism "jakarta hidden tour": Designing eco-cultural based pro-poor tourism. *European Journal of Interdisciplinary Studies, 3*(1), 111–121.

Presiden Republik Indonesia. (2007). Undang-undang Republik Indonesia Nomor 26 tahun 2007 tentang Penataan Ruang. *Lembaran Negara Republik Indonesia Tahun*.

Punch, S. (2003). Childhoods in the majority world: Miniature adults or tribal children? *Sociology, 37*(2), 277–295.

Purba, F. D., Hunfeld, J. A., Fitriana, T. S., Iskandarsyah, A., Sadarjoen, S. S., Busschbach, J. J., & Passchier, J. (2018). Living in uncertainty due to floods and pollution: the health status and quality of life of people living on an unhealthy riverbank. *BMC Public Health, 18*(1), 782.

Purwanto, E., Sugiri, A., & Novian, R. (2017). Determined Slum Upgrading: A challenge to participatory planning in nanga bulik, central kalimantan, Indonesia. *Sustainability, 9*(7). https://doi.org/10.3390/su9071261

Putra, G. Y., Koestoer, R., & Lestari, I. (2019). Local resilience towards overcoming floods of local climate change for adaptation: A study of marunda community in north jakarta. *IOP Conference Series: Earth and Environmental Science*.

Putri, P. W., & Rahmanti, A. S. (2010). Jakarta waterscape. *Nakhara: Journal of Environmental Design and Planning, 6*, 59–76.

Revell, K. (2010). Working with informality: increasing resilience in cities of the Global South. 46th ISOCARP Congress,

Roth, D., & Winnubst, M. (2014). Moving out or living on a mound? Jointly planning a Dutch flood adaptation project. *Land Use Policy, 41*, 233–245. https://doi.org/10.1016/j.landusepol.2014.06.001

Rukmana, D. (2015). The change and transformation of Indonesian spatial planning after suharto's new order regime: The case of the Jakarta metropolitan area. *International Planning Studies, 20*(4), 350–370.

Saleh, H.A., Allaert, G., De Sutter, R., Kellens, W., De Maeyer, P., & Vanneuville, W. (2009). Intelligent decision support system based geo-information technology and spatial planning for sustainable water management in Flanders, Belgium. Water and Urban Development Paradigms,

Sanders, E. B.-N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *Co-Design, 4*(1), 5–18.

Schefold, R., & Nas, P.J. (2014). Indonesian Houses: Volume 2: Survey of Vernacular Architecture in Western Indonesia (Vol. 2). Brill.

Schipanski, M. E., MacDonald, G. K., Rosenzweig, S., Chappell, M. J., Bennett, E. M., Kerr, R. B., & Lundgren, J. G. (2016). Realizing resilient food systems. *BioScience, 66*(7), 600–610.

Schneider, P., Walz, A., Albert, C., & Lipp, T. (2021). Ecosystem-based adaptation in cities: Use of formal and informal planning instruments. *Land Use Policy, 109*, Article 105722.

Schrier, G. V. d, Van Oldenborgh, G. J., Van den Hurk, B., Aldrian, E., Swarinoto, Y., Sulistya, W., & Sakya, A. E. (2017). A very unusual precipitation event associated with the 2015 floods in Jakarta: an analysis of the meteorological factors. *Weather and Climate Extremes, 16*, 23–28.

Severinsen, C. A., & Howden-Chapman, P. (2014). The problem and politics of temporary housing. *Housing, Theory and Society, 31*(2), 125–147.

Shannon, K. (2008). The 'Agency of Mapping'in South Asia: Galle-Matara (Sri Lanka), Mumbai (India) and Khulna (Bangladesh). *Footprint* (pp. 105–119).

Shava, S., Tidball, K. G., Krasny, M. E., & O'Donoghue, R. (2010). Local knowledges as a source of community resilience. *Environmental Education Research*.

Simarmata, H. A., & Krishnan. (2018). *Phenomenology in Adaptation Planning*. Springer.

Sjaifudian, H. (2002). Encouraging Citizen Participation Through Partnership Approach: The Experience of IPGI. Logolink International Workshop on Participatory Planning Approach for Local Governance, Bandung, Indonesia,

Soltani, A., Namdarian, A., & Dayarian, N. (2012). Feasibility of transport demand management through a bottom-up planning approach. *Theoretical and Empirical Researches in Urban Management, 7*(4), 63–71.

Steinbrink, M., Frenzel, F., & Koens, K. (2012). Development and globalization of a new trend in tourism. *Slum tourism: Poverty, Power and Ethics*, 1–18.

Sterling, E. J., Filardi, C., Toomey, A., Sigouin, A., Betley, E., Gazit, N., & Bergamini, N. (2017). Biocultural approaches to well-being and sustainability indicators across scales. *Nature Ecology & evolution, 1*(12), 1798–1806.

Sutanudjaja, E. (2018, 10 September 2018). Kampung and our urban commons. On temporarity public lecture, Jakarta.

Swyngedouw, E. (2004). *Social power and the urbanization of water: Flows of power*. OUP Oxford.

Tambunan, M. P. (2017). The pattern of spatial flood disaster region in DKI Jakarta. *IOP Conference Series: Earth and Environmental Science, 56*(1), Article 012014. ⟨http://stacks.iop.org/1755-1315/56/i=1/a=012014⟩.

Tengö, M., Hill, R., Malmer, P., Raymond, C. M., Spierenburg, M., Danielsen, F., & Folke, C. (2017). Weaving knowledge systems in IPBES, CBD and beyond—lessons learned for sustainability. *Current Opinion in Environmental Sustainability, 26*, 17–25.

Texier, P. (2008). Floods in Jakarta: When the extreme reveals daily structural constraints and mismanagement [Article]. *Disaster Prevention and Management, 17*(3), 358–372. https://doi.org/10.1108/09653560810887284

Todes, A. (2012). New directions in spatial planning? Linking strategic spatial planning and infrastructure development. *Journal of Planning Education and Research, 32*(4), 400–414.

Tomlinson, J. (1999). *Globalised culture: the triumph of the West?* na.

Turan, M. (1990). *Vernacular architecture: paradigms of environmental response* (Vol. 4). Gower Publishing Company,.

United Nations HABITAT. (2015). Habitat III Issue Papers, 22–Informal Settlements. United Nations Conference on Housing and Sustainable Urban Development,

van der Molen, P. (2015). Rapid urbanisation and slum upgrading: What can land surveyors do? *Survey Review, 47*(343), 231–240. https://doi.org/10.1179/1752270614Y.0000000125

Van Voorst, R. (2016). Formal and informal flood governance in Jakarta, Indonesia. *Habitat International, 52*, 5–10.

Vellinga, M., & Asquith, L. (2006). *Vernacular architecture in the twenty-first century: Theory, education and practice*. Taylor & Francis,.

Walker, G., & Burningham, K. (2011). Flood risk, vulnerability and environmental justice: Evidence and evaluation of inequality in a UK context. *Critical Social Policy, 31*(2), 216–240.

Watson, V. (2009a). The planned city sweeps the poor away…': Urban planning and 21st century urbanisation. *Progress in Planning, 72*(3), 151–193.

Watson, V. (2009b). Seeing from the South: Refocusing urban planning on the globe's central urban issues. *Urban Studies, 46*(11), 2259–2275.

Widianingsih, I., & Morrell, E. (2007). Participatory planning in Indonesia: seeking a new path to democracy. *Policy Studies, 28*(1), 1–15.

Williams, G., Meth, P., & Willis, K. (2014). *Geographies of developing areas: the Global South in a changing world*. Routledge.

Wilson, G. (2012). *Community resilience and environmental transitions*. Routledge.

Winarso, H., & Firman, T. (2002). Residential land development in Jabotabek, Indonesia: Triggering economic crisis? *Habitat International, 26*(4), 487–506.

Wohl, E. E. (2000). *Inland flood hazards: human, riparian, and aquatic communities*. Cambridge University Press.

Wu, Y., & Zhang, Y. (2022). Formal and informal planning-dominated urban village development: A comparative study of luojiazhuang and Yangjiapailou in Hangzhou, China. *Land, 11*(4), 546.

Yin, R. K. (2013). *Case study research: Design and methods*. Sage publications.

Adam Prana is a post-doctoral researcher at the Research Center for Sustainable Production System and Life Cycle Assessment, National Research and Innovation Agency (BRIN), Republic of Indonesia. Additionally, he lectures in the master's program for Urban and Regional Planning at Tarumanagara University, Indonesia. He has also served for over 13 years as a civil servant in the Ministry of Spatial Planning and Agrarian Affairs/National Land Agency, Republic of Indonesia. This background propels Adam to conduct research not only from an academic perspective but also as a government practitioner in the fields of urban planning, geography, urban design and environmental science.

Rita Dionisio research's focuses on adaptive urbanism, community resilience, and bicultural planning; aiming at socio-ecological justice. In Human Geography and urbanism, she demonstrates high competence – not only through scientific dissemination and external funding – but particularly by opening pathways to advance the integration of traditional ecological knowledge in decision-making processes, and urban living outcomes.

Angela Curl is a social scientist interested in the relationships between urban environments, transport and health. She is particularly interested in how public policies, particularly in transport, urban planning and housing, can address health inequalities and transport disadvantage.

Deirdre Hart researches the physical, biological and human (including built environments) processes and interactions in coastal environments via an approach that is fundamentally multi-disciplinary. She is passionate about the dissemination of coastal science through education, informed management, and community engagement. Her research and teaching interests include temperate and tropical coastal and river-mouth science, engineering and management,

Christopher Gomez's research deals with the chain of environmental-processes that act at the landscape scales, integrating hydrology, sediments, vegetation and human activities, with an emphasis on hazardous earth-processes.

Heri Apriyanto. Graduated with a doctoral degree in Natural Resources and Environment Management Science (NREMS), IPB University; Master in Environmental Engineering Program, ITB, and S1 in the Physical Geography Study Program, Faculty of Geography, UGM. Currently working as a Senior Researcher at Research Center for Sustainable Production System and Life Cycle Assessment, BRIN. Actively writing in various international scientific journals and books, and being an international research reviewer.

Hermawan Prasetya. Graduated with doctoral degree in Agroindustrial System Engineering, IPB University. Graduated Master Degree from Development Study Program, ITB and Bachelor Degree in Regional Development Planning, Departement of Geography, UGM. Recently, employed as Unit coordinator of SMEs, Tourism Industry and Creative Economy Policies. Actively writing journal and seminar papers on Sustainable bioenergy and industry.