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# Morphological Change of Coastal *Kampung Kota*: Resilience and Vulnerability of *Kampung* Cungkeng and Sinar Laut, Bandar Lampung, Indonesia

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***Abstract***. *'Kampung kota' (urban villages) in Indonesia represent informal settlements that emerge organically and unplanned, blending urban living with local cultural identities. Despite their unplanned growth and associated risks, such as flooding, fires, and economic instability, these communities exhibit remarkable resilience through strong social ties, adaptive spatial practices, and cultural continuity. Using urban morphology as an analytical lens, this study examined the resilience and vulnerability of Kampung Cungkeng and Sinar Laut, two coastal Bugis settlements in Bandar Lampung. The morphological changes reveal the development patterns and social and economic data integration within their structure. The research was conducted by field observations, in-depth interviews, and spatial analysis by satellite imagery to study the settlements. Their morphological transformations were examined over decades. The findings reveal how physical adaptations, such as stilt houses and mangrove planting, help mitigate vulnerabilities. Additionally, socio-economic strategies like the multifunctional use of space contribute to reducing risks while preserving cultural heritage. However, unregulated expansion and environmental pressures exacerbate risks, highlighting the need for integrated planning. The findings underscore the dual nature of 'kampung kota' as both resilient and vulnerable, offering insights for sustainable urban development. The study's results contribute to the global discourse on informal urban resilience by highlighting how coastal 'kampung kota' can contribute to the world discourse on informal urban resilience through unique spatial adaptations and cultural sustainability*

***Keywords***. *Kampung kota, morphology, resilience, urban village, vulnerability.*

## Introduction

*Kampung kota* (urban villages) refer to informal settlements that can be seen as an urban phenomenon that develops and emerges in developing countries such as Indonesia. These settlements are characterized by their organic growth, blending urban living with local cultural identities. As living spaces, kampung kota represent manifestations of urban contextuality that

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blend with local cultural identities. Kampung kota grow informally, unstructured, and unplanned (Jones, 2017). Kampung kota are considered an urban agglomeration problem due to limited access to infrastructure and facilities (Jones, 2017), high unemployment rates, high population density, and high crime rates. Due to their unplanned growth, kampung kota have high risks, such those of fires (Tambunan *et al.*, 2021), floods (Ricafort & Makki, 2023; Yodsurang & Uekita, 2022), crime (Hawken *et al.*, 2018), economic instability, and others.

Despite facing complex problems and risks, kampung kota are resilient against threats, risks, and pressures. Kampung kota reflect community adaptation responses to urban problems (Yodsurang & Uekita, 2022). Residents adapt to environmental challenges, demonstrated by their ability to recover from environmental changes and challenges with their strong flexibility and high level of resilience (Sudmeier-Rieux, 2014). However, this resilience also indicates a simultaneous vulnerability to change (Collier *et al.*, 2013).

Resilience is a response to environmental disturbances or how habitats and ecosystems can spontaneously rearrange after disturbances (Collier *et al.*, 2013; Meerow & Newell, 2016). Resilience can be viewed from various perspectives, including those of individuals, communities, regions, and countries. Meanwhile, urban resilience is defined as the ability of a city to respond, adapt, and grow in the face of various forms of stress/disturbance/hazard, such as natural disasters, climate change (Collier *et al.*, 2013), gentrification (Kourilova *et al.*, 2023), and other external disturbances. On the other hand, vulnerability refers to the possibility that a system can be negatively affected by a stressor, disturbance, or threat (Lankao & Qin, 2011). It is often seen as the opposite of resilience. Thus, the higher a city's vulnerability, the lower its resilience.

There are several reasons why kampung kota communities remain in their living environment despite inadequate and vulnerable conditions. Strong social ties prevent relocation (Shirleyana *et al.*, 2018). Communities utilize alleys for physical connectivity and to facilitate social and economic interactions (Lathif, 2020). Moreover, strong place attachment and identity prevent them from relocating (Shirleyana *et al.*, 2018; Widya *et al.*, 2019). Social and economic attachments make communities survive and adapt (Widya *et al.*, 2024).

Kampung Cungkeng and Sinar Laut face this condition in Bandar Lampung, Indonesia. These kampung kota are located on the city's coast and are immigrant kampungs of Bugis people. Some traditional Bugis houses still stand tall, although some have transformed, observable through their exterior and interior (Widya *et al.*, 2023). The traditional Bugis houses in Kampung Cungkeng and Sinar Laut have adopted traditional Bugis architecture in layout, form, and building structure (Lestari *et al.*, 2020). Kampung Cungkeng and Sinar Laut are inhabited by low- and middle-income families, mostly working in the informal sector (fishermen, traders, boat builders, fish sorters). The onslaught of urbanization and the threat of tidal flooding pose threats to Kampung Cungkeng and Sinar Laut, including traditional houses.

The resilience and vulnerability of Kampung Cungkeng and Sinar Laut are interesting to explore, as they reflect the dynamics between tradition and modernity in an urban context. The contextuality of the kampung amid the development of Bandar Lampung city remains present despite modernization. Several studies have examined kampung kota resilience with transformation as an embodiment of adaptation (Ricafort & Makki, 2023; Yodsurang & Uekita, 2022). Research on urban resilience is generally discussed as a response to climate change (Sitadevi, 2017), tidal flooding (Buchori *et al.*, 2018; Dewi *et al.*, 2021; Yodsurang & Uekita, 2022), and migration (Buchori *et al.*, 2018; Jones & Jones, 2017; Thomas, 2013). The present

research explored the resilience and vulnerability of Kampung Cungkeng and Sinar Laut through a morphological study of the area.

Morphological studies are needed to review the transformation of Kampung Cungkeng and Sinar Laut as a response to the resilience and vulnerability of kampung kota as a form of adaptation. This research explored the chronological spatial development of Kampung Cungkeng and Sinar Laut in Bandar Lampung through the area's morphology and the factors influencing it to identify the resilience and vulnerability level of kampung kota. Similar research has been conducted by Basee and Abdulla (2022), who examined the vulnerability and resilience of Haifa Street and the surrounding historical layout of Baghdad through the area's morphology. Additionally, Yodsurang (2022) previously conducted transformation research to review resilience levels through changes in residential character and cultural landscape; the research was conducted around the Chao Phraya River in Thailand.

Collier *et al.* (2013) and Meerow & Newell (2016) conceptually offer a theoretical framework of resilience centered on socio-spatial justice. The morphological approaches of Basee & Abdulla (2022) in Iraq and Yodsurang & Uekita (2022) in Thailand methodologically integrate chronological transformation analysis to assess vulnerability. However, contextually, the present study did not address the dynamics of coastal kampung kota with specific ethnic architectures such as that of the Bugis in Indonesia, where physical adaptations (such as stilt houses) interact in complex ways with environmental pressures.

Building on studies by Basee and Abdulla (2022) and Yodsurang (2022), conducted in different geographic contexts, this research focused on kampung kota located in coastal areas, specifically those characterized by distinctive Buginese architectural features. By examining morphological changes in these settlements, the study aimed to understand how their unique coastal setting creates a dual exposure to environmental and socio-economic vulnerabilities. At the same time, it offers an opportunity to explore localized adaptation strategies and community-based resilience mechanisms that may be less apparent in inland kampung kota.

The ability of kampung kota to adapt and survive various threats will make cities sustainable and equitable. This research provides opportunities to better understand how to improve the quality of life and involve local communities in urban development by involving communities in spatial transformation planning. Furthermore, this research has the potential to become a model for developing urban resilience in other cities with similar cases, providing a guide for developing effective urban resilience strategies with understanding and solutions to identified issues.

This aligns with the desire to preserve local culture through sustainable spatial planning based on regional morphology, which can maintain the unique cultural heritage and define the city's identity. Knowing the community's ability to respond to urban pressures is important. This is also part of the community's living heritage to maintain the authenticity and integrity of the dwellings or area. Kampung kota's inability to survive and adapt would result in the degradation of urban vitality, potentially leading to the 'death' of a city.

## Spatial Characteristics and Morphology of *Kampung Kota*

The typical characteristics of urban areas in regions such as Asia, Africa, and Latin America (the Global South) are marked by a mix of rural and urban elements (McGee & Wolfe, 1991). Unlike informal settlements in South America, which commonly develop on public land or

abandoned areas, incremental development in Asia and Africa tends to occur on privately owned land, often in former villages or agricultural fields (Roy, 2005; Seo & Lee, 2019). Urban villages, often called 'villages-in-the-city', represent a critical urban phenomenon in the Global South, characterized by integrating rural settlements into rapidly expanding metropolitan areas.

Urban villages are 'mediators between rural and urban systems', bridging formal governance structures and informal livelihood practices (Seo & Lee, 2019; Van Oostrum & Dovey, 2024). They often function as transitional spaces where rural migrants adapt to urban life while maintaining social networks, cultural practices, and economic strategies rooted in their places of origin. Urban villages are known by various terms in different countries, such as *kampung kota* and *urban kampung* in Indonesia and Malaysia (Lathif, 2020; Widya *et al.*, 2024), *Làng trong phố* in Vietnamese cities (Thinh, Gao, *et al.*, 2024), *Chengzhongcun* in Chinese cities, *Ashwaiyyat* in Egypt (Thinh, Kamalipour, *et al.*, 2024).

Kampung kota are shaped by various factors, including political context, topography, climate, and economic conditions, which influence their form and growth patterns (Dovey *et al.*, 2020). These settlements often emerge organically, without formal recognition, and lack adequate access to essential infrastructure and public services (Kraff *et al.*, 2020). Referred to as 'arrival cities,' they provide affordable housing and crucial entry points for rural migrants and the urban poor to access urban functions and economic opportunities (Taubenböck *et al.*, 2018).

Informal settlements – particularly urban villages in China and India – emerge when rural communities become enveloped by expanding cities but retain distinct social and spatial characteristics (Van Oostrum & Dovey, 2024). This growth is not merely the result of spontaneous squatting or illegal occupation; it is driven by structural factors such as converting agricultural land for industrial and urban uses, ambiguous or plural land rights, and gaps in formal governance systems. As cities expand, these villages transform in situ, shifting from agrarian economies to rental economies that provide affordable housing for migrant workers and the urban poor.

It is important to distinguish informal settlements from the common perception of 'slums.' While some may face poor living conditions, many demonstrate remarkable resilience and ingenuity in addressing housing challenges (Dovey *et al.*, 2021). Rather than being seen as planning failures, kampung kota represent adaptive responses to persistent inequalities in land and housing systems (Thinh, Kamalipour, *et al.*, 2024).

Kampung kota, as informal settlements, exhibit distinct spatial patterns shaped by incremental, self-organized, and often unauthorized development processes (Dovey *et al.*, 2021; Kamalipour & Dovey, 2020). These settlements emerge in response to urban housing shortages, rural-urban migration, and economic constraints, resulting in unique morphological features that differentiate them from formal urban areas. Informal settlement development is incremental, unfolding gradually as residents adapt to financial constraints and evolving needs. Structures are often expanded room by room, reflecting the irregular flow of income and familial growth. These settlements emerge without formal state authorization, outside legal land use and construction frameworks. However, this lack of formal approval does not equate to chaos; informal codes and community-driven norms often govern spatial organization, property rights, and shared amenities. Informal settlements are inherently self-organized, with residents collaboratively negotiating access to resources, infrastructure, and public spaces.

The morphogenesis of kampung kota in Indonesia has been studied primarily in urban peripheries (Ramadhani & Fatimah, 2023), coastal areas (Darjosanjoto, 2002), flood-prone

zones (Ricafort & Makki, 2023), and under specific city contexts (Novianti *et al.*, 2023; Ramadhani & Fatimah, 2023; Rini & Ridho, 2021; Susanti, 2021). However, the morphology of kampung kota in uniquely characterized coastal areas remains largely underexplored. Their typologies offer a valuable framework for policymakers to design upgrading strategies that balance infrastructure improvement with the preservation of social capital (Thinh, Kamalipour, *et al.*, 2024). Understanding the morphogenesis and typology of coastal kampung kota can support urban planners in developing more inclusive and sustainable approaches to upgrading informal settlements (Dovey *et al.*, 2020).

## Urban Morphology as a Lens to Understand Resilience and Vulnerability

Urban morphology is a science that, if studied at different times and through various perspectives, results in different methodologies and has various schools of thought. Urban morphology is the study of the physical form of urban components and the relationships between those components, describing the composition and configuration of urban areas over time. They continuously evolve through urbanization and historical changes. The information urban morphology provides, includes the quality of visual elements, aesthetic forms, physical analysis, spatial cognition, urban public space characteristics, and the overall significance of urban landscapes, collectively constituting a city's identity (Sadeghi & Li, 2019).

Urban morphology includes cities' layout, design, and spatial organization, reflecting natural connections and relationships in urban environments (Kropf, 2018; Oliveira, 2016). Barau (2015) states that urban morphology involves examining human settlements' shape and development processes, encompassing the spatial analysis of urban structures, land use, street layouts, buildings, and open spaces. Besides examining and studying the formation and transformation of human settlement processes, urban morphology also studies the development of urban form and component elements of urban areas (Oliveira, 2016).

Urban morphology provides an established framework of hierarchical elements. This framework helps to explore intermediate spatial scales, which are often overlooked in resilience research (Stangl, 2018). While urban morphology primarily focuses on physical characteristics and spatial organization of a city, it also allows for the development patterns and the integration of social and economic data within its structure (Mottelson & Venerandi, 2020). The following section will outline the key principles of urban morphology, followed by a discussion on how certain resilience and vulnerability studies have engaged with these spatial scales and the potential they offer. Urban form, consisting of land plots, open spaces, buildings, and road networks, is a key variable in shaping a resilient city (Senjana *et al.*, 2024).

In informal settlements like kampung kota, urban morphology provides insight into how communities organize themselves spatially in response to resource limitations, legal ambiguity, and external risks such as flooding, climate change, or economic shocks. Conversely, morphological features can also expose vulnerabilities. For instance, high density without proper infrastructure can increase exposure to hazards and reduce a community's capacity to recover from crises. The morphology of kampung kota is not merely the result of disorder, but rather a complex and incremental adaptation to resource constraints and urban pressures (Arif *et al.*, 2022; Kamalipour & Dovey, 2020). Morphological studies are about how informal settlements emerge, adapt, and interact with formal urban structures over time (Thinh *et al.*, 2023).

Employing urban morphology as a tool for analysis enables planners, decision-makers, and researchers to go beyond one-size-fits-all solutions and instead craft interventions tailored to

specific contexts. This method encourages spatially informed strategies for improving conditions and building resilience, which are closely connected to how communities live and organize space. It also ensures that efforts to improve physical infrastructure are balanced with the need to preserve social networks. Informal support systems are key elements of resilience in underserved urban areas. Recent studies have begun to bridge these fields, opening up opportunities for more in-depth research (Hameed Basee & Riadh Abdulla, 2022; Yodsurang & Uekita, 2022).

As GIS technology advances in its ability to process complex information, the possibility of examining impacts and responses across different spatial levels continues to expand (Stangl, 2018). Understanding the resilience and vulnerability of coastal kampung kota through the lens of urban morphology using GIS technology can bridge the gap between physical planning and socio-spatial dynamics. This integrated perspective contributes to developing more inclusive, adaptive, and sustainable urban environments.

## Methodology

### *Research Location*

The research location was in Kampung Cungkeng and Kampung Sinar Laut. Kampung Cungkeng is located in Kota Karang Sub-district, while Kampung Sinar Laut is part of Kota Karang Raya Sub-district within Teluk Betung Timur District, Bandar Lampung City. These two coastal fishing kampungs lie on the outskirts of Bandar Lampung and are directly adjacent to one another. The boundary between the two kampungs is shown in Figure 1, where the dashed line (–···–···) represents the administrative division.

Previously, both kampungs were part of the same administrative unit, the Kota Karang Sub-district. Before the administrative subdivision, the entire area was collectively known as Kampung Cungkeng. Historically, it was inhabited by a homogeneous population, primarily the Bugis ethnic group. Kampung Cungkeng is considered one of the oldest coastal settlements in the city and is notable for preserving the cultural originality of the Bugis people, making it distinct from other coastal kampung kota. Even though this kampung kota has excellent potential in fisheries and marine, attention to it is still minimal.

Kampung Cungkeng has existed since the early development of Bandar Lampung and has evolved alongside the city, rather than being a product of modern urban expansion. In addition to its unique cultural and architectural identity, Kampung Cungkeng and Sinar Laut were selected as research sites because they offer valuable insights into the resilience and vulnerability of kampung kota in Bandar Lampung, particularly in coastal areas. Given that a significant portion of Bandar Lampung's southern region is coastal, understanding the resilience and vulnerabilities of these settlements can help maximize the city's potential while minimizing risks and threats.

Both Kampung Cungkeng and Sinar Laut share similar physical and socio-economic characteristics. Most residents are employed in the marine and fisheries sector, including roles such as fishermen, fish traders, shipbuilders, and boat rental service providers, with average household incomes below the regional minimum wage. Additionally, many housewives from both kampung kota work part-time as anchovy salting laborers on Pulau Pasaran. The primary focus of this study was on Kampung Cungkeng and Sinar Laut, as they typify coastal kampung

kota that face complex challenges related to resilience and vulnerability, while retaining a strong sense of cultural authenticity.

This research did not include an analysis of Pulau Pasaran's resilience and vulnerability, as the island represents a distinctly different settlement typology. Pulau Pasaran is a stilt-based settlement built over the sea and functions as a key production center for salted fish in Bandar Lampung. The island's significant economic value has driven its rapid development as a commercial hub. The decision to limit the study area was based on the fact that, despite its proximity to Kampung Cungkeng and Sinar Laut, Pulau Pasaran does not possess the same socio-cultural attributes typically associated with coastal kampung kota.

Pulau Pasaran's growth and development are closely linked to its role as a center of the salted fish economy. Historically uninhabited, the island was later occupied by residents from Kampung Cungkeng and Sinar Laut who sought to establish a fish processing and trade base. Over time, the increasing intensity of these economic activities led to a stilt-based settlement, predominantly inhabited by fishery workers and entrepreneurs from the two kampung kota.

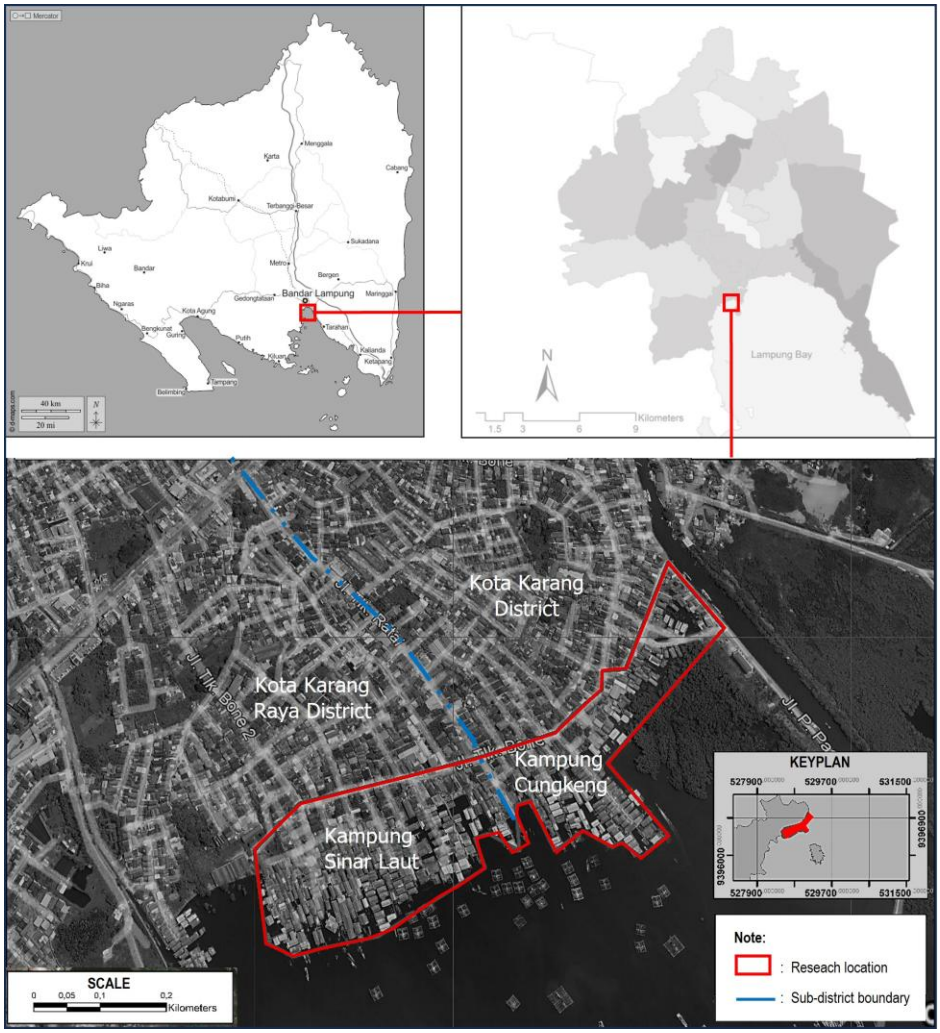


**Figure 1.** Research location in Kampung Cungkeng and Sinar Laut, Bandar Lampung.

### *Primary Data Collection*

Primary data was collected through direct field observations and in-depth interviews with residents. Observations involved directly examining the physical conditions of Kampung Cungkeng and Sinar Laut, including documentation of existing housing, roads, connectivity, and infrastructure. The results of the observations were compiled into a base map showing existing conditions, including the physical state of housing and supporting facilities, settlement density, infrastructure presence, and inter-kampung kota connectivity.

In-depth interviews were conducted with residents of Kampung Cungkeng and Sinar Laut. Interview sample selection was conducted using the mixed sampling technique (Kumar, 2005). Probability sampling was used to determine the number of respondents needed to ensure the generalizability of findings. Respondents were then selected using non-random (purposive) sampling. The selected respondents were coastal residents living in Kampung Cungkeng or Sinar Laut who were willing to share their experiences verbally and could explain the changes in the area from year to year. However, most of the selected respondents were long-time residents of Cungkeng Village, namely Bugis residents, assuming that these residents would provide more accurate information due to their long settlement history.

Unstructured interviews were conducted to allow for more open and comprehensive responses. Residents were asked to describe the development of Kampung Cungkeng and Sinar Laut by manually sketching how the area looked when they first settled there. In addition to verbal descriptions, respondents were also asked to illustrate changes manually using maps prepared by the research team (e.g., land use shifts, infrastructure additions, road widening, etc.). During the interviews, researchers explored the development of the kampung in terms of spatial patterns, forms, and structures, as well as community and government responses to various threats (e.g., tidal flooding, fires, and other hazards). These explanations were also visualized through individual cognitive maps drawn by each respondent, reflecting diverse perspectives on the spatial transformation of their kampung kota.

As a limitation of the study, the researcher did not include socio-economic conditions or household type in the interview and analysis. Although both factors can affect adaptation capacity, especially regarding the transformation of individual housing, at the spatial level, variations in household types can indirectly affect the density and vulnerability of kampung kota areas.

### *Secondary Data Collection*

To complement the primary data, secondary data collection was conducted to analyze the spatial transformation of Kampung Cungkeng and Sinar Laut from a regional perspective. This included satellite imagery and a literature review to support subsequent spatial analysis. The satellite imagery provided visual and spatial representations of the kampung kota's physical transformation over time. Available satellite images span from 2001 to 2023. However, satellite imagery before 2000 is not available.

Historical maps before the 2000s were reconstructed using provisional mapping based on in-depth interviews and literature review to overcome this limitation. This study was limited by its cross-sectional approach, as data were collected at only one point in time. As a result, capturing detailed dynamics of morphological change was challenging, and identifying causal relationships behind the transformations was limited.

To address these limitations, triangulation analysis was conducted to fill data gaps and provide a more comprehensive chronological understanding of the spatial changes in the kampung kota. Triangulation was also used to confirm findings from different sources and reconstruct the changes in the morphological map of Kampung Cungkeng and Sinar Laut over time.

### *Data Analysis*

All primary and secondary data collected were then triangulated to reduce bias and complement their respective information. This was done to increase the reliability and validity of the research results. The researchers combined and compared data and then verified the data by cross-checking the findings.

Data triangulation was done through field observations, in-depth interviews, and satellite imagery to overcome limitations arising from the cross-sectional nature of the research and the discovery of historical spatial records from before 2000. Triangulation was carried out in two phases: first, to validate spatial patterns by cross-referencing verbal accounts with physical evidence and satellite data; Second, to enhance the chronological reconstruction by synthesizing personal narratives of change with documented physical transformations.

Contradictory cases arose, for example, different accounts of the time or causes of specific morphological changes. Greater weight was given to accounts that were consistent across some respondents and corroborated by spatial or visual evidence (e.g., satellite imagery or documented urban programs). Rather than discarding outlier narratives, these were noted as indicators of possible variations in life experiences or perceptions and were reflected in discussions of community heterogeneity. Insight from multiple sources was integrated to build a multi-dimensional understanding of spatial transformation, resilience strategies, and vulnerability factors.

The interim findings were then grouped chronologically and the physical transformation of the kampung kota and its causes were sorted chronologically. To make it easier for the researchers to do grouping, the researchers created a time range based on the significance level of the changes that occurred. In the final stage, morphological growth was visualized in 2D with the ArcGIS software and the data were interpreted to obtain research results. The flow diagram shows a summary of the methodology (Figure 2).

## Results

### *Demographics of Respondents*

The total number of respondents collected was 24 people, consisting of 13 from *Kampung* Cungkeng and 11 from *Kampung* Sinar Laut. The gender proportion showed 75% women (18 people) and 25% men (6 people). Respondents were dominated by the Bugis tribe, as much as 50% (12 people), followed by the Javanese tribe at 37.5% (9 people) and the Sundanese tribe at 12.5% (3 people). Most respondents were born between 1965 and 1980 (13 people), followed by 6 people born between 1981 and 1996, and 5 people between 1946 and 1964.

In terms of length of residence, 5 respondents have lived for two decades, 9 respondents for three decades, 8 respondents for four decades, and 2 respondents for half a century. The survey results showed that 58.3% of respondents (14 people) were first-time immigrants, while the rest

(41.7%) were second-generation *Kampung* Cungkeng and Sinar Laut residents. The majority of respondents came from areas around Bandar Lampung (13 people), Makassar (7 people), and outside Lampung (4 people). The main reasons for moving included the following: family (12 people), relocation from evicted *kampung kota* (6 people), government transmigration programs (6 people), and other reasons (3 people).

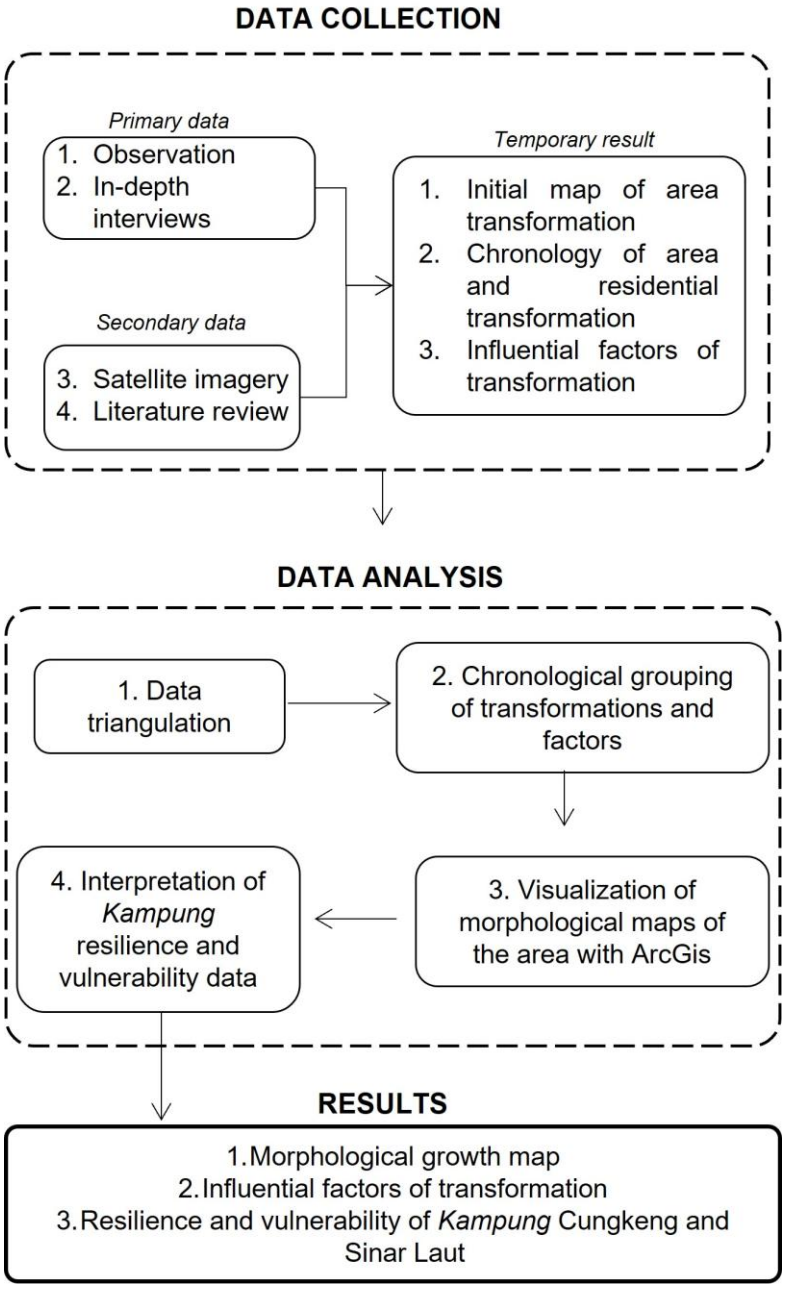


**Figure 2.** Data collection and analysis diagram

### *Development Kampung Cungkeng and Sinar Laut*

Based on the analysis, significant changes occurred in several aspects of the development of Kampung Cungkeng and Sinar Laut. Due to the limited data and the level of significance of the growth of the kampung kota, the explanation is divided into several periods, namely: 1) 1950-1970s, which were the early years of Bugis settlement; 2) 1970-1990s; 3) 2000-2005; 4) 2006-2011; 5) 2012-2017, and 6) 2017-2023. The development of Kampung Cungkeng and Sinar Laut is illustrated through a morphological change map (Figure 3) and a site section (Figures 4-5). The selected site section represents an area that has undergone significant changes and indicates the resilience and vulnerability of the kampung kota.

Some Bugis people migrated to Kampung Cungkeng in the 1950s-1970s. The migration of the Bugis people was due to the heating up of political conflict in Sulawesi during that period. Kampung Cungkeng and Sinar Laut used to be rice fields directly adjacent to the coast. Bugis immigrants who settled in Cungkeng built stilt houses with Buginese architecture to prevent water from entering the house. Bugis houses in Kampung Cungkeng still reflect traditional architecture in terms of spatial layout, shape, architectural details, and structure (Lestari *et al.*, 2020). Changes in Kampung Cungkeng and Sinar Laut began during this period with house construction on the mainland of the kampung kota (Figure 3). The illustration on the map shows that from 1950 to 1970, there was already a road network that reached Kampung Cungkeng and Sinar Laut, with the emergence of settlements along the road network. During this period, houses built over the sea were still one in Kampung Cungkeng and Sinar Laut each.

In 1970-1990, there was a significant increase in settlements. The increase in settlements in Kampung Cungkeng and Sinar Laut was in line with the increase in population. The increase in population was driven by the need for jobs (laborers) due to the development of Pulau Pasaran as a dried fish processing area. In addition, the eviction of residents from other kampung kota in the early 1990s, made Kampung Cungkeng and Sinar Laut the choice for building houses. During this period, rice fields were converted into housing due to the increase in population. In the late 1990s, a plan for coastal reclamation emerged, so that many coastal residents who previously lived over the sea were relocated to the mainland.

Based on the illustration in Figure 3, it can be seen that the addition of residential areas in Kampung Cungkeng and Sinar Laut is increasingly jutting out towards the sea. In the early 2000s, the relocated community rebuilt settlements over the sea, because the relocation funds were considered insufficient to buy houses on the mainland. Based on the illustration map (Figure 3), it can be seen that there is an additional residential area that has begun to appear jutting out towards the sea. In 2006, the city government determined the end limit of the development of sea houses, because the growth of houses towards the sea was no longer controlled. It was done so that houses would not be affected by the sea's ebb and flow. However, this policy has not been fully enforced and is used only as a guideline for residents.

The development of Kampung Cungkeng and Sinar Laut in 2012-2017 cannot be separated from the development of Pulau Pasaran. In 2014, green mussel cultivation training by students and related agencies required jobs for the community (green mussel cultivation managers, mussel cleaning workers, sellers, suppliers, and others). This caused an increase in the population of Sinar Laut. It also encouraged the development of housing towards the sea and the densification of the sea area with green mussel cultivation fields. In 2012, Kota Karang was designated a slum area. Limited social and public facilities, density and irregularity of housing, unsuitable housing, and limited sanitation and clean water encouraged the current arrangement of Kampung Cungkeng and Sinar Laut.

Meanwhile, the government dredged the river to reclaim and build land access for the bridge to Pulau Pasaran in 2012, fitted with gabions along the riverbank towards the sea in 2017. Based on the illustration (Figure 3), the area that later became a mangrove forest can be seen in Figure 4. Meanwhile, the area of river dredging in the context of reclamation and construction of land access for the bridge to Pulau Pasaran can be seen. The map also shows a significant expansion of the residential area, which is increasingly jutting out towards the sea (Figure 5).

In 2017-2022, the development of settlements over the sea has become increasingly dense and a sub-network of roads leading to settlements over the sea has begun to form. Based on the illustration on the map (Figure 3), a road network can be seen that has been formed up to the settlements over the sea. During this period, facilities were constructed to repair and widen the bridge infrastructure to Pulau Pasaran. The government also built the Kota Karang office and Government Junior High School 42 Bandar Lampung in 2019. In 2018-2023, to improve the quality of housing, the government assisted several residents in Kampung Cungkeng through a house renovation program, Self-Help Housing Stimulus Assistance (*Bantuan Stimulan Perumahan Swadaya*). Several houses were transformed both vertically and horizontally.

Meanwhile, the area with houses over the sea in Kampung Sinar Laut is slowly growing out into the sea. Due to limited financial access to legally obtain houses and land, residents build houses over the sea. The government's determination to impose building limits in 2006 controlled efforts to build these houses, because it increases the vulnerability of houses to tidal flooding (Figure 5). In addition, the density of housing does not consider the level of fire risk that may occur. A fire in 2022 burned down 26 non-permanent houses and four permanent houses.

### *Residential Transformation*

Traditional Bugis houses transform vertically downwards (under the house) and horizontally. It shows that people adapt by modifying their homes rather than moving from Kampung Cungkeng. Houses on land generally change the function of rooms, especially under the house, into service rooms, bedrooms, and standard rooms (Figure 6). In addition, the transformation is in the form of adding new rooms, growth, and division of space by adding/demolishing residential walls, expanding rooms, and changing room zones.

The transformation of the interior space in land houses is triggered by internal factors (inefficiency and space requirements due to additional family members and limited space for movement, financial capacity, and land availability) and external factors (home improvement incentives and economic opportunities). In contrast to houses on land, the expansion of space in houses over water only grows horizontally. The addition of private and shared spaces is also horizontal. Several houses were found to have narrow living rooms, so the shop (formerly the terrace) became wider. Houses over the sea are generally built using the original traditional Bugis architectural construction with wood materials. However, several houses were found to have replaced the wooden foundations with concrete and the plank floors with ceramic floors.

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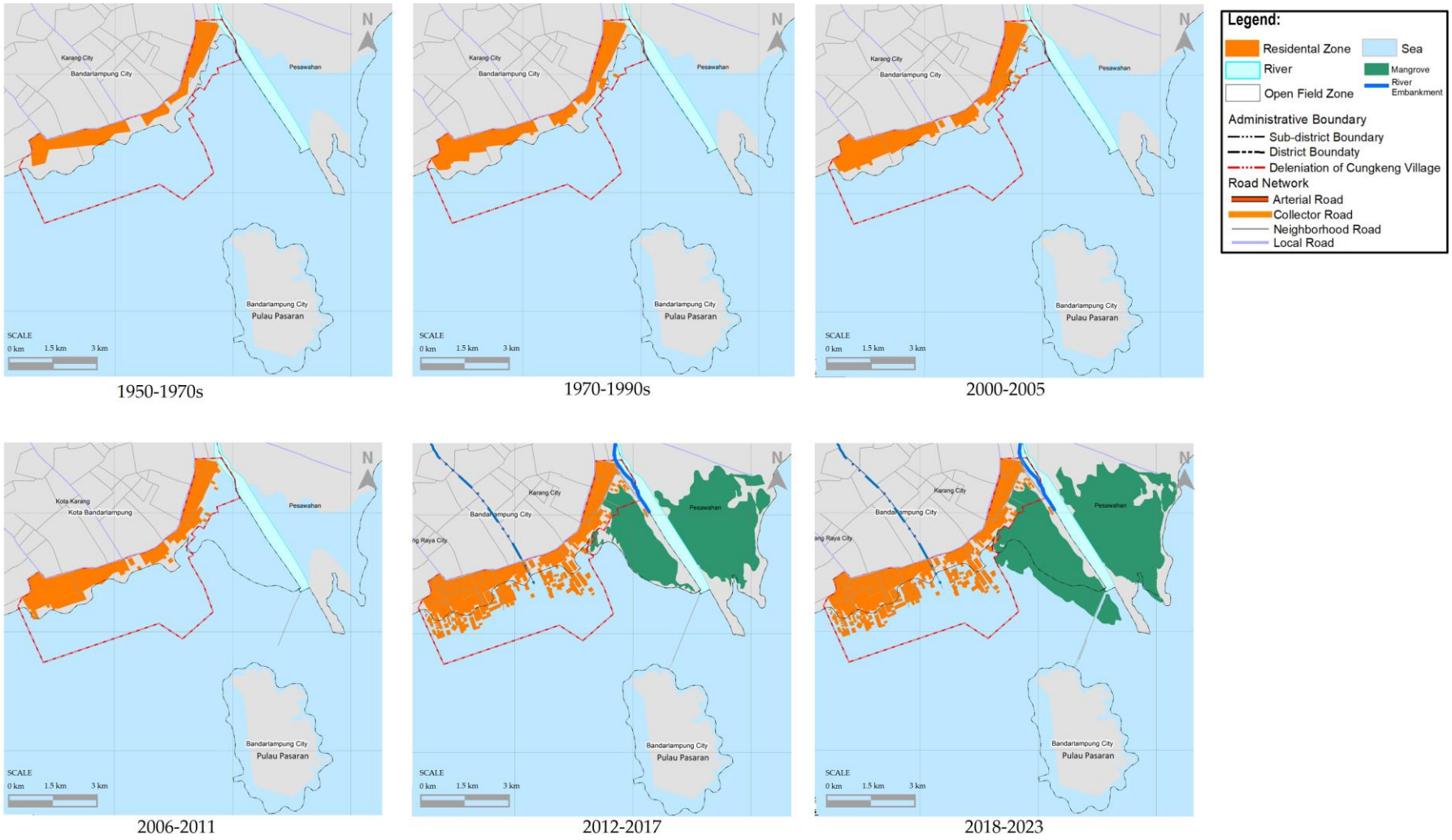


**Figure 3.** Morphology Change of *Kampung* Cungkeng and Sinar Laut

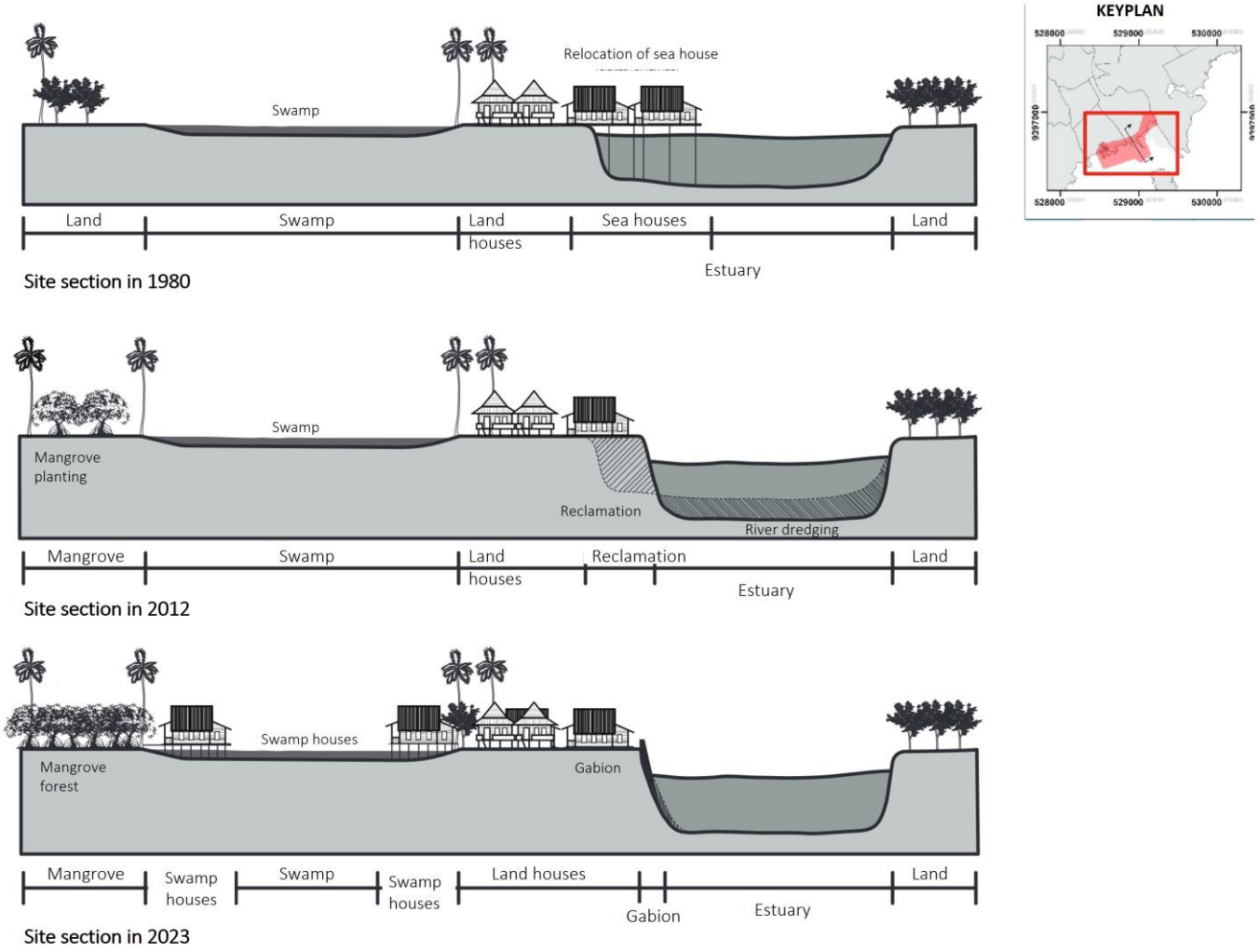


**Figure 4.** Sample site section in *Kampung* Cungkeng

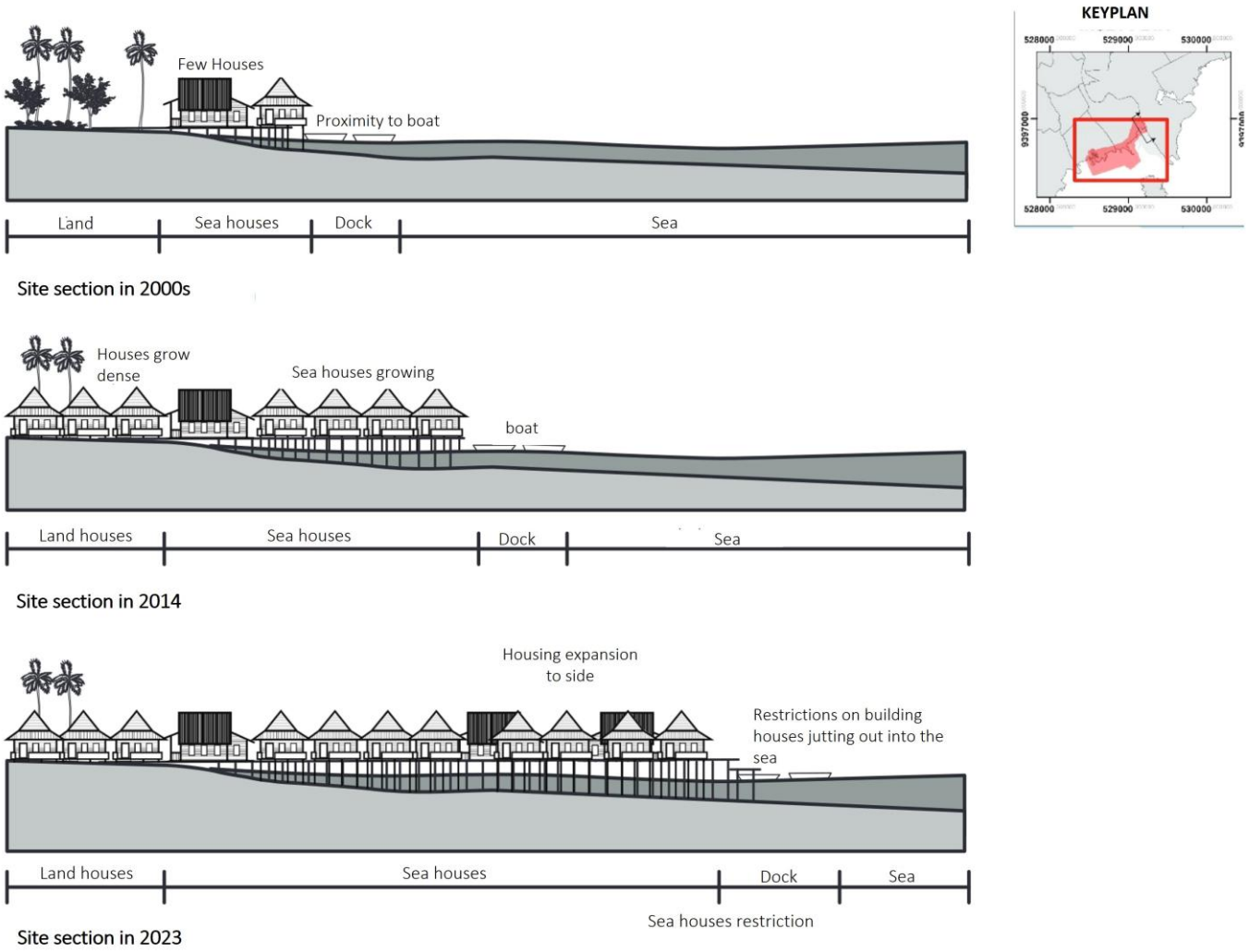


**Figure 5.** Sample site section in *Kampung* Sinar Laut

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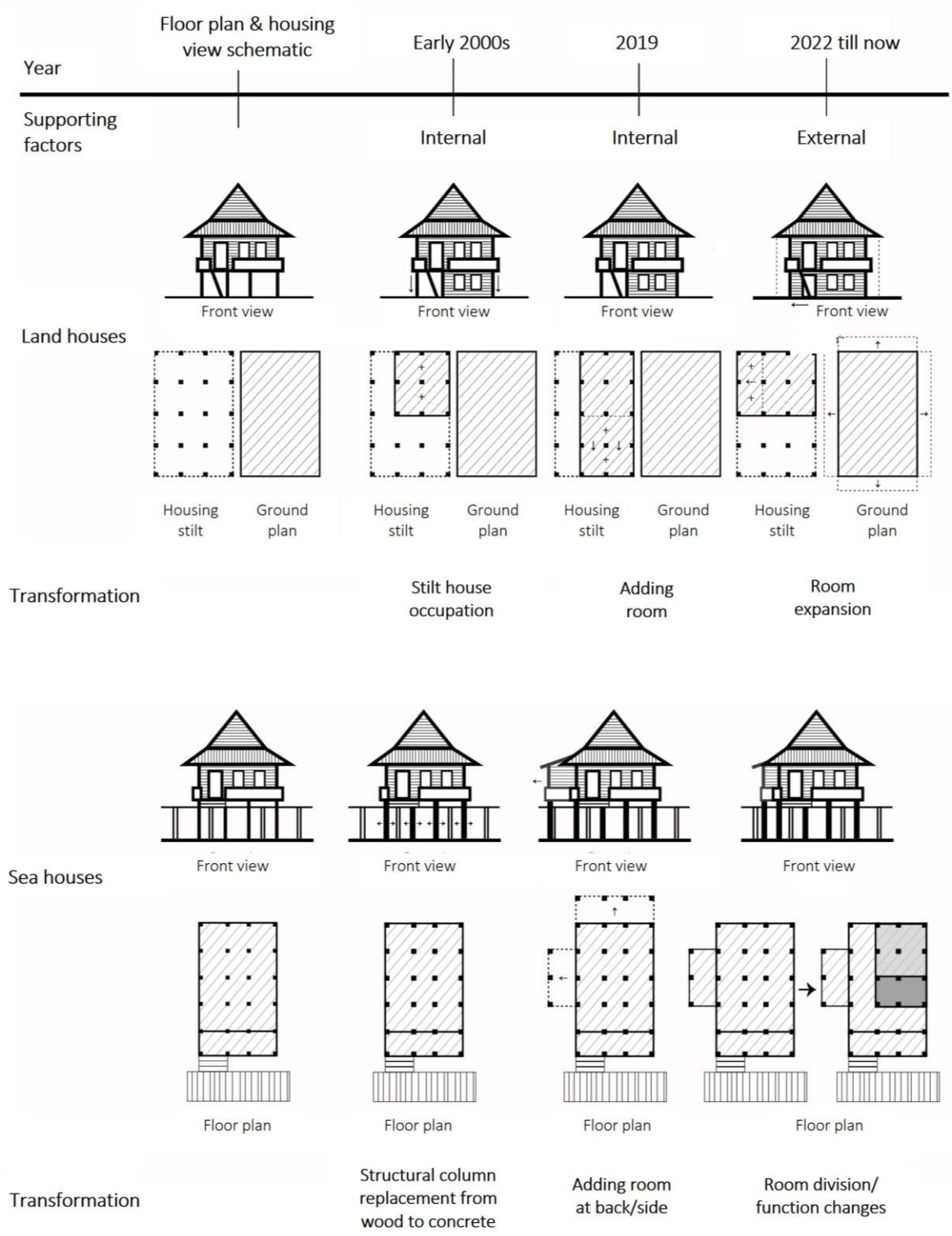


**Figure 6.** Schematic of transformation of houses on land and sea

## Discussion

### *Resilience of Coastal Kampung Kota*

Kampung kota resilience can be observed through spatial, economic, and socio-cultural dimensions. Physically, several strategies have been implemented to reduce tidal flooding, such as constructing gabions along the riverbanks (Figure 4). Green zones have been expanded to mitigate coastal abrasion, and mangrove forests have been planted—demonstrating environmental awareness in local spatial planning. These interventions have altered the physical structure of Kampung Cungkeng and Sinar Laut, influencing how residents interact with their environment.

Maintaining traditional house forms in Kampung Cungkeng and Sinar Laut reflects environmental adaptation and cultural resilience. These stilt houses, rooted in Bugis architectural traditions, are elevated to reduce tidal flood risks and allow air circulation beneath the structure. Although materials have changed over time—from wood to concrete—many households retain the original spatial layouts and typologies. This preservation strengthens community identity, intergenerational continuity, and the unique physical character of the kampung kota.

Economic resilience is reflected in the adaptive use of home space for income-generating activities, such as converting terraces into kiosks or informal workspaces (Figure 6). This reflects the community's flexibility in utilizing limited space to support household economies, especially in light of limited access to formal employment and government economic assistance.

Social resilience is demonstrated through strong communal ties, including mutual aid practices (*gotong royong*), local cooperatives, and neighborhood associations (*paguyuban*). Collective adaptation strategies further reinforce this resilience. Residents work together to address common problems—for instance, constructing informal drainage channels, maintaining public alleys, or organizing community clean-ups after flooding. These informal but effective support systems reflect a bottom-up form of resilience without formal state intervention, showing the community's ability to self-organize and respond to adversity.

Such ties are formed through shared histories, cultural backgrounds (particularly within the Bugis community), and intergenerational settlement in the kampung kota. This strong sense of belonging fosters a collective identity that motivates residents to remain despite environmental risks or inadequate infrastructure. The kampung kota thus functions not only as a place of residence but also as a social system where neighbors rely on each other for daily support, emotional connection, and mutual assistance during crises (Widya *et al.*, 2019).

### *Vulnerability of Coastal Kampung Kota*

Changes in the area's structure, connectivity and accessibility, landscape, and housing and infrastructure growth can display the gradual transformation over a long period. The area's structure at the beginning of the period was still simple, with limited residential areas spread along the coastline. The morphology of Kampung Cungkeng and Sinar Laut, originally swamps/rice fields, changed function to become residential areas that continue to grow (Figure 3).

The unplanned development of kampung kota underscores their structural vulnerabilities. The inadequacies of formal housing systems compound this phenomenon to anticipate surging

housing demands, prompting communities to seek alternative solutions through informal settlements. A similar dynamic has been observed in agricultural villages in Korea, where population growth has driven changes in land use and heightened housing demands (Seo & Lee, 2019). These parallels underscore the universal nature of informal settlement growth as an adaptive response to urban housing challenges.

Due to population growth, coastal reclamation was carried out to accommodate the population's housing needs. There was significant land expansion until the late 1990s in the development of settlements, especially along the coastline, which was in line with the development of settlements on Pulau Pasaran. This residential growth continues to occur. It certainly increases the environmental risk to the kampung kota, caused by flooding and fires. Similar patterns of vulnerability are also recorded in many other informal settlements across the Global South.

The morphology of informal housing in the Global South tends to develop gradually and irregularly, as seen in the coastal growth of the Kampung Cungkeng and Sinar Laut, which has extended towards the sea due to increasing spatial demands. Spatial transformation emerges as a form of adaptation to social and ecological pressures, as can also be observed in residential areas along the Chao Phraya River in Thailand (Yodsurang & Uekita, 2022) and Haifa Street, Baghdad ((Hameed Basee & Riadh Abdulla, 2022).

The physical resilience of the kampung kota to tidal flooding can be observed through planting mangrove forests and constructing gabions along the river. However, the reduction of tidal flooding has a contrasting impact on the undercarriage of stilt houses. It is a new threat to the loss of traditional values in traditional Bugis housing. The undercarriage of traditional houses is used as a form of community adaptation to the risk of flooding, changing its function to expand residential space. The stilt house structure in the traditional Bugis house is a form of ecological adaptation to the tropical environment. The raised floor structure uses wood taken from the surrounding environment and the stage design allows air to circulate under the house, reducing humidity and preventing pest attacks such as termites (Carina *et al.*, 2023).

Most of the Bugis stilt houses in Kampung Cungkeng and Sinar Laut have changed, including changing the space under the house (stilt) to a living room, which can disrupt air circulation and strengthen the risk of floods and fires. This practice can damage people's long-term adaptive capacity. Sudmeier-Rieux (2014) notes that resilience strategies that focus on short-term responses often ignore vulnerability, leading to unintended consequences and, in some cases, increased risk.

This condition suggests that not all risk reduction efforts are sustainable, especially when they ignore the original adaptive housing design. Underfloor space for residential purposes reflects a form of housing vulnerability that aligns with Sudmeier-Rieux's (2014) warning about the dangers of resilience measures that ignore underlying vulnerabilities and provide only temporary relief. Meanwhile, Basee and Abdulla (2022) also revealed that specific modern interventions can exacerbate urban vulnerability, negatively impacting people's lives and the wider urban environment.

If examined more deeply, the vulnerability in these two kampung kota is mainly caused by factors: 1) geographical location. These kampung kota are located on the coast, so they are vulnerable to the threat of tidal flooding, and unplanned housing development increases its vulnerability to natural disasters and climate change; 2) socio-economic conditions, where most of the population works in the informal sector with low income, so their ability to repair or strengthen their houses is minimal. In addition, population density has also been found to

increase vulnerability, such as the risk of fire, health, and safety (Dehghani *et al.*, 2023; Ricafort & Makki, 2023).

### *Urban Morphology as a Reflection of Resilience and Vulnerability*

Through documenting spatial transformations over several decades, this study offers a detailed, chronological analysis of how informal settlements adapt physically and socially to environmental challenges and urbanization, centering the study on coastal kampung kota in Bandar Lampung. This context has remained underrepresented in international urban studies (Stangl, 2018). By doing so, it broadens both the geographic and thematic scope of urban resilience research. It provides important insight for other rapidly urbanizing coastal cities facing similar issues, highlighting that the interaction of tradition, informality, and modernization is crucial for understanding and managing urban transformation.

Adding to these perspectives, Dovey *et al.* (2020) highlight the incremental and often informal growth of urban settlements as a dominant mode of urbanization in the Global South. Their insight into how informal settlements adapt spatially and socially to urban pressures resonate with the findings from Kampung Cungkeng and Sinar Laut, where unregulated seaward expansion and adaptive use of stilt houses illustrate the community's efforts to address socio-economic and environmental vulnerabilities. These findings emphasize that the morphology of informal settlements is not merely a response to resource constraints but also a reflection of resilience and creativity in the face of challenges or threats.

Resilience is embedded in morphological elements that demonstrate inherited and intentional adaptation. The retention of traditional stilt houses reflects cultural continuity and environmental responsiveness, as these structures are elevated to cope with tidal flooding. Similarly, the persistence of compact yet interconnected alleyways supports community cohesion and everyday interaction, facilitating social resilience. Lathif (2020) found that alleys in kampung kota provide better circulation and connectivity between houses and streets and contributes to maintaining stability of connectivity and communication. These spatial configurations, though informal, have evolved to balance physical constraints and social needs.

In contrast, vulnerability arises from unregulated and reactive morphological changes. The uncontrolled horizontal expansion of housing over the sea, often without adequate infrastructure or safety planning, has led to over-densification and reduced accessibility. This morphological pattern increases the risk of disasters such as fires and hinders emergency response efforts. Additionally, infilling under-house spaces, initially intended as flood buffers, further compromises structural safety and increases exposure to environmental hazards.

The urban morphology of Kampung Cungkeng and Sinar Laut is more than just a physical layout; it acts as a living record that captures the community's history, cultural values, and adaptation methods. The design of Bugis coastal communities, which are characterized by stilt houses, serves not only as a practical environmental adaptation but also as a cultural emblem passed down through generations. For instance, the Bugis stilt house was initially crafted to address flooding issues. However, it also represents local wisdom and ethnic identity, setting this kampung kota apart from other urban areas.

Thus, urban morphology serves as a reflection and indicator of kampung kota resilience and vulnerability. While some spatial forms enhance adaptability and continuity, others expose more profound systemic weaknesses, especially those resulting from ad-hoc growth. Recognizing these morphological patterns allows for a more grounded understanding of how informal

settlements function and what spatial interventions might be necessary to strengthen urban resilience.

The results of this study show that the case of Kampung Cungkeng and Sinar Laut is one of the various informal urbanism phenomena widespread throughout the Global South. Although each location has different social and political conditions, they face similar challenges, such as unsafe land ownership, vulnerability to coastal risks, and limited basic infrastructure. This underscores the need for contextual resilience strategies based on the strengths of the local communities. The results of this study also provide an essential lesson for urban coastal areas in the Global South, namely that coastal development must be governed by strong regulations and planning to ensure control and meet urban environmental standards.

### *Strategies to enhance resilience and mitigate vulnerability*

The findings of this study highlight the complex interplay between resilience and vulnerability in Kampung Cungkeng and Sinar Laut. Despite various efforts to improve resilience, geographical and socio-economic challenges make this area vulnerable to disaster threats, and vulnerability remains prominent in Kampung Cungkeng and Sinar Laut. Morphological changes (Figure 3) indicate dynamic but unplanned growth, thus exacerbating vulnerability conditions. A more holistic and sustainable approach is needed to minimize vulnerability and increase resilience, considering physical factors such as green infrastructure (Bănică *et al.*, 2020; Meerow & Newell, 2016) and the community's socio-economic and cultural factors.

Meerow & Newell (2016) argue that resilience approaches become ineffective when they are not holistic, especially when they ignore the social justice side and sustainability issues. In this case, the spatial adaptation that occurs in kampung kota areas reflects the pragmatic efforts of the community to overcome spatial and economic pressures. Although in practice this adaptation often occurs without adequate systemic support, such as spatial planning regulations or the protection of basic infrastructure.

Urban and settlement regulations regarding housing expansion and zoning must be implemented to prevent uncontrolled overhead housing growth, which can exacerbate the risk of flooding and clutter. Retrofitting traditional Bugis stilt houses with shapes and materials and flood-resistant spaces that can be adjusted to the homeowner's needs can also be the preservation of cultural identity. Expanding green infrastructure, such as mangrove forests and green open spaces, and then implementing gabion systems along riverbanks can reduce the risk of erosion and tidal flooding. Proper drainage planning and regulated building spacing in narrow alleys can also help minimize waterlogging and fire hazards.

Livelihood expansion can increase socio-economic resilience (Octifanny & Norvyani, 2021) through vocational training tailored to the local potential of Cungkeng and Sinar Laut Villages. For example, developing mangrove-based ecotourism and promoting traditional Bugis culinary products can reduce dependence on the unstable informal fisheries sector. However, this and must be supported through incentives and adequate facilities and infrastructure.

Strengthening resilience of kampung kota requires integration into broader urban development planning, which is facilitated by adopting integrated coastal zone management and formulating long-term planning documents. In the case of the development of Kampung Cungkeng and Sinar Laut, it should not be seen separately but linked to a broader development plan for Pulau Pasaran.

The morphology of Kampung Cungkeng and Sinar Laut cannot be separated from the development of Pulau Pasaran as a minapolitan tourist area. Pulau Pasaran is bordered by the sea adjacent to Kampung Cungkeng and Sinar Laut. Residents/tourists who visit Pulau Pasaran will pass through a bridge or boat crossing through Kampung Cungkeng or Sinar Laut as the gateway to Pulau Pasaran. However, due to the different character of the settlement, this study did not include Pulau Pasaran because this research focused on the architectural and cultural values of Cungkeng and Sinar Laut Villages.

The results of this research can be considered to be helpful in improving the quality or revitalizing existing coastal kampung kota. The process and outcomes of kampung kota improvement must be thoroughly reviewed in terms of their long-term impact on kampung kota resilience and vulnerability. Urban planners and architects are at the forefront of integrating social, economic, and environmental aspects to create sustainable solutions for kampung kota. Together with the government and the community, they are responsible for designing improvement strategies that meet physical needs and strengthen the resilience of communities and kampung kota to future environmental, economic, or social changes.

The spatial patterns and adaptive strategies observed in Kampung Cungkeng and Sinar Laut can be a reference for developing community-led improvement models. The strong sense of cooperation among residents provides a strong foundation for participatory planning programs that support the resilience and sustainability of kampung kota areas. The use of multifunctional terraces and alleys as social and economic spaces for the community shows the potential for integration into the environmental-level co-design approach.

This study used a cross-sectional approach, meaning that data were collected simultaneously. This approach provides a static picture of current conditions but can less accurately capture change dynamics over time. Despite the limitations in the study's scope, the results provide valuable insight into the conditions and dynamics in Kampung Cungkeng and Sinar Laut. A longitudinal approach is recommended to capture changes more accurately and comprehensively to improve the effectiveness and relevance of future research.

Thus, more appropriate strategies can be designed to address vulnerabilities, support community resilience, and improve the community's quality of life and well-being. Understanding vulnerability is important in recognizing the threats that must be addressed to improve the residents' quality of life and well-being. Effective mitigation strategies can be developed by identifying and analyzing the factors that cause vulnerability. It can help reduce disaster risk and plan for more sustainable and inclusive development.

## Conclusions

This study examined the resilience and vulnerability of Kampung Cungkeng and Sinar Laut in Bandar Lampung through an urban morphology approach. These coastal kampung kota inhabited by the Bugis community face various threats, such as tidal flooding and modernization, but still show significant adaptability. The physical transformation can be seen through changes in the structure of the area, changes in connectivity and accessibility, and changes in the landscape, housing, and infrastructure growth. Efforts to increase resilience have been carried out through constructing gabions, dredging rivers, planting mangrove forests, and limiting residential areas over the sea. Economic opportunities, easy access to work, and strong kinship relationships between residents support the resilience of the kampung kota.

However, although some aspects of resilience support it, vulnerability in Kampung Cungkeng and Sinar Laut is more dominant than resilience. The study's results indicate that strengthening resilience indirectly also increases vulnerability, mainly due to under-housing occupancy, which can increase disaster risk. This finding is supported by evidence from the literature showing that resilience efforts often have the potential to create new challenges that increase the risk of vulnerability (Meerow & Newell, 2016; Sudmeier-Rieux, 2014). Furthermore, a society can be highly resilient but at the same time unsustainable and non-inclusive.

Regarding broader applicability, the findings from Kampung Sinar Laut and Cungkeng demonstrate that resilience represents community capacity. Social cohesion, adaptive land use, and hybrid livelihood strategies are key elements. These lessons offer valuable insight for other coastal cities in the Global South. Although spatial configurations may differ due to geographic and cultural contexts, the fundamental principles of locally rooted and adaptive resilience are transferable. They can inform context-sensitive approaches to urban resilience in similarly vulnerable settings.

Vulnerability is often more pronounced in coastal urban contexts undergoing rapid physical and social transformation. As explained in the study by Meerow and Newell (2016), while adaptation efforts can improve some aspects of resilience, they often ignore the social and economic factors underlying vulnerability. This gap highlights the need for a more holistic and sustainable approach to urban planning, focusing on infrastructure and considering communities' socio-economic and cultural aspects. The study by Ricafort and Makki (2023) emphasizes the importance of integrating technical and social strategies to reduce vulnerability and increase overall resilience. Thus, to reduce vulnerability and increase resilience in Kampung Cungkeng and Sinar Laut, more integrated planning is needed that considers the complex interactions between physical, social, and economic changes. An approach that considers all of these aspects will be more effective in building sustainable resilience and reducing the risk of future disasters.

The results of this study practically provide insight for coastal city planning in Indonesia and even Southeast Asia. This research helps bridge the geographical and thematic gaps in the study of the resilience of informal coastal settlements by offering empirical evidence from the Southeast Asian context, which has been underrepresented in the literature.

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